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FINAL

# National Ecological Observatory Network (NEON) Environmental Assessment


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# EXECUTIVE SUMMARY

## Introduction

The National Ecological Observatory Network (NEON) is being developed by the ecological research community as a tool that would allow scientists to analyze, understand, and forecast the nature and pace of biological change at scales ranging from local to continental. It is widely recognized that greater understanding of ecological systems is possible, but only if site-based research can be placed into a larger, more integrated regional or continental context.

Numerous reports by Presidential Commissions, the National Research Council (NRC), professional societies, and National Science Foundation (NSF) Advisory Committees have identified the major issues (called "Grand Environmental Challenges") that must be addressed through research to understand the biosphere and forecast ecological change. Two NRC reports, *Grand Challenges in Environmental Science* (2001) and *NEON: Addressing the Nation's Environmental Challenges* (2003), identify the Grand Environmental Challenges and associated research questions that cannot be addressed with existing research infrastructure because of the need to obtain environmental measurements on a regional to continental scale.

Research on these scales requires infrastructure that integrates persistent and episodic sensing, supports synoptic remote sensing campaigns, and facilitates experiments across gradients of change. The infrastructure must be able to collect multiple types of data for short periods of time over large or diverse geographical areas and also must be optimized to collect specific data at fixed locations over longer time intervals. The design divides the U.S. into 20 domains, each representative of a specific range of ecoclimatic conditions, encompassing the range of environmental variability of the U.S. Under this system, when any variable is measured over time in all 20 domains, a continental picture of the quantity, changes in, and spatial heterogeneity of that variable would be obtained. Given the time required to observe changes in some ecological parameters, NEON is designed to have a 30-year operational lifespan.

## Format of Environmental Assessment

This document is divided into seven sections. Section 1 provides background on the NEON project and identifies the purpose and need for the action. Section 2 consists of two distinct parts. The first part of Section 2 provides a description of the NEON project and describes the typical components of the NEON project. The first part of Section 2 is not specific to any domain. The latter part of Section 2 provides descriptions of each domain and identifies where a specific domain would vary from the typical NEON description. Section 3 provides a description of the resource areas and method of analysis. This is followed by domain-specific descriptions of the affected environment and the domain-specific analysis of potential direct, indirect, and cumulative impacts. Section 4 provides a general summary of impacts from the overall project that is not domain-specific. Section 5 discusses the domain-specific permitting and approvals that would be necessary to construct and operate NEON. Section 6 identifies the document preparers, and Section 7 provides a list of acronyms and abbreviations used in the document.

## Purpose and Need

The biosphere is the living part of Earth. It is one of the planet's most complex systems, with countless internal interactions among its components and external interactions with the Earth's physical processes and its oceanic and atmospheric environments. A wide range of biotic and physical processes link the biosphere, geosphere, hydrosphere, and atmosphere. Despite this, the understanding of the biosphere does not match the increasingly sophisticated understanding of Earth's physical and chemical systems at regional, continental, and global scales.

The purpose of NEON is to provide an integrated research tool for scientists to achieve a better understanding of the biosphere and processes operating at large scales. Further, NEON would establish and sustain the scientific infrastructure needed to address critical questions about the effects of land use and climate changes on ecological systems and to evaluate the impacts of those changes on the environment and human culture.

## Scope of Analysis

The NEON Environmental Assessment (EA) was prepared in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations of 1978, and 45 Code of Federal Regulations (CFR) Part 640, and 36 CFR Part 800. The federal action being addressed is whether the NSF should establish and support the NEON system.

For analysis purposes, this EA considers potential impacts from:

- Establishment and operation of Core Sites, which would be permanent (30-year) infrastructure deployments typically consisting of no more than three Fundamental Instrument Units (FIUs), an Aquatic Array, and multiple Fundamental Sentinel Unit (FSU) sampling points to collect ecological data. Core Sites would be representative of undeveloped areas within the domain.
- Initial deployment and operation of Relocatable Sites, which would be intermediate length (3- to 5-year) infrastructure deployments consisting of one FIU, one Aquatic Array, and multiple FSUs. Relocatable Sites would be deployed to collect data along gradients relevant to the Core Site investigation. Typically, a Relocatable Site would have fewer FSUs than a Core Site.
- Deployment and operation of Mobile Deployment Platforms (MDPs), which would include a small to medium sized transportable tower. MDPs would be used for short-term research objectives and education or other related activities.
- Deployment of Airborne Observation Platforms (AOPs), which would be used to collect spatial data to allow extrapolation of data collected locally from in-situ measurements to regional and continental scales.

- Deployment and operation of a stream observatory network (STREON), which would include experiments with long-term manipulation of stream ecosystems.
- Development and operation of the NEON Land Use Analysis Package, which would be used to transfer data sets produced by federal agencies and other scientific or commercial sources to the NEON data archive and to reanalyze these existing data for use alongside data from the NEON program.

To conservatively bound the analysis of impacts, this EA analyzes the potential impacts from the maximum amount of infrastructure that may be deployed at a site and the maximum level of sampling that could occur. As a matter of practice, the amount of infrastructure deployed at a site may be less than the amount analyzed, but would not exceed the amount analyzed.

The NSF invites public participation in the proposed federal action through the NEPA process. Consideration of the views and information of all interested persons promotes open communication and enables better decision-making. All agencies, organizations, and members of the public having a potential interest in the Proposed Action, including Native American organizations and minority, low-income, and disadvantaged groups, are urged to participate in the decision-making process.

## Site Selection

The process for identifying, considering, and selecting sites for deployment of NEON infrastructure considered hundreds of potential sites, involved hundreds of stakeholders, and included multiple evaluation stages. The process has been lengthy, thorough, scientifically and statistically based, considered construction and operations costs and logistics, and included evaluation of environmental considerations at all development stages. Establishing the site criteria and the selection and review processes has involved research community workshops, Blue Ribbon committees, and NRC and NSF merit reviews.

Locations were chosen to deploy NEON infrastructure across the continental United States, Alaska, Hawai'i, and Puerto Rico using a statistically determined design stratified by climate and land use (Hargrove and Hoffman, 1999, 2004; Keller et al., 2008). The design divides the U.S. into 20 domains, each representative of a specific range of eco-climatic conditions.

In October 2006, the NEON Project Office announced a Request for Information (RFI) inviting members of the ecological research community to submit ideas about (1) specific research projects they would conduct using NEON and (2) potential Core and gradient (Relocatable) sites (http://neoninc.org/milestones/2006/request-for-information.html). The office received more than 60 responses from the ecological research community, including recommendations for research designs, experimental designs, and wildland areas within a domain where NEON observational resources could be deployed within the identified domains.

In evaluating the RFI responses, NEON, Inc. conducted visits to proposed Core Site areas to evaluate whether existing infrastructure could be used to accommodate NEON projects with minimal modification and also whether environmental conditions would allow implementation of NEON projects without substantial impacts. At this stage, each domain included one candidate Core Site and five to seven candidate Relocatable Sites. NEON, Inc. then reviewed all proposed locations with regard to scientific suitability, practicality, and environmental conditions and selected the 20 proposed Core Sites. Natural and human environmental issues that were given consideration throughout the process included:

- The potential for impacts to wetlands and other waters of the United States.
- The potential for species protected under the Endangered Species Act (ESA) to occur in areas where infrastructure would be sited.
- The potential for NEON development to impact known historical or cultural resources listed or eligible for listing in the National Register of Historic Places.

In the preparation of this EA, the consideration of a single alternative in addition to the No Action Alternative reflects the substantial preliminary screening of alternative sites through successive steps of:

1. Preliminary response to the RFI.
2. Site-specific field activities that refined the analysis to confirm that in the general area proposed for the sites, the environmental constraints could likely be met in an area within 2 to 3 kilometers (km) of the location of the towers.
3. Working with property owners and site managers to identify specific locations that would meet scientific requirements and minimize impacts.
4. Additional data collection prior to and during the preparation of this EA that focused on a smaller footprint (generally within a 5-km diameter circle for protected species and other resources and a 3.2-km diameter circle for cultural resources) with relocation of towers or facilities if necessary to avoid impacts to sensitive resources.

## Proposed Action

Under the Proposed Action, the NSF would establish a continental-scale network of long-term ecological infrastructure deployments called the National Ecological Observatory Network (NEON). The design divides the U.S. into 20 domains, encompassing the range of environmental variability of the U.S.

Within each domain, the regional footprint would include field study sites and associated field and laboratory facilities. The network of deployments would form a fully integrated continental-scale research platform.

NEON would consist of multiple components:

- 20 Core Sites (1 per ecological domain) - NEON Core Sites would include a standard set of instruments to collect biological, biophysical, biogeochemical, and land use and land management data, three towers, a panelized modular enclosure called an instrument hut, and in some cases an Aquatic Array. A variety of data collection packages would be deployed as subsystems. Core sites would be operational for 30 years.

- 41 Relocatable Sites (typically, 2 per ecological domain) - A Relocatable Site would consist of a suite of instruments that could be moved to collect data outside the fixed Core Sites and would include a single FIU Tower and would have fewer FSU sampling plots and productivity transects than Core Sites. Relocatable Sites would be located up to 300 km from a Core Site and would be initially deployed for 5 years at a given site.
- 10 MDPs - MDPs (instruments on vehicles or on trailers towed by vehicles) would be used to study sudden events on the landscape, such as wildfires, natural catastrophes, disease outbreaks, or the emergence of an invasive species. MDPs would be deployed from a few days to several months at any given location.
- 26 Aquatic Arrays - An Aquatic Array would be placed in and adjacent to a stream or lake. The Aquatic Array would automatically monitor stream physical, chemical, and biological properties. Each Aquatic Array would collect data from a 500-meter (m) stream reach. Dataloggers would either store data for download or automatically transmit data to a support facility.
- 2 AOPs – AOPs would include two aircraft equipped with remote sensing instruments that would provide regional information for scaling and extrapolation. Each domain would be flown once per year during the growing season (typically April through October).
- 10 STREON Sites - The STREON experiments would provide an assessment of ecosystem response to predicted future conditions by accelerating known drivers of ecosystem structure and function. STREON experiments would be long-term experiments, planned to be conducted over a 10-year time period.

Each component listed above is discussed in more detail in Section 2.2.1 of the EA.

NEON is designed to collect data on the natural world and allow scientists to achieve a better understanding of ecosystem-level systems and processes. To that end, NEON, Inc. must minimize the effect on the environment or risk compromising the integrity of the data collected. NEON would include Project Design Features and Best Management Practices (BMPs) to avoid or minimize impacts to the extent practicable.

# Ecological Domains

Collectively, the domains evaluated for the NEON Project represent ecological and climate variability across the continental United States, Alaska, Hawai'i, and Puerto Rico.

Domain 1 is the northeastern United States. All of New England and New York, as well as northern New Jersey, northern and western Pennsylvania, and much of West Virginia are included in this domain. The research focus for this domain is the forests of the northern Appalachian Mountains and the Adirondack Mountains. Climate in this region is varied due to its coastal orientation and geographic setting, which extends from coastline to mountain ranges. Domain 1 is within the Lower New England-Northern Piedmont and Northern Appalachian-Acadian ecoregions. Glacier activity has shaped much of this domain and has created a diverse geology with low mountains and many lakes in the interior central and southern parts of the domain and glacially deposited sandy soils that form a broad plain with many ponds toward the Atlantic Ocean.

Domain 2 is located in the Mid-Atlantic States and includes parts of Delaware, Georgia, Maryland, New Jersey, North Carolina, Pennsylvania, South Carolina, Virginia, and West Virginia. Domain 2 extends from the ocean to the eastern slopes of the Appalachian Mountains. The foci of research in this domain are changing land uses and invasive species. Much of the climate in this region is directly influenced by its proximity to the ocean. Coastal regions within Domain 2 are susceptible to hurricanes in the summer and fall, while the regions in higher elevations are subject to snowstorms in the winter and early spring.

Domain 3 is the Southeastern Coastal Plain and includes parts of Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Texas. This domain is characterized by vegetation communities that are adapted to periodic fire. NEON stations in Domain 3 would initially focus on fire responses as a component of the research. The climate in the southeastern United States typically includes hot, humid conditions in the summer and relatively mild conditions in the winter.

Domain 4 is the Atlantic Neotropical area, including Puerto Rico and south Florida. The Puerto Rican climate is considered tropical. South Florida has a sub-tropical climate and has higher humidity levels, 85 to 90 percent for much of the year, with temperatures similar to those in Puerto Rico. Both regions are susceptible to hurricanes in the summer and early fall; the peak of the rainy season occurs during the summer.

Domain 5 is the Great Lakes region of the United States. Domain 5 includes northeast Minnesota, northern Wisconsin, Michigan, and the northern regions of Indiana and Ohio. Annual precipitation rates and temperatures throughout much of Domain 5 are influenced by the Great Lakes. Weather fronts in this region move predominantly from west to east and southwest to northeast, with heavy snowfall in the winter for most of the region.

Domain 6 is the prairie peninsula in the Midwestern United States. Iowa and Illinois comprise the center of Domain 6. Also included are southern Minnesota, southern Wisconsin, southeast South Dakota, southeast Nebraska, eastern Kansas, and northern Missouri. Research in Domain 6 would focus on tallgrass ecosystems and the effects of fires and grazing on natural components. The climate throughout Domain 6 is variable. Mean annual precipitation ranges from 54 to 150 centimeters (cm), primarily during spring and summer as a result of frontal storms.

Domain 7 encompasses the Appalachian/Cumberland Plateaus. It includes central and southern Ohio, southern Indiana, southwest West Virginia, the western tip of Virginia, the northeast corner of Georgia, the northwest corner of South Carolina, eastern and central Tennessee, and all but the western tip of Kentucky. The research focus for this domain is the contiguous forest habitats of the Smoky Mountains and Appalachian Mountains. The climate in this region varies, as the weather is unpredictable. Spring-time conditions can occur at any time between January and April, and the peak rainfall typically occurs during the summer months.

Domain 8 is the Ozarks Region, which extends from southeast Kansas to the southeast into Alabama. Domain 8 encompasses much of the lower Mississippi River valley, extending from central Alabama, Mississippi, and Louisiana north to southern Missouri and also includes Arkansas and much of west Tennessee. The climate in Domain 8 varies between areas in the lowlands and those at higher elevations. Typically the lowlands are warmer and more humid than the hilly or mountainous regions.

Domain 9 is the Northern Plains, including the Prairie Pothole Region. It covers portions of Minnesota, Montana, Nebraska, and Wyoming, a very small eastern portion of Iowa, most of South Dakota, and all of North Dakota. The research focus for this domain is the diverse ecology of the Prairie Pothole Region. Domain 9 has an interior continental climate with hot summers and frigid winters. High winds are from the northwest. The area is susceptible to severe weather in the spring and summer that is known to produce intense lightning, damaging winds, hail, and tornados.

Domain 10 is the Central Plains, which covers a broad geographic area from the Rocky Mountains eastward to central Nebraska and south through Kansas, Oklahoma, and the Panhandle of Texas. The research focus for this domain is centered on the analysis of contrasting land uses within urban, suburban, and exurban fringe areas. The climate within Domain 10 is characterized by periodic drought and significant climatic fluctuations throughout the year. Moisture from the Pacific Ocean reaches this region with little precipitation due to the rain-shadow effect of the Rocky Mountains.

Domain 11 is the Southern Plains, which extends from the Osage Plains in southern Kansas and central Oklahoma through the Oaks and Prairies region in central Texas, continuing into the South Texas Brushlands and Coastal Prairies to the U.S.-mexico border. The research focus for this domain is the transition zone between the eastern deciduous forests and the central plains to the west. The climate in Domain 11 changes from humid to subhumid from the south to the north due to moisture coming in from the Gulf of Mexico.

Domain 12 is the Northern Rocky Mountains. Domain 12 encompasses western Wyoming (Yellowstone National Park area), western Montana, and nearly all of central and northern Idaho extending to the border with Canada. The research focus for this domain is ecological responses to global change in suburban areas and areas where little human activity has occurred. The Rocky Mountains have variable weather patterns that are continuously changing. The climate changes as the altitude increases. Summers are typically mild and winters are cold, with significant snowfall.

Domain 13 is the Southern Rocky Mountains-Colorado Plateau Domain. The domain includes southern and eastern Utah, western Colorado, southeast Nevada, northeast Arizona, and much of New Mexico. The research focus for this domain is the alpine tundra ecosystem with a focus on urban, suburban, exurban, and rural land use intensities and contrasts. There are two main physiographic provinces within Domain 13: the Colorado Plateau and the Basin and Range. The Middle Rocky Mountains province and the southern-most region of the Wyoming Basin province are also here. Topography in Domain 13 is characterized by large gradients, both west to east and south to north.

Domain 14 is the Desert Southwest and extends north from the Mexico border across the states of New Mexico, Arizona, and California. It is defined by its seasonality of precipitation, which results in differential periods of water availability that define the three DSW deserts (the Mojave, the Chihuahuan, and the Sonoran). The Mojave is dominated by winter precipitation, the Chihuahuan by summer precipitation, and the Sonoran is intermediate. The research focus for this domain is the desert ecosystem and impacts from urbanization.

Domain 15, the Great Basin, ranges from southern Nevada extending to the east into Utah and Wyoming, west to the California/Nevada border, and north through southeastern Idaho, eastern Oregon, and eastern Washington to the border with Canada. The climate characteristic of Domain 15 features cool, moist air flowing westerly from the northern Pacific Ocean where it is intercepted by the Sierra Nevadas and the Cascades. These mountains create very dry conditions for the Intermountain Region. The overall climate of the Intermountain Region is arid to semiarid, with cool, moist winters and hot, dry summers. In the extreme northern and western parts of the domain, nearly all precipitation occurs from fall through spring. In southern and eastern parts of the domain, equal amounts of precipitation may fall in the winter and summer.

Domain 16 is the Pacific Northwest, which extends from northern California to southeast and southern Alaska. Warm, dry summers and mild, wet winters are common and strong west-to-east gradients of precipitation and temperature are controlled by the mountainous terrain, extending from the coastal fog belt to the dry east side of the mountains where conifer forests give way to drier vegetation types. The research focus for this domain is the ecologies of the west-side Pacific Northwest forests and impacts from silviculture.

Domain 17 is the Pacific Southwest and is entirely within the state of California. It extends from the Baja California border to the Shasta National Forest, excluding the southeastern desert and the northwestern mountains. There are significant contrasts in the climate of Domain 17, largely due to the physiographic diversity within this region. The domain includes the California Coastal Range, the Central Valley, and the Sierra Nevada Mountains. It also includes the California Trough and the Lower California Province.

Domain 18 is the Tundra of northern Alaska. It is typically referred to as "arctic tundra" because it lies above the Arctic Circle. It includes western and northern Alaska. This domain is characterized by areas of poorly drained, treeless plains interspersed with thaw ponds, lakes, rolling hills, and plateaus grading from the coastal plain to the uplifted sedimentary rock of the Brooks Range to the south. This area receives so little precipitation that it is described as a cold desert. The arctic tundra is underlain by permafrost.

Domain 19 is the Taiga in Alaska. Wildfire is prevalent throughout the domain, and produces a mosaic of successional communities, including herbaceous and scrub communities, broadleaf forest, coniferous forest, and mixed forest. The vegetation structure is typical of interior Alaska, with major vegetation groups consisting of closed and open coniferous forest, coniferous woodland, open and closed deciduous forest, closed mixed forest, closed tall shrub, shrub tundra, and tussock tundra.

Domain 20 is the Pacific Neotropical in Hawaiʻi. The islands of the state of Hawaiʻi make up all of Domain 20. The Hawaiʻi Experimental Tropical Forest (HETF) is an overlay on state land designations of the Laupāhoehoe Natural Area Reserve (LNAR), the Laupāhoehoe Section of the Hilo Forest Reserve, the Puʻu Waʻawaʻa Forest Reserve, and the Puʻu Waʻawaʻa Forest Bird Sanctuary. The Laupāhoehoe Experimental Tropical

Forest (LETF) within HETF includes the Laupāhoehoe Section of the Hilo Forest Reserve (1,800.5 hectares [ha] and the Laupāhoehoe Natural Area Reserve (3,194.5 ha) administered by the Hawai'i Department of Land and Natural Resources. The Pu'u Wa'awa'a Forest Reserve and the Pu'u Wa'awa'a Forest Bird Sanctuary make up the Pu'u Wa'awa'a Section of the HETF. The HETF was recently created through a cooperative agreement between the Department of Land and Natural Resources Division of Forestry and Wildlife (DLNR-DOFAW) and the U.S. Forest Service (USFS). The subject area is the LETF and PWETF, which are recently created State-owned properties.

## Affected Environment and Environmental Consequences

The existing environmental and socioeconomic conditions potentially affected by the Proposed Action, as well as the potential environmental and socioeconomic impacts of implementing the Proposed Action were evaluated for each domain. In compliance with NEPA, CEQ guidelines, and 45 CFR Part 640, et seq., the description of the affected environment focuses on those resources and conditions potentially subject to impacts from the Proposed Action.

Five resource areas were determined to have no potential for impacts and would not be a factor in the decision about whether to implement NEON. These resource areas (**Land Use**, **Topography**, **Hydrogeology and Groundwater**, **Demographics**, and **Community Resources**) are briefly discussed in Section 3.2.1 and are not further discussed in this document.

Three resource areas were determined to have similar impacts among all domains with no substantial variation as a result of domain-specific conditions. These resource areas (**Hydrology**, **Hazardous and Toxic Substances**, and **Socioeconomic Impacts on the Local Economy**) are discussed in 3.2.2.

All other resource areas are considered under each location within each domain, as site-specific conditions could influence potential impacts. Following the description of the components of the affected environment, Section 3.2.2 presents the analysis of the direct, indirect, and cumulative environmental and socioeconomic effects that would likely occur with the Proposed Action and identifies any adverse environmental effects that cannot be avoided through project design.

The following resource areas are evaluated in detail for each domain:

1. **Geology** – Geology takes into account how the materials of which the Earth is made, the structure of those materials, and the processes acting upon them may influence or be influenced by the Proposed Action.

2. **Soils** – soils and soil horizons differ depending on how and when they formed. Factors influencing soil formation include the underlying parent material, climate, topography, biological factors, and time.

3. **Climate** – Climate encompasses the sum total of the meteorological elements that characterize the average and extreme conditions of the atmosphere, including temperature, precipitation, and wind speed.

4. **Air Quality** - The Clean Air Act requires the U.S. Environmental Protection Agency (USEPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. NAAQS include primary and secondary air quality standards. Primary standards protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly.

5. **Air Space** - U.S. airspace is regulated by the Federal Aviation Administration (FAA), which controls the areas and altitudes open for aviation purposes. Certain aircraft operations are restricted either on a temporary or permanent basis through the use of Temporary Flight Restrictions, Air Defense Identification Zones, and Flight Restriction Zones.

6. **Noise -** For determination of impacts to human receptors, noise measurements are weighted to increase the contribution of noises within the normal range of human hearing and decrease the contribution of noises outside that range.

7. **Water Quality** - Water quality is a term used to describe the chemical, physical, and biological characteristics of water. Water quality is regulated primarily by the Clean Water Act (CWA), which establishes designated uses for given waterbodies (such as public water supply, aquatic habitat, industrial supply, and recreation).

8. **Wetlands** - Wetlands are transitional lands between aquatic and terrestrial systems. Plants present in wetlands are those that are adapted for life in standing water or in prolonged saturated soil conditions.

9. **Floodplains** - Floodplains are strips of land bordering streams where overbank flow occurs during periods of high water. They typically contain sediments carried by the stream that are deposited in the slack water beyond the influence of the swiftest current.

10. **Common Vegetation and Plant Communities** - Common vegetation and plant communities are the plant components of the environment that could be impacted by NEON. These resources are influenced by the spatial and chemical heterogeneity of the landscape and also by biotic factors (such as grazing).

11. **Common Fauna** - Common fauna represent the typical animals occupying or expected to occupy habitats at and around proposed NEON sites. These resources are influenced by the number, types, and sizes of habitat patches that occur in areas where NEON would be implemented.

12. **Sensitive Ecological Communities** - A sensitive ecological community is a habitat type that is rare in the general area and one that may be at risk of being eradicated by development. Sensitive communities also would include any area designated by the U.S. Fish and Wildlife Service (USFWS) under Section 4(a)(3)(A) of the ESA as critical habitat for a species listed as threatened or endangered under the ESA.

13. **Sensitive Species** - A sensitive species is a species or a defined sub-population of a species that is naturally rare, declining in number, or at risk of becoming extinct over all or a substantial portion of its range within the governing political boundary.

14. **Cultural Resources** - Cultural resources that could be affected by construction and operation of NEON infrastructure include prehistoric and historic archaeological sites; standing historic structures, buildings, districts, and objects; locations of important historic events; and sites of traditional/cultural importance to various groups.
15. **Utilities** - Electric power transmission is the bulk transfer of electric power via a network that connects power plants to substations to individual locations. The transmission capacity of this infrastructure (e.g., lines, transformers) determines whether or not it must be upgraded to handle the additional demand from new or expanding users.
16. **Transportation** - A transportation network represents the infrastructure that permits the conveyance of people and commodities. For a given area, the transportation infrastructure may include roads, railroads, airports, and ports.
17. **Human Health and Safety** - Health and safety addresses the risk factors and hazards of the workplace. Risk is managed by identifying potential hazards and implementing appropriate controls to promote a safe environment.
18. **Environmental Justice** - Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.
19. **Protection of Children** – Executive Order (EO) 13045, Protection of Children from Environmental Health Risks and Safety Risk (Federal Register [FR]: April 23, 1997, Volume 62, Number 78) specifies guidelines for the protection of children.
20. **Recreation** - The analysis identifies the potential for disruption of recreational activities among the general public as a result of NEON implementation.
21. **Aesthetics and Visual Resources** - Impacts to aesthetics and visual resources are evaluated by analyzing project-related changes to existing views, landscape character, land cover types, and land uses.

## Conclusions

The NEON EA analyzed the potential environmental and socioeconomic impacts that would result from implementation of NEON. The analysis examined construction and installation of proposed NEON infrastructure and subsequent operation of NEON by NEON, Inc. for 30 years at Core Sites and 5 years at initial Relocatable Sites. The analysis also considered potential impacts that would result from decommissioning NEON infrastructure at the close of the project.

Analysis indicated that NEON would have no effect on land use, topography, hydrogeology and groundwater, demographics, and community resources in any of the 20 domains. It also was determined that, even though NEON would not result in a change in demographics, there would be minor short-term and long-term beneficial impacts to the local economy of the areas where infrastructure would be placed through secondary spending by construction crews, maintenance technicians, and researchers.

NEON would have negligible adverse impacts on hydrology and hazardous and toxic substances that would be similar across all 20 domains. NEON, Inc. would develop and implement spill prevention, control, and countermeasures (SPCC) plans at all sites where hazardous and toxic materials or fuel would be stored to minimize the potential for adverse impacts. NEON, Inc. also would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for hydrologic impacts. With the implementation of appropriate BMPs and project design features, impacts to hydrology and hazardous and toxic substances would be less than significant.

While NEON would have no impact on the underlying **geology** in any domain, there are areas where NEON, Inc. would have to account for karst terrain or potential seismic activity in design and construction of infrastructure. Where NEON infrastructure would be placed in karst terrain, NEON, Inc. would design to avoid sites prone to sinkhole development and would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for indirect impacts to water quality from runoff entering karst systems. NEON, Inc. would implement designs for infrastructure in Domain 18 that would minimize the potential for impacts to permafrost areas and that would not contribute to permafrost thawing. In areas where the potential for strong earthquakes is present, NEON, Inc. would design infrastructure to withstand greater stresses from movement of the Earth.

Implementation of NEON would have minor temporary adverse impacts on **soils**. Less than 0.01 ha would be disturbed at any one location and upon completion of NEON, infrastructure would be removed and the area restored.

Proposed NEON, Inc. activities would have no potential to impact **climate**, but there are areas where NEON, Inc. would have to account for extreme climatic conditions in design and construction of NEON infrastructure. In areas of extreme cold, NEON infrastructure would have to be capable of withstanding the severe winter conditions. In addition, fuel for the two primary generators in Domain 18 would have to remain functional at extremely cold temperatures. In permafrost areas, construction and transport of materials would be done during the time of year when the ground is covered with snow to avoid damage to the sensitive permafrost soils.

NEON would have minor adverse temporary impacts on **air quality** in all domains from equipment and vehicle emissions and generation of fugitive dust during construction and operation. During peak sampling periods, up to seven vehicle trips per day would be expected at each site, with four or fewer trips per day anticipated at other times, including construction. This small number of vehicle trips would have a negligible impact on air quality. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for fugitive dust generation during construction. Routine maintenance throughout the duration of NEON would keep the three primary and one standby generators running efficiently and minimize emissions during operation. The operation of primary generators would produce the most emissions during operation, but the amount of emissions at any given location would be minimal.

Where NEON infrastructure would be near FAA-regulated airfields, NEON, Inc. would coordinate with FAA in design of infrastructure to be compliant with all applicable FAA regulations and guidance. NEON, Inc. also would obtain any permits or approvals required by FAA in advance of construction. No impacts on **airspace** would result.

There would be short-term negligible direct **noise** impacts to onsite workers and minor direct noise impacts to wildlife from construction of NEON infrastructure. These impacts would also occur during removal of NEON infrastructure: after 5 years at Relocatable Sites and 30 years at Core Sites. During the operation of NEON, long-term minor impacts to wildlife would result from the noise created by the three primary generators, one standby generator, and vehicles used to access sites for data collection. AOP overflights may be a nuisance to residents where such overflights would include populated areas. Any impacts from noise would be less than significant.

Construction of NEON infrastructure could have the potential to impact **water quality** during construction from sedimentation or transport of nutrients or other pollutants into receiving waters. During operation of NEON, spills of fuel or chemicals associated with NEON operations would have the potential to introduce contaminants to receiving waters. NEON, Inc. would develop and implement SPCC plans at all sites where fuel or chemicals would be stored to minimize the potential for adverse impacts.

During the final design stage, NEON, Inc. would plan sites to avoid placing infrastructure in **wetlands** except where necessary to meet scientific goals for data collection in Domains 1, 3, and 9 or where unavoidable to provide access or power across a wetland necessary to reach an instrument location. During construction, NEON would make site-specific adjustments to further minimize any unavoidable encroachment into wetlands. Further, NEON, Inc. would minimize the size of proposed infrastructure within wetlands by placing support infrastructure outside of wetlands and only placing necessary data collection infrastructure within a wetland. NEON, Inc. also would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for direct and indirect impacts to wetlands during construction. Where routine access across wetlands is necessary, NEON, Inc. would construct boardwalks to minimize disturbance to wetland soils and vegetation from data collection and maintenance activities.

During the final design stage, NEON, Inc. would plan sites to avoid placing infrastructure in **floodplains** and other flood prone areas except where necessary to meet scientific goals (data collection from within a stream or site within a floodplain) or where unavoidable (access across a floodplains and other flood prone areas necessary to reach instrument location for access or power). During construction, NEON would make site-specific adjustments to further minimize any unavoidable encroachment into floodplains and flood prone areas. When flooding is forecast for an area, NEON, Inc. would temporarily remove sampling equipment from streams and floodplains.

Construction, access, and consumptive sampling would have the potential to impact **common vegetation and plant communities**. Minor clearing of common vegetation would occur to place towers and instrument pads, instrument huts, utility lines, and boardwalks. These impacts would be long-term, lasting until the NEON closure, when infrastructure would be removed and vegetation restored.

Minor direct impacts to wildlife (i.e., **common fauna**) could occur from construction and operation of NEON infrastructure. Disturbance would be limited to less than 0.01 ha at any one location. Negligible indirect impacts to wildlife could result from loss of habitat. During construction, wildlife would likely be displaced from construction areas and immediately adjacent areas. Animals would likely return to the areas following construction. No disruption of wildlife breeding would be expected. No population-level impacts would occur.

Impacts to **sensitive ecological communities** would occur only when NEON infrastructure is placed within a sensitive community specifically to collect data on that community type or when NEON infrastructure is placed within a larger area designated as critical habitat for a species listed under the ESA. Compliance with the ESA requires that NEON, Inc. consult with the USFWS prior to any disturbance or alteration of designated critical habitat.

Impacts to **sensitive species** would be similar to those described for common vegetation and fauna. No population-level impacts to sensitive species would occur.

NEON, Inc. worked with property managers and NSF examined archival records for geomorphologic history, settlement history, and cartographic review within the study areas. According to the archival research, there are no NEON features that will have a significant impact on known **cultural resources**. NEON, Inc. would select the final position of infrastructure at a site to avoid adverse effects on significant cultural resources. If infrastructure positioning is unable to avoid impacts to significant cultural resources, mitigation of impacts, as determined in consultation with the State Historic Preservation Office (SHPO) and others, would be implemented to ensure that the magnitude of any impact would be less than significant.

NEON would not overly burden the electric power or telecommunications systems or other **utilities** in any domain. Where there is insufficient existing electrical power infrastructure at the proposed Relocatable Tower in the Moab Desert of Domain 13, the Toolik Lake Core Site (Domain 18), and the Relocatable Tower (R-35) in Domain 18, NEON, Inc. would install and operate generators to provide a full-time power supply. NEON, Inc. would extend existing transmission lines to provide service at the proposed locations. The impacts to other resources that would result from extension of utility service have already been addressed. Any impacts to utilities would be less than significant.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. Workers would carpool and construction-related vehicle trips would not be expected to exceed four trips per day. Construction vehicle trips would have a negligible impact on traffic at any proposed NEON location. Similar impacts would be expected at site closure. Minor improvements to field roads would not impact **transportation** in the region. No new roads would be constructed.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to **human health and safety**. As appropriate, NEON, Inc. would require workers follow standard safety practices for the type of work being performed, and would require that workers adopt suitable safety measures, as appropriate, for working at heights, near fall hazards, during cold or hot weather, and around electrical hazards to minimize risk of injury. NEON, Inc. would develop site-specific safety policies, procedures, and plans to address unique hazardous conditions at different locations.

Construction and operation of NEON infrastructure would not disproportionately impact minority or low-income populations. All direct impacts would be confined to the proposed locations, where minority or low-income populations do not occur. While there would be limited loss of areas for subsistence hunting and fishing due to NEON, the total area made unavailable would be small at any given location and the impact on subsistence hunting and fishing would be negligible. Any **Environmental Justice** impacts would be negligible.

Where NEON towers would be placed in areas with easy access by unsupervised children, there could a temptation to try to climb the tower. However, access to the tower would be restricted with secure fencing and locked gates. As a result, no pathway for direct exposure to an environmental health or safety risk would be available to children. No impacts to the environmental health and safety of children would occur. Any impacts related to **protection of children** would be less than significant.

Recreational opportunities at and adjacent to NEON construction sites would be constrained for the duration of construction. After construction, recreational activities would not occur on NEON tower sites. However, the area that would be withdrawn from potential recreational use would be small in any one area and the impact on **recreation** would be negligible.

Implementation of NEON would not cause impacts to **aesthetics or visual resources** in most locations. Towers and powerlines would be the most prominent features added to the visual landscape. Infrastructure typically would be placed in areas that are not routinely viewed for aesthetic quality or in urban lands where aesthetic quality is impaired.

Because NEON would be spread across a very large area and would occur over a 30-year period, there is limited potential for NEON to interact with other past, present, or reasonably foreseeable future projects to create adverse **cumulative impacts**.

## Permitting

Section 5.0 of the EA evaluates permits required for the NEON project separately for each domain. The discussion of air permitting is limited to proposed NEON locations that would be within areas designated as in non-attainment for one or more criteria pollutants. Because U.S. regulatory limits are expressed in English units of measure, English units are used throughout this section.

There are 10 domains where STREON experiments would release nutrients into waters of the U.S. over multiple years. These domains include 2, 4, 6, 7, 8, 14, 15, 16, 17, and 19. These releases generally represent small but discrete point discharges that may be regulated under either federal (Puerto Rico) or state programs, where these states have primacy for the National Pollutant Discharge Elimination System (NPDES) under the CWA. Alaska is currently transitioning to assume primacy and will administer the NPDES program for domestic discharges (Individual and General permits), log storage and transfer facilities, seafood processing facilities (Individual and General permits), and hatcheries when the transition is complete. The federal government would retain primacy for STREON-type experiments. Texas has primacy for NPDES permits with the exception of activities associated with oil or gas development.

In situations where NEON sampling would involve animal trapping or collection, individual researchers would develop an animal handling plan that would be approved by the institution with which the researcher is affiliated. After this approval is obtained, the animal handling plan would be submitted to the land management agency where the work is proposed as part of the permitting process to authorize the research. No animal trapping or collection would occur before all necessary approvals of the animal handling plan are obtained.

Where NEON facilities would connect with existing electrical power or telecommunications infrastructure, NEON, Inc. would coordinate with existing providers for authorization of extensions and connections.

A Special Use Permit would be required to place proposed towers and associated infrastructure in select domains. Special Use Permits may be required from USFS, the National Park Service (NPS), USFWS, or the Bureau of Land Management (BLM). Domains requiring a Special Use Permit include: 1, 8, 11, and 13 through 20.

This EA identifies project design features and BMPs that would be implemented to eliminate or minimize impacts. NEON, Inc. would obtain all necessary permits and authorizations prior to construction, conducting destructive (harvest) sampling, and implementing manipulative experiments on waterways. Further, NEON, Inc. would comply with all permit conditions. Where additional site-specific data are needed to determine the extent of impacts, NEON, Inc. would coordinate with appropriate regulatory agencies, collect any needed data, and implement any specified mitigation required by agencies.

NPS Director's Order 12 and the accompanying NPS handbook outline the procedures by which the NPS carries out its responsibilities under NEPA. To fully comply with NPS Director's Order 12, the NPS may require additional site-specific NEPA documentation of that portion of the action that would be constructed and operated on NPS property.

The Hawai'i Environmental Policy Act of 1974 (Hawai'i Revised Statutes 343, HEPA) requires analysis for any action that proposes to use state lands. The NEON sites proposed for Domain 20 would be located on state lands. Because of the national scope of the proposed NEON project, the analysis prepared in this document to meet the requirements of NEPA may not fully satisfy the requirements of HEPA with regard to state concerns. This NEPA analysis may be used to supplement the HEPA process.

## NEPA Finding

Based on the analysis in this EA, NSF has determined that implementation of NEON, with the condition that appropriate project design features and BMPs would be implemented as needed and additional agency coordination would be completed where necessary, would result in no significant adverse impacts to the natural or human environment. The NSF held two public meetings, one in Arlington, Virginia, and the other in Boulder, Colorado, to provide public participation opportunities with respect to this EA. The Preliminary Final EA was made available to the public for comment for a period of 30 days. At the end of the 30-day public review period, the NSF considered all comments submitted by individuals, agencies, or organizations. The NSF determined that implementation would not result in significant impacts and is executing a Finding of No Significant Impact and will proceed with implementation of the Proposed Action.

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## *ADDENDUM A*

Matrix of Public Comments and Responses to Comments

# 1.0 PURPOSE, NEED, AND SCOPE

## 1.1 Introduction

The National Ecological Observatory Network (NEON) is being developed by the ecological research community as a tool that would allow scientists to analyze, understand, and forecast the nature and pace of biological change at scales ranging from local to continental. It is widely recognized that greater understanding of ecological systems is possible, but only if site-based research can be placed into a larger, more integrated regional or continental context. Numerous reports by Presidential Commissions, the National Research Council (NRC), professional societies, and National Science Foundation (NSF) Advisory Committees have identified the major issues (called "Grand Environmental Challenges") that must be addressed through research to understand the biosphere and forecast ecological change. These reports recommended basic research strategies and identified the research infrastructure needed to meet these challenges. Two NRC reports, *Grand Challenges in Environmental Science* (2001) and *NEON: Addressing the Nation's Environmental Challenges* (2003), identify the Grand Environmental Challenges and associated research questions that cannot be addressed with existing research infrastructure because of the need to obtain environmental measurements on a regional to continental scale. The infrastructure required must have the capability to simultaneously address questions associated with changes in living systems over large spatial and long temporal scales.

Research on these scales requires infrastructure that integrates persistent and episodic sensing, supports synoptic remote sensing campaigns, and facilitates experiments across gradients of change. The infrastructure must be able to collect multiple types of data for short periods of time over large or diverse geographical areas and also must be optimized to collect specific data at fixed locations over longer time intervals. The NEON project is designed to minimize impacts to ecological communities and other resources to ensure accurate measurement of the selected observation parameters. NEON has been explicitly designed to allow scientists, engineers, and students to conduct Grand Environmental Challenge research and provide an innovative educational and training platform that meets all of these requirements. Given the time required to observe changes in some ecological parameters, NEON is designed to have a 30-year operational lifespan.

NEON, Inc. is an independent 501(c)3 corporation created to manage large-scale ecological observing systems and experiments on behalf of the scientific community. NEON is a specific NSF-funded large facility project managed by NEON, Inc., which operates the NEON Project Office on behalf of the NSF.

The NSF is developing this Environmental Assessment (EA) to analyze the potential environmental and socioeconomic impacts that would result from implementation of NEON, as proposed.

## 1.2 Purpose and Need for the Proposed Action

The biosphere is the living part of Earth. It is one of the planet's most complex systems, with countless internal interactions among its components and external interactions with the Earth's physical processes and its oceanic and atmospheric environments. In an era of dramatic changes in land use and other human activities, understanding the responses of the biosphere to human drivers of environmental change is both an intellectual grand challenge and a practical necessity. Humans depend on a diverse set of biosphere services and products, including food, fiber, and fuel, and are dependent upon the maintenance of air and water quality. These services and products are strongly affected by the human drivers of change, drivers such as climate change, land use and management, air pollution, and water management. Enhancements or disruptions of these services by human-caused environmental change could alter the fundamental trajectory of the human endeavor over large parts of the world.

A wide range of biotic and physical processes link the biosphere, geosphere, hydrosphere, and atmosphere. Despite this, the understanding of the biosphere does not match the increasingly sophisticated understanding of Earth's physical and chemical systems at regional, continental, and global scales. Because many of these responses and feedbacks are large-scale, they cannot be investigated with disconnected studies on individual sites or over short periods of observation. NEON is a bold effort to build on recent progress in many fields to open new horizons in the science of large-scale ecology. The scientific work that would be conducted through NEON would focus explicitly on questions that relate to grand challenges in environmental science, that are relevant to large regions, and that cannot be addressed with traditional ecological approaches (ISEP, 2006).

The proposed NEON platform must observe both the human drivers and biological consequences of environmental change. Environmental monitoring networks typically observe either the cause (for example, climate, air pollution, or satellite-based land cover change) or the consequences (for example, phenology [the study of the timing of natural events] or avian populations). Rarely do environmental networks provide integrated observations of aspects of both cause and effect to allow increased understanding of the underlying processes. NEON would be unique in that it would observe both a suite of key causes of environmental change (climate, land use, exotic species invasions) and a wide range of consequences. Because NEON would link cause and effect, it would operate as a research system and not an environmental monitoring program.

The purpose of NEON is to provide an integrated research tool for scientists to achieve a better understanding of the biosphere and processes operating at large scales. Further, NEON would establish and sustain the scientific infrastructure needed to address critical questions about land use and climate changes on ecological systems and to evaluate the impacts of those changes on the environment and human culture. The need for the NEON program is to enable scientific advances by providing the technical means and support personnel to achieve a fully integrated and distributed national network of research infrastructure. A uniform and standardized aspect of the design is essential to informing the science, testing the hypotheses, and conducting research at the continental scale. By systematically controlling for sources of uncertainty in quantities measured over large time and spatial scales, the standardized design would provide the statistical power to distinguish between scientific phenomena and systematic error.

## 1.3 Scope of Analysis

This document was prepared in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations of 1978, 45 Code of Federal Regulations (CFR) Part 640, and 36 CFR Part 800. The Federal action being addressed is whether the NSF should establish and support the NEON system.

This EA identifies, documents, and evaluates the effects of establishing a nationwide network of infrastructure deployments to collect long-term data for analysis. An interdisciplinary team of scientists, planners, economists, engineers, archaeologists, and historians analyzed the Proposed Action and alternative actions in consideration of existing conditions to identify relevant beneficial and adverse effects associated with the actions.

For analysis purposes, this EA considers potential impacts from:

- Establishment and operation of Core Sites, which would be permanent (30-year) infrastructure deployments typically consisting of no more than three Fundamental Instrument Units (FIUs), an Aquatic Array, and multiple Fundamental Sentinel Unit (FSU) sampling points to collect ecological data. Core Sites would be representative of undeveloped areas within the Domain.
- Initial deployment and operation of Relocatable Sites, which would be intermediate length (3- to 5-year) infrastructure deployments consisting of one FIU, one Aquatic Array, and multiple FSUs. Relocatable Sites would be deployed to collect data along gradients relevant to the Core Site investigation. Typically, a Relocatable Site would have fewer FSUs than a Core Site.
- Deployment and operation of Mobile Deployment Platforms (MDPs), which would include a small to medium sized transportable tower. MDPs would be used for short-term research objectives and education or other related activities.
- Deployment of Airborne Observation Platforms (AOPs), which would be used to collect spatial data to allow extrapolation of data collected locally from in-situ measurements to regional and continental scales.
- Deployment and operation of a stream observatory network (STREON), which would include experiments with long-term manipulation of stream ecosystems.
- Development and operation of the NEON Land Use Analysis Package (LUAP), which would be used to transfer data sets produced by federal agencies and other scientific or commercial sources to the NEON data archive and to reanalyze these existing data for use alongside data from the NEON program.

To conservatively bound the analysis of impacts, this EA analyzes the potential impacts from the maximum amount of infrastructure that may be deployed at a site and the maximum level of sampling that could occur. As a matter of practice, the amount of infrastructure deployed at a site may be less than the amount analyzed, but would not exceed the amount analyzed. The same situation would apply to data collection, particularly with regard to consumptive sampling. If there is a reduction in infrastructure deployed or sampling effort, there would be a corresponding reduction in the potential impacts when NEON is implemented.

The individual components of the Proposed Action are described in Section 2. The format of the EA is as follows:

- Section 1: Introduction and Statement of Purpose and Need.
- Section 2: Description of Proposed Action and Alternatives, including the No Action Alternative.
- Section 3: Description of the Affected Environment and Environmental Consequences, including a discussion of current conditions, as defined by existing information, discussion of the expected effects of the Proposed Action, and discussion of the potential for cumulative effects of environmental impacts and the mitigation measures determined to be appropriate. This section identifies resource areas where there is no potential for significant impacts, identifies resource areas with similar impacts across all ecoclimatic domains, and then presents detailed analysis divided by domain and sites within each domain.
- Section 4: Conclusions.
- Section 5: Permitting Requirements.
- Section 6: List of Preparers
- Section 7: Acronyms and Abbreviations.

## 1.4 Agency and Public Participation

The NSF invites public participation in the proposed federal action through the NEPA process. Consideration of the views and information of all interested persons promotes open communication and enables better decision-making. All agencies, organizations, and members of the public having a potential interest in the Proposed Action, including Native American organizations and minority, low-income, and disadvantaged groups, are urged to participate in the decision-making process.

For almost two decades, the ecological sciences research community has been calling for the national ecological research and observation capability (Long Term Ecological Research [LTER], 1990; AIBS, 2003; NEON, 2006) needed to promote understanding of the biosphere. Two NRC reports, *Grand Challenges in Environmental Science* (2001) and *NEON: Addressing the Nation's Environmental Challenges* (2003), identify Grand Environmental Challenges and the associated research questions that are critically important to address now, cannot be addressed with existing research infrastructure, and require environmental measurements on a regional to continental scale. From 2000 through 2007, the design for this capability evolved through 47 workshops conducted by the research community, the American Institute of Biological Sciences, the Ecological Society of America, and NEON, Inc. to identify the key scientific questions and hypotheses related to each Grand Challenge area. In this process, the technological and scientific requirements associated with those questions and hypotheses were developed. Since 2007, the design has been refined, re-scoped, and optimized for research on regional to continental scale ecological questions, thereby enabling the development of the field of large-scale ecology. The scientific, technical, and deployment requirements were derived through additional planning and design activities by NEON, Inc., including a Request for Information and Evaluation Workshops, site visits, and research community evaluation (see: www.NEONInc.org for details).

The NSF held two public meetings, one in Arlington, Virginia, and the other in Boulder, Colorado, to provide public participation opportunities with respect to this EA. The Preliminary Final EA was made available to the public for comment for a period of 30 days. At the end of the 30-day public review period, the NSF considered all comments submitted by individuals, agencies, or organizations. A Matrix of Public Comments and Responses to Comments is provided in Addendum A. The NSF determined that implementation would not result in significant impacts and is executing a Finding of No Significant Impact and will proceed with implementation of the Proposed Action.

## 1.5 Regulatory Framework

In addressing environmental considerations, the NSF is guided by 45 CFR 640, other relevant statutes (and their implementing regulations), and executive orders (EOs) that establish standards and provide guidance on environmental and natural resources management and planning. These include the following:

**Federal Statutes**

- NEPA (42 United States Code [USC] 4321–4370)
- Endangered Species Act of 1973 (ESA) (16 USC 1531–1543)
- Fish and Wildlife Coordination Act (16 USC 661, et seq.)
- Migratory Bird Treaty Act (MBTA) (16 USC 701, et seq.)
- Clean Water Act of 1977 (CWA) and the Water Quality Act of 1987 (WQA) (33 USC 1251 et seq., as amended)
- Farmland Protection Act of 1981 (7 USC 4201 et. seq., as amended)
- National Historic Preservation Act of 1966 (NHPA) (16 USC 470 et seq., as amended)
- Archeological Resources Protection Act of 1979 (16 USC 470)
- Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.)
- American Indian Religious Freedom Act (42 USC 1996, as amended)
- Clean Air Act (CAA) (42 USC 7401 et seq., as amended)
- Noise Control Act of 1972 (42 USC 4901–4918)
- Federal Land Policy and Management Act

**Regulations**

- CEQ Regulations for Implementing NEPA 40 CFR 1500–1508
- Compliance with the National Environmental Policy Act (45 CFR 640)
- Protection of Historic Properties (36 CFR 800)

**Executive Orders (EOs)**

- EO 11514, Protection and Enhancement of Environmental Quality (as amended by EO 11991)
- EO 11988, Floodplain Management
- EO 11990, Protection of Wetlands
- EO 12088, Federal Compliance with Pollution Control Standards
- EO 12372, Intergovernmental Review of Federal Programs
- EO 12580, Superfund Implementation
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
- EO 13045, Protection of Children from Environmental Health Risks and Safety Risk
- EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds
- EO 13195, Trails for the 21st Century
- EO 13327, Federal Real Property Asset Management (amended by EO 13423)
- EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management
- EO 13175, Consultation and Coordination with Indian Tribal Governments
- EO 13007, Indian Sacred Sites

These authorities are addressed in various sections throughout the EA when relevant to particular environmental resources and conditions. Other regulations may be applicable to construction and operation of the proposed NEON project or at specific locations. Such regulations will be discussed in the document where relevant to the NEPA analysis.

# 2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

This section presents information regarding the site selection and alternatives considered but not carried forward, as well as the Proposed Action and Alternatives. The site selection and alternatives considered but not carried forward are discussed in Section 2.1. The Proposed Action is described in Section 2.2. The No Action Alternative is presented in Section 2.3. Because of the constraints on initial site evaluation to meet scientific data collection needs, no additional action alternatives are considered in this EA. The Proposed Action described in Section 2.2 will be the preferred alternative.

## 2.1 Site Selection and Alternatives Considered but Not Carried Forward

The process for identifying, considering, and selecting sites for deployment of NEON infrastructure considered hundreds of potential sites, involved hundreds of stakeholders, and included multiple evaluation stages. The process has been lengthy, thorough, scientifically and statistically based, considered construction and operations costs and logistics, and included evaluation of environmental considerations at all development stages. Establishing the site criteria, selection, and review processes has involved research community workshops, Blue Ribbon committees, and NRC and NSF merit reviews.

Locations were chosen to deploy NEON infrastructure across the continental United States, Alaska, Hawai'i, and Puerto Rico using a statistically determined design stratified by climate and land use (Hargrove and Hoffman, 1999, 2004; Keller et al., 2008). The design divides the U.S. into 20 domains, each representative of a specific range of eco-climatic conditions. With the suite of 20 domains encompassing the total ecoclimatic environmental variability of the U.S., when any variable is measured over time in all 20 domains, a continental picture of the quantity, changes in, and spatial heterogeneity of that variable is obtained (Figure 2-1).

Two statistical analyses were performed to determine what spatial sampling density would be required to meet the science requirements. Multiple iterations of a multivariate analysis, stratified by climate and land use, partitioned the continental U.S. into alternative "domain" scenarios, ranging from 5 to 2,500 domains (Hargrove and Hoffman, 1999, 2004; Keller et al., 2008). A second statistical analysis determined that the minimum number of domains needed to capture the maximum environmental heterogeneity of the continental U.S. is 17, a number consistent with other "eco-region" partitions of the continent used by Ameriflux, the U.S. Environmental Protection Agency (USEPA), and the U.S. Forest Service (USFS) (Bailey, 1995; Omernik, 1995).

In October 2006, the NEON Project Office announced a Request for Information (RFI) inviting members of the ecological research community to submit ideas about (1) specific research projects they would conduct using NEON and (2) potential Core and gradient (Relocatable) sites (http://neoninc.org/milestones/2006/request-for-information.html). NEON, Inc. conducted a webcast on November 1, 2006, to assist respondents in providing information (see: www.NEONInc.org for details) and responses were requested by January 5, 2007. The office received more than 60 responses from the ecological research community, including recommendations for research designs, experimental designs, and wildland areas within a domain where NEON observational resources could be deployed within the identified domains. NEON, Inc. received 36 responses to the RFI regarding potential locations for domain Core facilities. The United States Geological Survey (USGS) Earth Research Observing and Science (EROS) Data Center convened scientific and technical experts to evaluate the proposed projects, develop statistical and integrated scientific criteria to evaluate the scientific suitability of the proposed infrastructure deployment sites, and recommend alternative strategies for the national deployment of NEON infrastructure (see http://www.neoninc.org/documents/design for several documents detailing Core and Relocatable deployment criteria and locations).

These initial recommendations were analyzed by NEON, Inc. to identify the most appropriate locations for placement of NEON infrastructure.

Over 800 alternative candidate sites were proposed. Candidate Core Sites were down-selected based on their "representativeness" of a domain and candidate Relocatable Sites were down-selected based on their ability to represent major gradients of change (e.g., land use, climate, and invasive species). This information aided NEON, Inc. in identifying a suite of candidate Core Sites (http://www.neoninc.org/documents/46) and gradients for the Relocatable Sites (http://www.neoninc.org/documents/45), which formed the basis for a site-dependent design.

In evaluating the RFI responses, NEON, Inc. conducted visits to proposed Core Site areas to evaluate whether existing infrastructure could be used to accommodate NEON projects with minimal modification and also whether environmental conditions would allow implementation of NEON projects without substantial impacts. At this stage, each domain included one candidate Core Site and five to seven candidate Relocatable Sites. NEON, Inc. then reviewed all proposed locations with regard to scientific suitability, practicality, and environmental conditions and selected the 20 proposed Core Sites. Natural and human environmental issues that were given consideration throughout the process included:

- The potential for impacts to wetlands and other waters of the United States.
- The potential for species protected under the ESA to occur in areas where infrastructure would be sited.
- The potential for NEON development to impact known historical or cultural resources listed or eligible for listing in the National Register of Historic Places.

Multiple locations were considered for Relocatable Sites in each domain, including areas proposed but not selected as Core Sites. As with the Core Sites, NEON, Inc. reviewed all proposed locations with regard to scientific suitability, technical practicality, and environmental conditions. The same environmental issues considered for Core Sites were applied to Relocatable Sites. NEON, Inc. selected the 40 proposed Relocatable Sites based on the highest ratings across all considered criteria.

Once all the proposed Relocatable Tower sites were selected, NEON, Inc. worked with the property owners and site managers to assess sites for scientific suitability, technical practicality, and environmental conditions before a proposed location was selected for Relocatable Site infrastructure. In some instances, after initial selection of a location, follow-on investigations identified previously unknown environmental conditions that could result in unacceptable environmental impacts. In these instances, NEON, Inc. worked with the property owners and site managers to select a different location where environmental conditions were acceptable.

In the preparation of this EA, the consideration of a single alternative in addition to the No Action Alternative reflects the substantial preliminary screening of alternative sites through successive steps of:

5. Preliminary response to the RFI.
6. Site-specific field activities that refined the analysis to confirm that in the general area proposed for the sites, the environmental constraints could likely be met in an area within 2 to 3 km of the location of the towers.
7. Working with property owners and site managers to identify specific locations that would meet scientific requirements and minimize impacts.
8. Additional data collection prior to and during the preparation of this EA that focused on a smaller footprint (generally within a 5-kilometer [km] diameter circle for protected species and other resources and a 3.2-km diameter circle for cultural resources) with relocation of towers or facilities if necessary to avoid impacts to sensitive resources.

Examples of specific relocations that have occurred as a result of this final screening step include:

- The J.W. Jones Ecological Center identified alternate locations following initial site selection of locations for a Relocatable Tower and an Aquatic Array on its property that would still meet the scientific design needs. The new locations identified by the J.W. Jones Ecological Center would allow the Relocatable Tower and Aquatic Array to share utilities, reducing the amount of new utility line and associated land disturbance that would have been required to supply the originally selected locations.
- The National Park Service (NPS) determined that the site originally proposed as a NEON Relocatable Site along Abrams Creek within the Great Smoky Mountains National Park (GSMNP) would have unacceptable environmental consequences from deployment of NEON infrastructure. The NPS proposed an alternate location that would meet the scientific needs of the project and where environmental impacts would be less. NEON, Inc. ultimately accepted the alternate location for the Relocatable Site.
- The NPS determined that the site originally proposed as a NEON Relocatable Site near Sprague Lake within the Rocky Mountain National Park (RMNP) would have unacceptable environmental consequences from deployment of NEON infrastructure. NPS proposed an alternate location that would meet the scientific

needs of the project and where environmental impacts would be less. NEON, Inc. ultimately accepted the alternate location for the Relocatable Site.

In summary, the issues that were considered for the location of Core or Relocatable Sites included those that would meet the scientific goals of the program as well as those factors that would affect access and environmental acceptability. Because of the very large areas represented by the domains, the selections of sites for placement of towers and ancillary infrastructure were initially driven by the responses to the RFI, which focused on scientific considerations and logistical constraints at a broad level. As these sites were further evaluated and specific locations ground-truthed by field teams, additional data were collected that included factors that would allow the scientific goals to be met while avoiding or minimizing potential impacts to natural, physical, historical/cultural, or human resources. Proposed NEON studies will not interfere with any ongoing research activities. NEON would request review of any new research proposals through the permitting process.

## 2.2 Proposed Action (Preferred Alternative)

Under the Proposed Action, the NSF would establish a continental-scale network of long-term ecological infrastructure deployments called the National Ecological Observatory Network (NEON). NEON would deploy infrastructure across the continental U.S., Alaska, Hawai'i, and Puerto Rico using a statistically determined design stratified by climate and land use (Keller et al., 2008). The design divides the U.S. into 20 domains, each representative of a specific range of ecoclimatic conditions, encompassing the range of environmental variability of the U.S. Under this system, when any variable is measured over time in all 20 domains, a continental picture of the quantity, changes in, and spatial heterogeneity of that variable is obtained. The deployment of NEON would not require development of new sensors or data collecting equipment.

Within each domain, the regional footprint would include field study sites and associated field and laboratory facilities. NEON, Inc. would implement standardized infrastructure deployments at all Core and Relocatable Sites. Candidate NEON sites that are already field data collection sites vary in the amount of current data collection instrumentation available. NEON, Inc. would leverage existing infrastructure and programs to the extent possible, and would enhance infrastructure at Core and Relocatable Sites where necessary. Advanced computational infrastructure would provide connectivity to allow Core and Relocatable Sites to function as an integrated regional research tool. The network of deployments would form a fully integrated continental-scale research platform.

NEON would consist of multiple components (Figure 2-2):

- 20 Core Sites (1 per ecological domain)
- 41 Relocatable Sites (typically, 2 per ecological domain)
- 10 MDPs
- 26 Aquatic Arrays
- 2 AOPs
- 10 STREON Sites

- NEON Project Office at NEON, Inc. Headquarters

Maps showing the locations for each of the Core, Relocatable, and STREON Sites on USGS 7.5-minute topographic quadrangle map (quad) backgrounds are provided as Figures 2.D0-1 through 2.D20-2. The specific components are discussed in the following sections.

All measurements in this document are presented in Système International (SI) units or temporarily retained non-SI units (such as hectares [ha]). A table developed from Cardarelli (1999) is provided in Appendix A to facilitate conversion from SI units to traditional English units.

## 2.2.1 NEON Components

This section describes the typical components of NEON sites. There may be site-specific variation from the typical description. Where this occurs, the variations are discussed in the appropriate domain sections.

### 2.2.1.1 Core Sites

Each domain would have one fully instrumented NEON Core Site located in a wildland area. Core Sites typically would vary in size from a minimum of approximately 2,000 ha to more than 20,000 ha. Within a Core Site, NEON sampling would occur over an area of 1,963 ha, but the amount of ground disturbance for placement of infrastructure would be less than 0.01 ha, or much less than 1 percent of this area. Core Sites would be operational for a 30-year period and would be located on lands where development would not occur during that period.

NEON Core Sites would include a standard set of instruments to collect biological, biophysical, biogeochemical, and land use and land management data, three towers, a panelized modular enclosure called an instrument hut (IH), and in some cases an Aquatic Array. A variety of data collection packages would be deployed as subsystems. These may include:

- An FSU, which would involve detailed manual surveying and sampling of biota and substrates in the NEON domains; subsequent chemical, isotopic, and genetic analysis; and archiving of samples. These data would be relayed back to NEON, Inc., Headquarters for further processing.
- An FIU, which would include a tower and a set of tower-, stream-, and ground-based sensors measuring atmospheric and terrestrial environmental parameters. These measurements would be relayed back to NEON, Inc., Headquarters for processing.
- An AOP, which would consist of commercial and custom-built remote sensing equipment deployed from leased aircraft to annually survey the NEON Core and Relocatable Sites.
- A LUAP, where data sets produced by federal agencies and other scientific or commercial sources would be transferred to the NEON data archive and reanalyzed for use with data from the other NEON science subsystems.

- An MDP, which would include a small to medium-sized tower with selected sensors and instruments placed on a truck or trailer that would be deployed on short notice for events of scientific interest (e.g. hurricanes, wildfires), or used in educational or other related activities.
- A STREON, currently proposed for 10 sites, which would consist of long-term nutrient addition and/or top-level consumer manipulation experiments conducted in addition to standard NEON stream measurements.

An FIU would consist of fixed towers that support sensor arrays used to collect comprehensive data on climate and canopy microclimate, air pollution and air quality, carbon cycle, soil characteristics, and water quality. Each tower and its associated sensor arrays would collect data from an area surrounding the tower with a radius of up to approximately 100 times the height of the tower. It is anticipated that no disturbance to ecological processes would result from NEON activities within this area.

One Advanced and two Basic FIU Towers would be installed at most Core Sites. Advanced FIUs would have more extensive instrumentation than Basic Towers. Typically, a tower would extend 10 meters (m) above forest vegetation or to 8 m in low vegetation, such as grassland or tundra. Towers would be constructed on a concrete foundation pad (1.5 m by 1.5 m). Guy wires would extend as much as 30 m from the tower base and would be attached to concrete anchors. Towers and equipment would be fenced to protect equipment and to prevent unauthorized access.

Where possible, towers would be located near roads to facilitate access, maintenance, and transport of materials. Electric power would be extended from an existing grid to an auxiliary portal (AP) that would serve the tower site. The AP would transition commercial power and communications to NEON systems. A single AP may serve multiple FIUs or other components, depending on the configuration of NEON infrastructure. Typically, the power line would be extended above-ground via poles and overhead lines along existing roads from the AP to as near an FIU as possible. Where existing roads are no longer available, the power extension would continue through surface conduits or shallowly buried conduits from the road to an IH, towers, and Aquatic Array (where a Core Site includes an Aquatic Array). A step-down transformer would be placed near the tower and power would be distributed to the tower and sampling equipment through buried or surface lines. All lines would be protected by external conduit. Telecommunication lines would be extended to NEON infrastructure in parallel with the power extension.

At core sites, existing infrastructure would be used to provide electricity to towers. However, there is no electrical power infrastructure at the Toolik Lake Core Site and Relocatable Site R-35 in Domain 18 or at proposed Relocatable Site R-25 in Domain 13. NEON, Inc. would use primary generators to provide power at these locations. A 100-kilowatt (kW) diesel-powered generator would be used to provide electricity at the Toolik Lake Core Site in Domain 18. A primary 100-kW diesel-powered generator would provide electricity to proposed Relocatable Site R-35 in Domain 18. A primary 130-kW propane-powered generator would provide electricity to proposed Relocatable Site R-25 in Domain 13.

Towers and sensor arrays would be equipped with a microwave antenna to allow transmission of data. Remote inspection of sensors and towers would be conducted through a dedicated portal and fiber optic cable.

Each Core Site would have one Advanced FIU Tower which would include an Advanced Tower, multiple FSUs, and associated sensor arrays. Each Core Site also would have two Basic FIU Towers, which would include a Basic Tower, multiple FSUs, and associated sensor arrays. Typically, a Basic Tower would have fewer FSUs than an Advanced Tower. An Aquatic Array also may be a component of the Core Site.

An IH would be present near the base of each tower. It would serve as the main supporting function for power distribution, scientific and data equipment, data gathering, and lab activities at each tower location. In most cases, the IH would be supported above the ground surface by a series of nine adjustable height leveling supports. The typical size of each IH would be approximately 3.05 m by 4.88 m by 2.93 m height. Each IH would be capable of providing secure and weather tight conditions for against wind or water leakage through the roof, wall, or floor panels. Access to the IH at the entry door would be from a boardwalk with a 4.57-m long ramp from natural grade to the floor level of the IH, with a platform area of 1.52 m by 3.05 m at the entry door location for equipment delivery and installation. The IH would house instrumentation, including data loggers for sensors, common field equipment, and supplies to support maintenance of instrumentation. The IH also would contain pressurized gas cylinders containing methane and carbon dioxide that would be used to calibrate instruments.

An auxiliary portal (AP) would consist of a 2.44 m by 6.10 m by 2.60 m height steel container placed at the point at which the respective utility company's power/communication services would enter the tower locations. The AP structures would be supported by cast-in-place foundations supporting the corners of the container or 1.0-m diameter concrete piers. Where feasible, the AP would be parallel to the existing road or path, shielding the propane tank as much as possible, with doors on the "downhill" side of the container, opening toward the 1.22-m wide cleared/improved path or 1.52-m wide boardwalk that leads to the IH. Electrical and communication conduits would extend from the AP along the path to the IH. Typically there would be one AP supporting each tower; however, in some cases, where multiple towers are in close proximity to each other, one AP would support numerous towers. Additionally, each AP would house a small local transformer, lighting, a thermostatically controlled exhaust fan, and essential tools and support equipment for the site. Domains 18 and 19 would have multiple containers comprising their APs.

Where diesel-powered primary generators would be used, at the proposed Toolik Lake Core Site and R-35 in Domain 18, it is anticipated that a single fuel tank would be placed on the scientific site side of the AP for each generator. Each tank would provide sufficient fuel capacity to maintain generator operation for up to 2 weeks at that location. At R-25 in Domain 13, a single propane tank would supply the generator and it is expected that deliveries would occur weekly.

In order to minimize the impact of support services in close proximity to the tower and array sites, a portal container set (PCS) would be used to store any non-essential physical requirements from the area near these sites. The PCS would provide additional storage capacity for materials and equipment that would routinely be utilized at each site. The PCS would consist of two 2.44 m by 6.10 m by 2.60 m height steel containers placed at a point that is typically a few to several kilometers from the sites, depending on the availability of land, at which these storage provisions would be placed. One of the containers would include site storage for essential cages and support equipment that does not need to be close to the sites and the other container would be used to store cage sized gas cylinders, as needed for support of the ecological mission, lighting, and a thermostatically controlled exhaust fan. The PCS would be located on leased private land, typically along the main road to the sites, with doors facing away from the road. Neither power nor communication lines would need to be extended to the PCS, since photovoltaic panels would be mounted to the roof of the PCS. The photovoltaic panels would be adequate in providing both lighting and exhaust. Each PCS would be painted before delivery to the site to minimize the visual impact when placed in the specific environment. NEON, Inc. would avoid placing PCS in ecologically sensitive areas. Pairs of containers would be bolted together where bolt heads are concealed within the containers on both sides. The two containers comprising the PCS would be supported by 1.0-m diameter concrete piers at the corners of each container with the inner corners sharing a footing.

An array of three to five soil samples would be taken by hand auguring near the base of FIU Towers. Any portion of the augured material not collected for analysis would be returned to the sample hole. Soil samples would be collected annually throughout the duration of NEON experiments at a given location.

For each Aquatic Array up to 10 shallow vadose zone wells, expected to average 20 centimeters (cm) to 35 cm, would be installed by hand auguring. Vadose zone wells would be installed on land around the stream.

Core Sites would include a Terrestrial Array of up to 50 FSU sampling plots. Components of FSUs typically would include:

- Sampling Plots, which would be circular areas encompassing 168 square meters ($m^2$) within which NEON, Inc. would conduct vegetation and soil sampling. Non-destructive vegetation surveys would occur weekly. Destructive vegetation sampling, consisting of collection of aboveground biomass (stems and leaves) in 1-$m^2$ quadrats, would occur up to three times a year. Soil sampling would occur once per year.
- Ecosystem Productivity Plots, which would include 50-m to 100-m sampling transects associated with the FIU Towers. Non-destructive vegetation surveys would occur weekly. Collection of aboveground biomass in 1-$m^2$ quadrats would occur up to three times a year. Bulk leaf litter would be collected bi-weekly to bi-monthly from 0.5-$m^2$ quadrats. Soil characterization would be conducted at Ecosystem Productivity Plots through deep soil cores (5-cm diameter to a 100-cm depth) that would be taken every 3 to 5 years and shallow soil cores (5-cm diameter to a 20-cm depth) that would be taken up to four times per year.
- Small Mammal Trap Plots, which would be placed in at least three habitat types and would consist of up to ten 300-m transects and up to three 1-ha web plots (traps placed in a grid spaced along radial axes from a central point). Trapping would

occur during 3 consecutive days up to three times a year. Some captured animals would be sacrificed to examine for pathogens and parasites.

- Bird Survey Grids, which would consist of at least five 1-square-km ($km^2$) survey grids. Visual encounter surveys of birds would occur daily for at least 6 weeks during the breeding season within each grid. Locations would be permanently marked with rebar, but there would be no destructive sampling.
- Insect Pitfall Trap Transects, which would be embedded 15 cm below the soil surface in ten 5-m transects associated with the 168-$m^2$ vegetation plots. Traps would be deployed for 2 months and checked weekly.
- Light Traps and Gravid Mosquito Traps, which would be hung in vegetation near the 168-$m^2$ vegetation plots. Traps would be checked weekly for 4 to 6 months a year.

The terrestrial array would have minimal ground disturbance, limited to (1) placement of permanent markers at a fixed sample point or at the ends of a sample transect and (2) placement of signage depicting the plots. Permanent markers would consist of rebar driven into the ground and would be placed only at the start of the project. If the terrestrial array were to be relocated during the project, the original rebar would be removed and new permanent markers would be placed. Electric power would not be extended to FSUs. FSUs could include constructed elevated walkways or footbridges to minimize the potential for trampling disturbance in sensitive habitats.

Most Core Sites also would include an Aquatic Array. If a suitable location is not present within the Core Site, an Aquatic Array would be located in conjunction with a Relocatable Site or would be established at an independent sampling location.

Aquatic Arrays would be placed in or adjacent to a stream or lake. The Aquatic Array would contain automatic sensors to monitor stream physical, chemical, and biological properties. Manual measurements of certain stream data also would be recorded. In addition, up to 10 groundwater wells would be associated with each Aquatic Array.

Sensors would be placed directly in the stream and would transfer information to dataloggers via cables. Each Aquatic Array would collect data from a 500-m stream reach or from a comparable area within a lake. Dataloggers would either store data for download or automatically transmit data to a support facility. FSU aquatic measurements would include water chemistry every 2 weeks; biodiversity surveys of plants, invertebrates, and fish twice a year; and stream morphology every 2 to 5 years. No ground disturbance would result from placement of an Aquatic Array. Dataloggers would be placed in weatherproof containers that would be secured to trees or boulders.

Where streams are near an FIU Tower (typically within 1 km to 2 km), power and communications would be supplied from the FIU Tower and portal. If the Aquatic Array is not near an FIU Tower (typically more than 2 km distant), then the Aquatic Array would operate independent of the FIU Tower with standalone power/communications required (and possibly a separate portal area).

Construction typically would take approximately 6 months for a crew of up to 10 contract workers plus oversight personnel from NEON, Inc. Workers would travel to and from the site together to minimize the number of vehicles traveling to a site. All work would be during the day. Equipment and materials would be hand-carried to the construction sites. Construction personnel would be housed offsite. No new roads would be constructed, but some existing roads may be improved (such as adding gravel) to improve access.

To minimize the potential for environmental damage, new improved trails of the minimum distance to reach a tower location may be created. These trails would not be open to the public and would be signed or gated to deter unauthorized recreational vehicle use. Boardwalks and single-person pedestrian bridges may be constructed to improve site access or protect sensitive areas, depending on site-specific conditions.

During operation, the number of people visiting the site would vary depending on what type of data is being collected. It is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. No personnel would stay onsite during operation.

#### 2.2.1.2 Relocatable Sites

A Relocatable Site would consist of a suite of instruments that could be moved to collect data outside the fixed Core Sites. Relocatable Sites would support extended and periodic investigations that expand measurements of environmental variability and gather ecological data along gradients of elevation, precipitation, and land use. Relocatable Sites would be located up to 300 km from a Core Site and would be initially deployed for 5 years at a given site. Relocatable Sites would be relocated within a domain as needed based on clearly defined research projects funded by the NSF.

Relocatable Sites would include a single FIU Tower and would have fewer FSU sampling plots and productivity transects compared to Core Sites. The Relocatable FIU Tower would generally be equipped with meteorological instruments, basic air quality monitors, soil respiration monitors, and physical and canopy measurements. Depending on the science question and location, a Relocatable Site may be equipped with any combination of four instrument packages: eddy covariance instruments, advanced air quality instruments, aquatic sensors, and/or dust sensors. All FSU sampling that would occur at Core Sites also would be conducted at Relocatable Sites.

Utility service and communications would be supplied to Relocatable Sites the same as described for Core Sites. Towers and equipment would be fenced to protect them and to deter unauthorized access.

#### 2.2.1.3 Mobile Deployment Platforms (MDPs)

MDPs (instruments on vehicles or on trailers towed by vehicles) would be used to study sudden events on the landscape, such as wildfires, natural catastrophes, disease outbreaks, or the emergence of an invasive species. They also would serve as an educational resource. MDPs would be deployed from a few days to several months at any given location. MDPs would consist of a movable tower and associated sensors for data collection.

#### 2.2.1.4 Fundamental Sentinel Unit - Terrestrial Array

The Fundamental Sentinel Unit (FSUs) terrestrial array consists of up to 30 fixed sampling locations where flora and fauna would be studied. Each FSU would have circular plots with a diameter of 168 m. The terrestrial array would have minimal ground disturbance, limited to placement of permanent markers at a fixed sample point or at the ends of a sample transect and signage depicting the plots. Permanent markers would consist of rebar driven into the ground. No power or communication lines would be extended to the terrestrial array. Each plot occupies approximately 2.2 ha, meaning up to 66 ha of land would be included in designated FSUs at each tower.

#### 2.2.1.5 Fundamental Sentinel Unit - Aquatic Array

An Aquatic Array would be placed in and adjacent to a stream or lake. The Aquatic Array would automatically monitor stream physical, chemical, and biological properties. Sensors would be placed directly in the stream and would transfer information to dataloggers via cables. Each Aquatic Array would collect data from a 500-m stream reach. Dataloggers would either store data for download or automatically transmit data to a support facility. No ground disturbance would result from placement of an Aquatic Array. Dataloggers would sit on the ground and would be secured to trees or boulders. Up to 10 shallow groundwater wells would be placed around each Aquatic Array.

Where streams are near an FIU Tower, power and communications would be supplied from the FIU Tower portal. If the Aquatic Array is not near an FIU Tower, then a separate portal would be required for the Aquatic Array. Power would be extended to the portal and from the portal to the array as described for Core Sites.

#### 2.2.1.6 Airborne Observation Platform (AOP)

The AOP with remote sensing instruments would provide regional information for scaling and extrapolation. Two aircraft would be equipped with Light Detection and Ranging (LiDAR) and hyperspectral sensors to collect quantitative information for extrapolating from the finer spatial scales resolved by the instrumented towers and field surveys to a regional or continental scale. The AOP would collect data on ecological attributes with a ground sampling resolution of 1 to 5 m.

Each domain would be flown once per year during the growing season (typically April through October). The growing season flight window would allow flexibility in scheduling flights to avoid potential disturbance to sensitive biological resources. Flights typically would be at 1,000 m above ground, but some flights may be as low as 150 m above ground.

Each AOP would have identical equipment, including:

- Remote sensing instrument payload
- Sensor maintenance and calibration facility
- Data processing and distribution facility
- Flight operations

The instrument payload would consist of an imaging spectrometer, a small footprint waveform LiDAR, a dedicated Global Positioning System (GPS) and Inertial

Measurement Unit (IMU) subsystem, and an instrument controller and data capture subsystem. The optical sensors would be mounted to a common optical bench to maintain mechanical alignment, provide vibration isolation, and facilitate rapid loading/unloading. The sensors would be configured to view through an open port in the bottom of the aircraft, providing a clear view to the ground during flight. The integrated GPS/IMU would be necessary to precisely measure instrument payload position and attitude during remote sensing data collection, which would be combined with knowledge of the relative orientation of the spectrometer and LiDAR in the GPS/IMU reference frame to compute the line-of-sight trajectory of each laser shot and spectrometer detector element at a specific time. Precision flight tracks require a real-time data system to provide the information necessary to fly predetermined flight tracks to within 100 m, and to re-direct flight tracks enroute if necessary.

A detailed flight plan would be developed for each domain, to include planned flight tracks, ground speeds, and flight altitudes.

#### 2.2.1.7 STREON Sites

The STREON experiments would provide an assessment of ecosystem response to predicted future conditions by accelerating known drivers of ecosystem structure and function. STREON experiments would increase ambient nutrient concentration in a stream reach and exclude top-level consumers from experimental baskets at 10 NEON stream sites. STREON experiments would be long-term experiments, planned to be conducted over a 10-year time period (Mullholland et al., 2008).

STREON Sites would focus on manipulative experiments on low-order streams. In addition to the standard Aquatic Array for instrumentation and associated groundwater wells, STREON experiments would include addition of soluble nitrogen (as $NH_4NO_3$) and/or phosphorus (as $H_3PO_4$), and also may include exclusion of top-level predators within 100-m to 300-m stream reaches. STREON experiments would be conducted in conjunction with a NEON Aquatic Array. Exclusion of predators would be done in select areas within the stream reach using baskets to prevent entry of top-level predators from outside the area. At each STREON Site where nutrient manipulation would occur, four to eight 210-liter drums containing nitrogen and phosphorus solutions would be stored. STREON nutrient addition experiments would add soluble nitrogen or phosphorus to streams continuously during ice-free periods to increase the concentration of the selected nutrient to five times the ambient stream concentration (Powell, 2009).

Nutrient solutions would be temperature-controlled to match the ambient stream temperature. Solutions would be heated or chilled, as necessary, to remain within 1°C of the stream temperature. Heating and chilling would be done at the storage tank or within the delivery pipe, depending on site design (Powell, 2009).

In addition, at STREON Sites sealed recirculation chamber experiments would be conducted in which a small amount of isotopic nitrogen (15N) would be added to each recirculation chamber as a tracer to quantify nutrient uptake rates. These experiments would be conducted once per year and would include an 8-hr incubation period in the recirculation chamber. Recirculation chambers would be completely sealed and 15N would not be added to the stream or lake.

If a STREON Site is near an FIU Tower, power and communications would be supplied from the FIU Tower portal. If the STREON Site is not near an FIU Tower, then a separate portal would be required for the Aquatic Array. Power would be extended to the portal and from the portal to the array as described for Core Sites. Each STREON Site would include a STREON hut, which would be similar to the IH at tower sites.

#### 2.2.1.8 Support Facilities

NEON support facilities at each domain would include repair workshops, laboratories, and offices associated with each Core Site. NEON, Inc. would use existing facilities within the domain near Core Sites to the extent such facilities are already developed. Where this is not possible, NEON, Inc. would locate the support facilities in a nearby (within 10 to 100 km) urban center. Because there would be no construction and no potential for environmental impacts, this NEON component is not discussed further in this EA.

#### 2.2.1.9 Land Use Analysis Package

The LUAP would support comprehensive assessment and analysis of patterns, changes, and drivers of land use, land cover, and land management. This component of NEON would be confined to existing facilities and would not result in construction of new infrastructure. Data collected from domains would be transferred to laboratories where geospatial analysis would occur. Because there would be no construction and no potential for environmental impacts, the LUAP component of NEON is not discussed further in this EA.

#### 2.2.1.10 NEON Project Office

Coordination and standardization would be necessary to the success of NEON. NEON, Inc. headquarters would be the NEON Project Office. NEON, Inc. would manage integration across the network of infrastructure and would:

- Develop and implement, in conjunction with NEON sites, core equipment, core data measurements, and data quality and control standards.
- Develop and implement information management standards, practices, and data accessibility policies.
- Provide technologies for storage, retrieval, manipulation, analysis, and visualization of complex data sets.
- Integrate NEON activities with existing federal, state, and local programs.
- Schedule usage.
- Integrate activities across the network.
- Coordinate interactions and communication among NEON sites.
- Identify and test leading edge technologies for environmental research.
- Provide training to the scientific community and other users.
- Coordinate outreach activities with the general public.

This component of NEON would be confined to existing facilities and would not result in construction of new infrastructure. Because there would be no construction and no potential for environmental impacts, this NEON component is not discussed further in this analysis.

### 2.2.2 Project Design Features to Minimize or Avoid Impacts

NEON is designed to collect data on the natural world and allow scientists to achieve a better understanding of ecosystem-level systems and processes. To that end, NEON, Inc. must minimize the effect on the environment or risk compromising the integrity of the data collected. NEON would include Project Design Features (PDFs) and Best Management Practices (BMPs) to avoid or minimize impacts to the extent practicable.

NEON PDFs could include, but would not be limited to:

- Selection of Core Sites where the infrastructure in place requires minimal upgrading to meet NEON requirements.
- Selection of Core Sites and Relocatable Sites near established access routes.
- Car- and vanpooling to minimize the number of vehicles traveling to a given site.
- Use of surface conduits to extend utility service through sensitive habitats.
- Construction of boardwalks and bridges to reduce the impact from trampling to access sites in sensitive areas.
- Use of noise-shielded generators (operational noise less than or equal to 70 a-weighted decibels [dBA]) as primary power source to reduce potential disturbance to wildlife from noise of primary generator operation at the three locations where primary generators are proposed.
- Development of site-specific animal welfare plans prior to implementation of small mammal trapping at tower locations.
- Use of species native to a specific area or region for revegetation of disturbed soils.
- Use of certified seed-free straw and mulch to minimize the potential for spread of exotic invasive plant species.
- Use of certified weed free gravel, rock, and soil backfill material for all proposed national park sites.

Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. These areas will be included as part of the area of potential effect for cultural resources analysis. If the area has been determined to be sensitive for archaeological resources, a cultural resources monitor will be present during trenching.

BMPs would be implemented to address specific impact concerns. NEON, Inc. would implement BMPs to suppress fugitive dust, to prevent soil erosion, and to prevent sedimentation in downstream waters. BMPs that may be used on NEON Core Sites and Relocatable Sites for suppression of fugitive dust include mulching and vegetative cover to reduce exposure of newly disturbed areas to wind and reduce the potential for dust to become airborne.

BMPs that may be implemented to reduce or prevent soil erosion include:

- A proper erosion, sedimentation, and pollution control plan.
- Installation of silt fencing.
- Installation of retention areas.
- Installation of energy dissipaters.
- Installation of slope breaks along trenched utility lines.
- Placement of ground cover over disturbed soils, which could include mulch, straw, natural fiber stabilizing mats, or woodchips. Where possible, vegetative debris created during clearing of paths and project footprint would be used for ground cover and mulch.
- Conservation of topsoil and use in revegetation and site restoration.
- Installation of erosion control geotextile blankets or jute mesh on steeper slopes and areas with highly erodible soils. Netting that contains biodegradable thread with strands that can move independently (gauze weave), will be used where appropriate to reduce the potential for nontarget impact to snakes from entrapment.
- Revegetation of disturbed areas as soon as practical using native seed if possible.

BMPs that may be implemented to reduce or prevent sedimentation in waters include:

- Installation of silt fencing.
- Installation of infiltration areas.
- Installation of sedimentation basins.
- Installation of energy dissipaters, which could include hay-bales certified as free of noxious weeds and noxious weed seed.
- Installation of slope breaks along trenched utility lines.
- Revegetation of disturbed areas as soon as practical using native seed if possible.
- Maintenance of a filter strip of undisturbed soil, vegetation, and forest litter between an area of exposed soils and a body of water or wetland.
- Installation of storm drain inlet protection in areas with storm sewers.

BMPs that may be implemented to reduce the introduction of exotic seed from the movement of equipment from site to site may include:

- Washing equipment to remove seeds or insects.
- Use of natural fiber stabilizing mats in lieu of straw.

BMPs that may be implemented at streams include:

- Installation of temporary dam for construction of utility lines across a stream channel. If a dam is necessary, materials that prevent sediment and other pollutants from entering the water body would be used, such as sandbags, or clean gravel with plastic liner.
- Restoration or stabilization of any stream bank or lake shore affected by the work would be accomplished using techniques such as brush layering, brush mattressing, live staking, and jute matting and coir logs to stabilize soil and re-establish native vegetation.

BMPs that may be implemented to reduce disturbances to wetlands include:

- Use of mats to prevent compaction and rutting when working in wetlands. Mats may be stacked two deep if the wetland is deeper than the thickness of one mat.
- Construction on sites in permafrost areas would be completed during frozen conditions.
- Use of boardwalks for site access to prevent damage to the underlying permafrost from traffic to these locations.

BMPs that may be implemented to protect migratory birds and threatened and endangered species include:

- Generally, impacts of towers to migratory birds are greatest in areas where there are clusters of towers, such as windfarms, towers with large footprints, or very tall towers (greater than 61 m in height). The Core and Relocatable Towers proposed by NEON, Inc. are isolated systems with very small footprints, and generally much less that 61 m in height with only up to 3 m of the tower open to exposure to migratory birds. Nonetheless, where appropriate, exposed lengths of towers would include use of daytime visual markers or bird flight diverters. The U.S. Fish and Wildlife Service (USFWS) recommends placing daytime visual markers on guy wires in areas located in known raptor or waterbird concentration areas, daily movement routes, major diurnal migratory bird movement routes, or stopover sites to prevent collisions by these diurnally moving species. The Arizona Game and Fish Department recommends that bird flight diverters be attached at 10-m intervals along the length of each guy wire.
- Installation of lights for aviation safety designed to minimize the potential risk to birds. If a tower is taller than 60 m, aviation safety lights must be used. For maximum protection of bird species, USFWS recommends use of the minimum amount of pilot warning and obstruction avoidance lighting required by the Federal Aviation Administration (FAA). Further, unless otherwise required by the FAA, only white (preferable) or red strobe lights would be used at night. Strobe lights would be the minimum number of lights required, the minimum intensity of illumination allowed, and the minimum number of flashes per minute (longest duration between flashes) allowed by the FAA. The use of solid red or pulsating red warning lights at night should be avoided because solid or pulsating (beacon) red lights may attract night-migrating birds at a much higher rate than white strobe lights.
  If tower is less than 60 m in height and safety lights are not required, then safety lights should not be added to the tower.

- Erection of small animal barriers. Barriers would be used around construction footprint in areas with smaller sensitive species and with evidence of nearby activity, including burrows. The barriers would stay in place until construction is completed. The barriers may consist of silt fencing.

BMPs that may be implemented to limit the potential for impacts to sensitive habitats and sensitive species include:

- Identification and avoidance of habitat components (such as larval host plants) necessary for completion of life history of sensitive species.
- Enhancement of natural revegetation through use of propagules of native species collected from within 2.5 km of the proposed NEON infrastructure.
- Cleaning vehicles and equipment to remove invasive species propagules prior to entry into sensitive habitats.
- Prompt control of invasive exotic species that become established on areas disturbed by NEON, Inc. during construction.

BMPs that may be implemented to limit erosion of the trails include:

- Installation of water bars, which could consist of a rock, earthen, or log barrier, or excavated channel, angled across trails to divert the water from the trails.
- Use of cross-drainage techniques, such as swales, and culverts or open-top culverts to divert water from trails as soon as possible.
- Installation of deflectors, including rubber belting fastened to treated timbers, placed in the ground to deflect water from trails.

BMPs that may be implemented to minimize visual impacts include:

- Use of non-reflective materials.
- Painting the infrastructure to reduce visibility.

Additional, site-specific BMPs would be implemented as appropriate.

### 2.2.3 Ecological Domains

NEON divides the 50 states and the Commonwealth of Puerto Rico into 20 ecoclimatic domains (Figure 2-1). Collectively, the domains represent ecological and climate variability across the continental United States, Alaska, Hawai'i, and Puerto Rico. Domains were delineated based on analysis of:

- Number of days above 32.2 degrees Centigrade (°C) during the local growing season.
- Number of days below 0° C during the local non-growing season.
- Precipitation sum during the local growing season.
- Precipitation sum during the local non-growing season.
- Number of days with measurable precipitation during the local growing season.

- Number of days with measurable precipitation during the local non-growing season.
- Soil plant-available water holding capacity to a depth of 1.5 m.
- Total solar insolation during the local growing season, including clouds, aerosols, slope, and aspect physiography.
- Total solar insolation during the local non-growing season, including clouds, aerosols, slope, and aspect physiography.

The discussion of each domain provides a description of the proposed Core Site advanced and Basic Tower locations; the proposed Relocatable Sites are described; followed by the proposed Aquatic Arrays and STREON Sites, where appropriate. Each proposed tower and Aquatic Array has been assigned a unique alphanumeric identifier. The identifier consists of an initial letter (C, R, A, S) designating whether it refers to a Core, Relocatable, Aquatic, or STREON Site and a two-digit number. The alphanumeric identifiers and proposed locations for NEON infrastructure in each domain are provided in Table 2.2.2-1.

#### 2.2.3.1 Ecological Domain 1

Domain 1 is the northeastern United States. All of New England and New York, as well as northern New Jersey, northern and western Pennsylvania, and much of West Virginia are included in this domain. The research focus for this domain is the forests of the northern Appalachian Mountains and the Adirondack Mountains. Climate in this region is varied due to its coastal orientation and geographic setting, which extends from coastline to mountain ranges. Significant weather events in the New England area bring droughts, heavy rains, tornadoes, hurricanes, blizzards, extreme cold, and extreme heat to this region (Keim, 1999).

Domain 1 is within the Lower New England-Northern Piedmont and Northern Appalachian-Acadian ecoregions. Glacier activity has shaped much of this domain and has created a diverse geology with low mountains and many lakes in the interior central and southern parts of the domain and glacially deposited sandy soils that form a broad plain with many ponds toward the Atlantic Ocean. Domain 1 includes eight physiographic provinces: New England, St. Lawrence Valley, Adirondack, Appalachian Plateau, Coastal Plain, Piedmont, Valley and Ridge, and Central Lowland (USGS, 2009a). The Domain 1 area is relatively stable in terms of seismicity. Throughout the domain, the maximum potential for movement of the earth as a result of seismic activity, measured as peak ground acceleration (% pga) with a 2 percent probability of occurrence in 50 years ranges from 12% pga to 40% pga for short wave motion and 4% pga to 14% pga for long wave motion (USGS, 2009b, 2009c). The higher ranges are associated with northwestern Vermont and northern New York near the border with Canada.

##### Core Site

The proposed Core Site for Domain 1 is within the Harvard Forest in Massachusetts. The Harvard Forest in north-central Massachusetts is located near the latitudinal midpoint of the domain. The Harvard Forest is representative of the domain in that it forms a

**TABLE 2.2.2-1**
Sites Proposed as NEON Research Sites
*National Ecological Observatory Network (NEON) EA*

| Domain | Site Identification Number | Site Type | Latitude | Longitude |
|---|---|---|---|---|
| 1 | C-01 | Core – Advanced | 42.536900 | -72.172660 |
| 1 | C-02 | Core – Basic | 42.537760 | -72.180320 |
| 1 | C-03 | Core – Basic | 42.541140 | -72.176200 |
| 1 | R-01 | Relocatable | 44.064640 | -71.288080 |
| 1 | R-02 | Relocatable | 42.516111 | -71.191664 |
| 1 | A-01 | Aquatic | 42.542957 | -72.176540 |
| 1 | A-02 | Aquatic | 42.523856 | -71.184436 |
| 2 | C-04 | Core – Advanced | 38.892885 | -78.139506 |
| 2 | C-05 | Core – Basic | 38.892741 | -78.143547 |
| 2 | C-06 | Core – Basic | 38.892093 | -78.135146 |
| 2 | R-03 | Relocatable | 38.890116 | -76.560004 |
| 2 | R-04 | Relocatable | 39.062100 | -78.054467 |
| 2 | A-03 | Aquatic | 38.892555 | -78.147865 |
| 2 | S-04 | STREON | 39.478030 | -76.687605 |
| 3 | C-07 | Core – Advanced | 29.689986 | -81.993534 |
| 3 | C-08 | Core – Basic | 29.702624 | -81.964943 |
| 3 | C-09 | Core – Basic | 29.705011 | -81.970611 |
| 3 | R-05 | Relocatable | 28.122766 | -81.434897 |
| 3 | R-06 | Relocatable | 31.195284 | -84.468506 |
| 3 | A-05 | Aquatic | 29.687054 | -82.016171 |
| 3 | A-06 | Aquatic | 29.676473 | -82.009089 |
| 3 | A-07 | Aquatic | 31.197697 | -84.470108 |
| 4 | C-10 | Core – Advanced | 17.975830 | -66.852267 |
| 4 | C-11 | Core – Basic | 17.975928 | -66.863555 |
| 4 | C-12 | Core – Basic | 17.956588 | -66.835104 |
| 4 | R-07 | Relocatable | 18.033000 | -67.066000 |
| 4 | R-08 | Relocatable | 17.988550 | -66.621517 |
| 4 | A-09 | Aquatic | 18.032500 | -67.074720 |
| 4 | S-10 | STREON | 18.109184 | -66.986124 |
| 5 | C-13 | Core – Advanced | 46.232594 | -89.545311 |
| 5 | C-14 | Core – Basic | 46.245146 | -89.542661 |
| 5 | C-15 | Core – Basic | 46.242074 | -89.345920 |
| 5 | R-09 | Relocatable | 45.493139 | -89.562028 |
| 5 | R-10 | Relocatable | 45.504889 | -89.588111 |
| 5 | A-11 | Aquatic | 46.219000 | -89.492000 |
| 5 | A-12 | Aquatic | 45.497316 | -89.551133 |
| 6 | C-16 | Core – Advanced | 39.100596 | -96.562988 |
| 6 | C-17 | Core – Basic | 39.101335 | -96.579833 |

**TABLE 2.2.2-1**
Sites Proposed as NEON Research Sites
*National Ecological Observatory Network (NEON) EA*

| Domain | Site Identification Number | Site Type | Latitude | Longitude |
|---|---|---|---|---|
| 6 | C-18 | Core – Basic | 39.098124 | -96.562470 |
| 6 | R-11 | Relocatable | 39.040000 | -95.192000 |
| 6 | R-12 | Relocatable | 39.110000 | -96.613000 |
| 6 | A-14 | Aquatic | 39.123775 | -96.610681 |
| 6 | S-15 | STREON | 39.105524 | -96.603846 |
| 7 | C-19 | Core – Advanced | 35.964618 | -84.280557 |
| 7 | C-20 | Core – Basic | 35.964039 | -84.280444 |
| 7 | C-21 | Core – Basic | 35.964634 | -84.279866 |
| 7 | R-13 | Relocatable | 37.371796 | -80.524488 |
| 7 | R-14 | Relocatable | 35.684700 | -83.500000 |
| 7 | A-17 | Aquatic | 35.687470 | -83.498580 |
| 7 | S-18 | STREON | 35.955983 | -84.278647 |
| 8 | C-22 | Core – Advanced | 32.950830 | -87.394488 |
| 8 | C-23 | Core – Basic | 32.949026 | -87.394256 |
| 8 | C-24 | Core – Basic | 32.950454 | -87.393374 |
| 8 | R-15 | Relocatable | 32.721930 | -87.777662 |
| 8 | R-16 | Relocatable | 31.843778 | -88.162494 |
| 8 | A-20 | Aquatic | 32.709344 | -87.793063 |
| 8 | A-21 | Aquatic | 31.843777 | -88.162495 |
| 8 | S-22 | STREON | 32.976260 | -87.412932 |
| 9 | C-25 | Core – Advanced | 47.127611 | -99.240108 |
| 9 | C-26 | Core – Basic | 47.136194 | -99.252611 |
| 9 | C-27 | Core – Basic | 47.144743 | -99.252308 |
| 9 | R-17 | Relocatable | 47.161000 | -99.111000 |
| 9 | R-18 | Relocatable | 46.769930 | -100.915800 |
| 9 | A-23 | Aquatic | 47.129990 | -99.250551 |
| 9 | A-24 | Aquatic | 47.159090 | -99.113880 |
| 10 | C-28 | Core – Advanced | 40.816361 | -104.749012 |
| 10 | C-29 | Core – Basic | 40.832828 | -104.721327 |
| 10 | C-30 | Core – Basic | 40.805794 | -104.770937 |
| 10 | R-19 | Relocatable | 40.464736 | -103.029581 |
| 10 | R-20 | Relocatable | 40.278126 | -105.545684 |
| 10 | A-25 | Aquatic | 40.320311 | -105.609794 |
| 11 | C-31 | Core – Basic | 33.330369 | -97.638214 |
| 11 | C-32 | Core – Advanced | 33.399247 | -97.568422 |
| 11 | C-33 | Core – Basic | 33.374789 | -97.594517 |
| 11 | R-21 | Relocatable | 35.407283 | -99.059497 |
| 11 | R-22 | Relocatable | 33.883600 | -96.800600 |

**TABLE 2.2.2-1**
Sites Proposed as NEON Research Sites
*National Ecological Observatory Network (NEON) EA*

| Domain | Site Identification Number | Site Type | Latitude | Longitude |
|---|---|---|---|---|
| 11 | A-26 | Aquatic | 33.375875 | -97.779383 |
| 11 | A-27 | Aquatic | 35.409186 | -99.066419 |
| 12 | C-34 | Core – Advanced | 44.955000 | -110.540000 |
| 12 | C-35 | Core – Basic | 44.954100 | -110.539000 |
| 12 | C-36 | Core – Basic | 44.954000 | -110.540000 |
| 12 | R-23 | Relocatable | 45.657030 | -111.046280 |
| 12 | R-24 | Relocatable | 45.458430 | -110.623030 |
| 12 | A-28 | Aquatic | 44.950110 | -110.587150 |
| 12 | A-29 | Aquatic | 45.666810 | -111.030750 |
| 13 | C-37 | Core – Advanced | 40.054207 | -105.582174 |
| 13 | C-38 | Core – Basic | 40.047957 | -105.570761 |
| 13 | C-39 | Core – Basic | 40.055395 | -105.589488 |
| 13 | R-25 | Relocatable | 38.161450 | -109.659470 |
| 13 | R-26 | Relocatable | 39.858900 | -105.863200 |
| 13 | A-30 | Aquatic | 40.042875 | -105.592296 |
| 13 | A-31 | Aquatic | 39.890400 | -105.866800 |
| 14 | C-40 | Core – Advanced | 31.910715 | -110.835489 |
| 14 | C-41 | Core – Basic | 31.789307 | -110.829620 |
| 14 | C-42 | Core – Basic | 31.820503 | -110.866178 |
| 14 | R-27 | Relocatable | 32.589880 | -106.842631 |
| 14 | R-28 | Relocatable | 33.355686 | -111.561347 |
| 14 | S-33 | STREON | 33.749005 | -111.508402 |
| 15 | C-43 | Core – Advanced | 40.176206 | -112.455742 |
| 15 | C-44 | Core – Basic | 40.170752 | -112.496929 |
| 15 | C-45 | Core – Basic | 40.182964 | -112.495189 |
| 15 | R-29 | Relocatable | 40.648003 | -111.916616 |
| 15 | R-30 | Relocatable | 40.781428 | -111.804246 |
| 15 | A-35 | Aquatic | 40.781144 | -111.803836 |
| 16 | C-46 | Core – Advanced | 45.820488 | -121.951912 |
| 16 | C-47 | Core – Basic | 45.802457 | -121.957485 |
| 16 | C-48 | Core – Basic | 45.813500 | -121.996500 |
| 16 | R-31 | Relocatable | 45.775717 | -122.299950 |
| 16 | R-32 | Relocatable | 45.713117 | -122.377750 |
| 16 | A-36 | Aquatic | 45.812300 | -121.995100 |
| 16 | S-37 | STREON | 44.212164 | -122.243742 |
| 17 | C-49 | Core – Advanced | 37.108722 | -119.731561 |
| 17 | C-50 | Core – Basic | 37.067772 | -119.194470 |
| 17 | C-51 | Core – Basic | 37.066597 | -118.988475 |

**TABLE 2.2.2-1**
Sites Proposed as NEON Research Sites
*National Ecological Observatory Network (NEON) EA*

| Domain | Site Identification Number | Site Type | Latitude | Longitude |
|---|---|---|---|---|
| 17 | R-33 | Relocatable | 37.031069 | -119.256431 |
| 17 | R-34 | Relocatable | 36.975178 | -119.048428 |
| 17 | A-39 | Aquatic | 37.053717 | -119.204233 |
| 17 | S-40 | STREON | 36.956330 | -119.032410 |
| 18 | C-52 | Core – Advanced | 68.660561 | -149.376369 |
| 18 | C-53 | Core – Basic | 68.616000 | -149.601289 |
| 18 | C-54 | Core – Basic | 68.643794 | -149.573294 |
| 18 | R-35 | Relocatable | 69.769983 | -148.720167 |
| 18 | A-42 | Aquatic | 68.629562 | -149.610509 |
| 18 | S-43 | STREON | 68.644464 | -149.403417 |
| 19 | C-55 | Core – Advanced | 65.154014 | -147.502581 |
| 19 | C-56 | Core – Basic | 65.157469 | -147.507461 |
| 19 | C-57 | Core – Basic | 65.152083 | -147.498111 |
| 19 | R-36 | Relocatable | 63.881111 | -147.459719 |
| 19 | R-37 | Relocatable | 65.163610 | -147.509719 |
| 19 | R-38 | Relocatable | 63.874000 | -149.211000 |
| 19 | R-41 | Relocatable | 60.549897 | -150.248339 |
| 19 | S-46 | STREON | 65.150800 | -147.519500 |
| 20 | C-58 | Core – Advanced | 19.930420 | -155.289000 |
| 20 | R-39 | No Tower, Relocatable Weather Station | 19.728790 | -155.892380 |
| 20 | R-40 | No Tower, Relocatable Weather Station | 19.725424 | -155.873644 |

Data Provided by NEON, Inc.

midpoint in regional gradients of geology, climate, vegetation, land use, and hurricane impacts. Harvard Forest is located in the central New England upland region, with moderate local relief ranging from 220 m to 410 m above sea level. Bedrock is characterized by metamorphic gneisses and schists typical of the region. Surficial deposits are predominantly glacial till of varying depths, with localized glaciofluvial deposits.

Harvard Forest was established in 1907 as a research site for Forestry students and researchers at Harvard University. As one of the oldest and intensively studied forests in North America, the 1,214-ha forest was designated as an LTES in 1988 (Harvard, 2009).

Harvard Forest is located in the Temperate Continental Cool Summer zone, near the boundary with the Temperate Continental Warm Summer zone. Average annual temperature is 7°C and average annual precipitation is 1,070 mm. A persistent snowpack forms in most years. Using the Fujita scale (The Tornado Project, 1999) as reference, F1-level wind damage from hurricanes occurs on average every 20 years. Harvard Forest is located at the boundary between the Adirondack – New England Mixed Forest –

Coniferous Forest zone and the Eastern Broadleaf Forest zone, and includes vegetation characteristic of both types.

The Advanced Tower (C-01, Figure 2.D01-1) and one of the Basic Towers (C-03, Figure 2.D01-1) would be placed in upland forest habitat consisting primarily of red oak and red maple and in some areas a conifer-hardwood mixture would allow for the presence of hemlocks. Basic Tower C-02 (Figure 2.D01-1) would be placed in Black Gum Swamp consisting primarily of red spruce, hemlock, red maple, and black gum trees (Keller, 2008). A boardwalk would be constructed to minimize impacts from weekly monitoring trips to the tower in Black Gum Swamp. The instrument storage unit associated with the tower in Black Gum Swamp would be placed outside the swamp.

All three towers associated with the Core Site would be 25 m tall and would be placed on concrete pads measuring 3.05 m by 3.35 m. Each of the tower locations would consist of an AP, placed near the existing power source, and an IH. Each AP would receive power from the grid and support the IH and related tower and arrays. In addition, there would be an offsite PCS which would be powered by a photovoltaic system.

The IH for each tower would be approximately 15 m from the base of the tower. An offsite PCS would be required near the Core Site and would support all three Core Site towers, Relocatable Tower R-02, and the Aquatic Array (A-01).

Electrical and communication service for the Advanced Tower (C-01) would originate at the AP on Lincoln Road and be supplied by separate and parallel underground lines that would extend approximately 212 m north to the IH. The corridor would be approximately 1.2 m wide. Electrical and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 125 m from the IH.

Electrical and communication service for Basic Tower 1 (C-02) would originate at an AP on Pierce Road and would extend approximately 510 m northwest to the IH. The corridor would be approximately 1.2 m wide. Electrical and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 125 m from the IH. The boardwalk associated with Basic Tower 1 (C-02) would extend approximately 125 m from the IH.

Electrical and communication service for Basic Tower (C-03) would originate at the AP on Lincoln Road and be carried by separate and parallel underground lines that extend approximately 521 m west to the IH. The corridor would be approximately 1.2 m wide. Electrical and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Basic Tower (C-03) would extend approximately 125 m from the IH.

### Relocatable Sites

Relocatable Sites proposed for Domain 1 are within the U.S. Forest Service (USFS) Bartlett Experimental Forest (R-01, Figure 2.D01-2) in New Hampshire and suburban Burlington, Massachusetts (R-02, Figure 2.D01-3) near the Plum Island LTER.

The Bartlett Experimental Forest Relocatable Site would be approximately 1.5 km south of the village of Bartlett, near a forest road in hardwood forest. In 1931, the Bartlett Experimental Forest was established as a 1,052-ha field research station for studying the ecology of northern hardwoods and their associated ecosystems. Recent revisions to the forest plan could lead to an expansion of the forest boundary that would nearly double its size (USFS, 2009a). Primary canopy dominants include sugar maple, American beech, and yellow birch. Spruce and fir occur at the higher elevations, while white pine is present mainly at lower elevations. Hemlock, balsam fir, and spruce are common and typically mix with hardwoods on cool steep slopes. Tower R-01 would be 31 m tall. One AP would be needed to support this tower. The PCS supporting the Core Site towers would also be utilized at this Relocatable Tower.

Relocatable Towers R-01 and R02 would be approximately 37 m tall and placed on a concrete pads measuring 3.66 m by 4.27 m. Similar to the Core Site, each Relocatable Tower would have an AP and IH.

Electrical and communication service for Relocatable Tower 1 (R-01) would originate at the intersection of Bear Notch Road and an unnamed road. From there, service would be extended in separate underground trenches for approximately 1,285 m west along the unnamed road to the AP. From the AP, electrical and communication lines would be placed in a shared trench approximately 70 m south to the IH. The corridor would be approximately 1.2 m wide. Electrical and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R-01 would extend approximately 238 m from the IH.

The Burlington Relocatable Site would be near the intersection of Mill Street and Skilton Lane, on the north side of the town of Burlington. Burlington is a suburban area approximately 21 km northwest of Boston. The 2008 population was estimated at 24,320; however, that number increases to 150,000 during the business week as commuters go to work in Burlington (Town of Burlington, 2008). The 2008 population density reported in Burlington was 790 persons per square km (Town of Burlington, 2008). Vegetative communities in Burlington are fragmented and are situated between residential and commercial development. The vegetation near the proposed Relocatable Tower location (R-02) has been largely replaced by development of houses with lawns. Remnant canopy trees of mixed hardwood species are scattered. Tower R-02 would be 22 m tall. One AP and one offsite PCS would be needed to support this tower and the nearby Aquatic Array (A-02).

Electrical and communication service for Relocatable Tower 2 (R-02) would originate at an AP on Mill Street and be carried by separate and parallel underground approximately 90 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 125 m from the IH. The boardwalk for Relocatable Tower R-02 is estimated to extend approximately 140 m from the IH.

#### Aquatic Arrays

Two Aquatic Arrays are proposed for Domain 1: one (A-01, Figure 2.D01-1) would be in Harvard Forest near the upland Core Site Basic Tower and the other (A-02, Figure 2.D01-3) would be on a suburban stream in Burlington, Massachusetts downstream of the proposed location of Relocatable Tower R-02. Each Aquatic Array would have up to 10 groundwater wells that would be monitored.

A-01 would be located on Bigelow Brook, which drains into the Swift River and the Quabbin Reservoir. Electrical and communication service would originate at the IH associated with Basic Tower C-03. Service lines would extend along a new 1.4-m wide corridor, through a shared trench from the IH, 212 m north, to the Aquatic Array.

A-02 would be located on Sawmill Brook within 1 km of R-02 in the Ipswich River watershed. Electrical and communication service would originate on Mill Street. Service lines would extend underground 155 m north from Mill Street to the Aquatic Array along a new 1.4-m wide corridor.

### 2.2.3.2 Ecological Domain 2

Domain 2 is located in the Mid-Atlantic States and includes parts of Delaware, Georgia, Maryland, New Jersey, North Carolina, Pennsylvania, South Carolina, Virginia, and West Virginia. Domain 2 extends from the ocean to the eastern slopes of the Appalachian Mountains. The foci of research in this domain are changing land uses and invasive species. Much of the climate in this region is directly influenced by its proximity to the ocean. Coastal regions within Domain 2 are susceptible to hurricanes in the summer and fall, while the regions in higher elevations are subject to snowstorms in the winter and early spring. Tornadoes, droughts, torrential rain, and extremely high and low temperatures are all common occurrences in the Mid-Atlantic.

Domain 2 lies upon five major physiographic provinces: Coastal Plain, Piedmont, Valley and Ridge, Appalachian Plateau, and Blue Ridge (USGS, 2009d). The Domain 2 area is relatively stable in terms of seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 12% pga to 24% pga for short wave motion and 6% pga to 8% pga for long wave motion (USGS, 2009e, 2009f).

#### Core Site

The Core Site proposed for Domain 2 is within the Smithsonian Conservation Research Center (SCRC) in Virginia. The SCRC encompasses 1,295 ha, of which 1,275 ha are owned by the General Services Administration and leased to the Smithsonian Institution, while the remaining 20 ha are owned outright by the Smithsonian Institution. Within the SCRC, 729 ha are used to house and pasture captive endangered species and this portion of the SCRC would not be used for NEON sites. The portion of the SCRC that would be used for NEON consists of mature (greater than 100-year) and young (less than 40-year) secondary forest that is primarily deciduous and representative of hardwood forests in the region. The three Core Site towers (C-04, C-05, and C-06, Figure 2.D02-1) would be placed in forest habitat of varying ages, elevations, and solar aspects.

All three towers associated with the Core Site would be approximately 25 m tall and would be supported by individual cast–in-place concrete piers measuring 1.7 m diameter and extending 1 m below grade Each Core Site tower would have an IH located within 15 m of the base of the tower. There would be an offsite PCS powered by a photovoltaic system supporting the Core Site towers. The containers would be placed away from ecologically sensitive habitats, possibly near the side of the road and painted prior to delivery to minimize visual impacts.

Electrical and communication service for all three Core Site towers and the Aquatic Array would originate at the existing source on Rivinus Road and be supplied by separate and parallel underground lines providing service to each AP. The lines would be placed parallel to an existing unnamed paved road. From the point of origin on Rivinus Road, to the furthest NEON site would require extending the service lines approximately 2,356 m to the Aquatic Array A-03. APs associated with each tower would be placed near the side of the private road and would intercept the new service lines as they continue west toward the Aquatic Array.

From the AP to Basic Tower C-06, the underground lines would be placed along an existing, well maintained path. Beyond C-06, continuing west to the proposed Aquatic Array location and passing the other two Core Site towers, the existing path would require modifications to increase the existing width to 1.2 m. Each Core Site tower would be similar in design. The electric and communication lines would split from the main path north for approximately 107 m until they reach each IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated soil arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk associated with each Core Site tower is estimated to extend approximately 125 m from the IH.

#### Relocatable Sites

Relocatable Sites proposed for Domain 2 include the Smithsonian Environmental Research Center (SERC) in Maryland (R-03, Figure 2.D02-3) and the Blandy Experimental Farm (BEF) in Virginia (R-04, Figure 2.D02-2).

The SERC is located on the western shore of the Chesapeake Bay in the Coastal Plain of Maryland. The surrounding landscape is a matrix of land uses, predominantly forest, cropland, and pasture. The Relocatable Site would be placed in a hardwood forest. Typical hardwood forests along the Chesapeake Bay consist primarily of white oak, loblolly pine, red maple, American beech, swamp white oak, southern red oak, willow oak, sweetgum, tulip poplar, black gum, American holly, and sweetbay (NPS, 2009). Common understory shrubs in this region are inkberry and blueberries (NPS, 2009). The SERC was established as a research center approximately 40 years ago, for the study of coastal ecozones.

Relocatable Tower R-03 would be approximately 35 m tall and would be placed on a concrete pad measuring 1.8 m by 2.4 m. Electrical and communication service for this tower would originate at the existing source on Old Muddy Creek Road. From the AP, electric and communication service would be supplied by separate and parallel underground lines approximately 262 m east to the IH. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk associated with this tower is estimated to extend approximately 125 m from the IH. Up to two PCSs may be utilized for this Site. They would be placed away from ecologically sensitive habitats, possibly near the side of the road and painted prior to delivery to minimize visual impacts.

The BEF is located approximately 20 km northwest of the SCRC in the agricultural matrix of the northern Virginia Piedmont. The BEF is home to the State Arboretum of Virginia. It is a 283-ha research center that is managed by the University of Virginia. A portion of the area north of the proposed Relocatable Tower location was selectively logged in 2006. The Relocatable Site would be placed within a young shrubby field that abuts an agricultural field. Typical vegetation within the BEF includes black gum, flowering dogwood, fringe tree, pond cypress, red bud, sweetgum, sycamore, white oak, and many species of ginkgo (BEF, 2009).

Relocatable Tower R-04 would be 11 m tall and supported on individual, cast-in-place, concrete piers with a diameter of 1.1 m and extending 1 m below grade. Electrical and communication service for this tower would originate on US Highway 17. From the AP, electric and communication service would be supplied by separate and parallel underground lines through an agricultural field for approximately 378 m southwest to the IH, requiring a 1.2 m corridor. Upon reaching the IH, electric and communication lines would then be co-located with a 1.5-m wide walkway, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electric and communication lines would extend approximately 15 m to the tower. The walkway associated with this tower would extend approximately 125 m from the IH. Up to two PCSs may be utilized for this Site. They would be placed away from ecologically sensitive habitats, possibly near the side of the road and painted prior to delivery to minimize visual impacts.

### Aquatic Array

The Posey Creek Aquatic Array (A-03, Figure 2.D02-1), which would be on a tributary of Sloan Creek, is within the SCRC and near one of the Basic Towers for the Core Site. Sloan Creek has good water quality and currently meets its designated uses (VDEQ, 2008). Power and communication would be provided from the Basic Tower portal for the Posey Creek Aquatic Array.

### STREON Site

The proposed STREON Site (S-04, Figure 2.D02-4) for Domain 2 is on Baisman Run in Oregon Ridge Park in Maryland. It is a perennial stream that flows into Beaverdam Run. Baisman Run and Beaverdam Run have good water quality and currently meet designated uses (MDOE, 2008). The Baisman Run STREON Site is within a watershed designated for research purposes. Three meteorological towers have been placed in the watershed for research projects. Oregon Ridge Park, located approximately 7 km north of Baltimore, offers recreation, including swimming, picnicking, hiking, and numerous special events such as concerts (BCDRP, 2009). The proposed STREON Site would be in the area of the park farthest away from the main attractions, but would be near the Ivy Hill Yellow Trail and Ivy Hill Pond on Baisman Run (ORNC, 2009).

The STREON hut would measure 2.4 m by 2.4 m. It would connect to the existing power and communications system at Ivy Hill Road. The electric and communications service would be supplied by underground lines in trenches separated 1.5 m from each other for approximately 174 m.

#### 2.2.3.3 Ecological Domain 3

Domain 3 is the Southeastern Coastal Plain and includes parts of Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Texas. This domain is characterized by vegetation communities that are adapted to periodic fire. NEON stations in Domain 3 would initially focus on fire responses as a component of the research. The climate in the southeastern United States typically includes hot, humid conditions in the summer and relatively mild conditions in the winter. This region is susceptible to hurricanes in the summer and fall which bring torrential rain, heavy winds, and intense lightning. During the spring and early summer, intense thunderstorms can bring flash floods, hail, and tornadoes.

Domain 3 lies mostly upon the Southeastern Coastal Plain physiographic province, but also includes the Mississippi Alluvial Plain, along the Mississippi River, and the West Gulf Coastal Plain (USGS, 2009g). The Southeastern Coastal Plain is relatively stable from the standpoint of seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 2 % pga to 6 % pga for long wave motion and 4 % pga to 12 % pga for short wave motion, with the exception of an area on the central South Carolina coast where seismic activity is higher (USGS, 2009h, 2009i).

#### Core Site

The Core Site proposed for Domain 3 is within the 3,683-ha Ordway-Swisher Biological Station (OSBS) in Florida. The OSBS contains a rich array of biological communities, including a diversity of natural forests and small pine plantations, permanent and ephemeral lakes and ponds, clear- and dark-water stream systems, and wildlife species characteristic of the various ecological communities in the region. The principal ecological communities at OSBS are fire-maintained, and research proposed for the site would focus on fire effects. The OSBS property was under single ownership since the 1930s and used as a private hunting and fishing camp prior to being obtained by the University of Florida Foundation in the 1980s. OSBS has a history of low human impact for approximately the past 75 years.

OSBS is managed and operated by the University of Florida Department of Wildlife Ecology and Conservation. Historical data are preserved and accessible, including voucher specimens maintained by the Florida Museum of Natural History. The Station maintains data files from studies conducted on site and baseline monitoring on terrestrial, atmospheric, and aquatic conditions are ongoing.

The two Basic Tower locations (C-08, C-09; Figure 2.D03-1) would be in areas subject to wildfires and the Advanced Tower (C-07, Figure 2.D03-1) location would be in a fire management area where wildfire would be less frequent due to the use of managed fire.

The Advanced Tower would be located in a longleaf pine-turkey oak-wiregrass community. Basic Tower C-08 would be in an oak dominated hardwood hammock and the Basic Tower C-09 would be in Ashley Prairie, a wetland habitat that periodically floods. The Ashley Prairie habitat is susceptible to disturbance from trampling; therefore, a boardwalk would be constructed to access the instruments at the Ashley Prairie Basic Tower. Towers and instrumentation at all locations would require deep grounding (ground to 6-m depth) and power filtering due to the intense lightning in the area.

All three towers associated with the Core Site would be approximately 18.3 m tall and would be placed on a concrete pad measuring 2.6 m by 3.1 m. Each of the tower locations would include an AP, placed near the existing power source, and an IH. Each AP would have its own power service to support the IH and related tower and arrays. In addition, there would be an offsite PCS which would be powered by a photovoltaic system and would support all three Core Site towers. The PCS would be placed away from ecologically sensitive habitats, possibly near the side of the road, and painted prior to delivery to minimize visual impacts.

Electrical and communication service for Advanced Tower C-07 would originate at the AP on an unnamed private road and be supplied by separate and parallel underground lines approximately 146 m northeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the C-07 would extend approximately 125 m from the IH.

Electrical and communication service for Basic Tower C-08 would originate at the AP on an unnamed private road and be supplied by separate and parallel underground lines approximately 188 m east to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 125 m from the IH.

Electrical and communication service for Basic Tower C-09 would originate at the AP on an unnamed private road and be supplied by separate and parallel underground lines approximately 546 m west-southwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 145 m from the IH.

#### Relocatable Sites

Relocatable Sites proposed for Domain 3 would be located at the Disney Wilderness Preserve (DWP) near Orlando, Florida (R-05, Figure 2.D03-2), and at the Joseph W. Jones Ecological Research Center (Jones Center) in southwestern Georgia (R-06, Figure 2.D03-3).

The DWP was established to provide compensatory mitigation for impacts to wetlands resulting from development at the Disney complex. This site is now owned and managed by The Nature Conservancy. The Florida Department of Environmental Protection and the South Florida Water Management District hold conservation easements on the DWP.

DWP consists of a mosaic of natural and restored wetlands interspersed with upland areas. Wetland restoration on DWP has been completed and The Nature Conservancy has recently begun restoring upland areas on the property. The location proposed for the NEON tower and instrumentation is an upland area that has been planted with native vegetation to restore the native longleaf pine flatwoods community. Deep grounding and power filtering, as discussed for the Core Site, may be necessary at DWP.

Relocatable Tower R-05 would be approximately 11 m tall and supported on 1.2-m diameter concrete piers. Electric and communication service would originate on an unnamed private road and be supplied by separate and parallel underground lines approximately 183 m east from the AP to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electric and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R05 would extend approximately 140 m from the IH. In addition, there would be an offsite PCS which would be powered by a photovoltaic system. It would be placed away from ecologically sensitive habitats, possibly near the side of the road and painted prior to delivery to minimize visual impacts.

The Jones Center began as Ichauway, an 11,740-ha area of longleaf pine and wiregrass area established and managed for quail hunting in the 1920s by Robert W. Woodruff. The management for quail also maintained the longleaf pine–wiregrass ecosystem, largely through the continuous use of prescribed fire. The Jones Center was established in 1991 after Mr. Woodruff's death. The Jones Center is divided into two management zones that accommodate the diverse conservation, research, and education goals of the center. The multiple-use zone conserves biological diversity while maintaining sustainable practices and patterns of land use for wildlife and forest management. The conservation zone is managed to conserve the natural ecosystems and associated elements of biological diversity and, eventually, to restore the structure and function of the natural landscape. Restoration activities include active hardwood tree removal, longleaf and groundcover plantings, and extensive use of biennial prescribed fire.

The location proposed for the NEON Relocatable Tower and instrumentation at the Jones Center is within a mixed hardwood and longleaf pine stand that would be restored to longleaf-wiregrass with hardwood removal, planting of pine seedlings, and continuation of prescribed burning. The Relocatable Tower would be located approximately 50 m above Ichawaynochaway Creek, to allow the instrumentation for an Aquatic Array to connect to the Relocatable Site portal.

Relocatable Tower R-06 would be approximately 28 m tall and would be placed on a concrete pad measuring 2.6 m by 3.1 m. Electric and communication service would originate on Highway 91 and would be extended south for 2.2 km along an existing road. The extended service lines would be placed in separate trenches 1.5-m apart and co-located with an existing unnamed road until reaching the AP. From the AP, lines would be extended in a shared trench for approximately 117 m northwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electric and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R06 would extend approximately 170 m from the IH. In addition, there would be an offsite PCS which would be powered by a photovoltaic system. It would be placed away from ecologically sensitive habitats, possibly near the side of the road and painted prior to delivery to minimize visual impacts.

#### Aquatic Arrays

There are two Aquatic Arrays proposed for OSBS:

- Suggs Lake (A-05, Figure 2.D03-1) – a perched black water lake that is fed by surface water and not connected to groundwater
- Barco Lake (A-06, Figure 2.D03-1) – a clear water lake that is fed by groundwater

Approximately 65 percent of the perimeter of Suggs Lake is wetland habitat. The Aquatic Array instrumentation would be placed such that the utility portal for Suggs Lake would be in upland habitat. A-05 would be located approximately 1,041 m from existing power and communication service. Service lines would be extended 1,041 m to the Aquatic Array. Lines would be placed in a shared trench and co-located with an existing road.

Barco Lake is surrounded by upland habitat. Deep grounding and power filtering, as discussed for the Core Site, would be necessary at both Suggs Lake and Barco Lake. A-06 would be placed near an existing power and communication source; therefore, no additional service would be extended for this site.

Aquatic Array A-07 (Figure 2.D03-3) is proposed for Ichawaynochaway Creek at the Jones Center. The locations for the Aquatic Array and the Relocatable Tower R-06 were coordinated to allow a single portal to serve both sites. Electric and communication lines would be extended from the unnamed road, 351 m west to the Aquatic Array in an underground trench along a new 1.5-m corridor.

### 2.2.3.4 Ecological Domain 4

Domain 4 is the Atlantic Neotropical area, including Puerto Rico and south Florida. The Puerto Rican climate is considered tropical. The average annual temperature is 26.7°C, with a relatively constant humidity level at approximately 80 percent for most of the region (worldtravels.com, 2009a). South Florida has a sub-tropical climate and has higher humidity levels, 85 to 90 percent for much of the year, with temperatures similar to those in Puerto Rico (worldtravels.com, 2009b). Both regions are susceptible to hurricanes in the summer and early fall; the peak of the rainy season occurs during the summer.

The southern tip of Florida, like the rest of the state, is located within the Coastal Plains physiographic province. The island of Puerto Rico is divided based on similar geological features. There are karst areas, mountainous areas, and the discontinuous coastal plain

(USGS, 2009j). Seismic activity in south Florida is very unlikely (USGS, 2009h, 2009i). The probability of a seismic event in Puerto Rico over the next 50 years is moderate to high. Throughout the island, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 30 % pga to 40 % pga for long wave motion and 80 % pga to 120 % pga for short wave motion (USGS, 2009k).

### Core Site

The Core Site proposed for Domain 4, consisting of one Advanced Tower (C-10, Figure 2-D04-1) and two Basic Towers (C-11 and C-12, Figure 2-D04-1), is within the Guánica Dry Forest Reserve (GDFR), which has been designated as a Biosphere Reserve by the United Nations Education, Scientific, and Cultural Organization (UNESCO) due to its high level of biodiversity (Engman, 2008). The GDFR is an intact mature dry forest with underlying karst topography. Soils have a hard and compact coral mastic substrate that would make placement of buried utility lines and soil borings more difficult. The Advanced Tower and one Basic Tower would be located more than 1.5 km inland from the coast and Basic Tower C-12 would be located within 250 m of the coast. There are three main groups or communities of vegetation in the GDFR: upland deciduous, semi-evergreen, and scrub (WWF, 2001). Typical vegetation representative of these families includes the pink trumpet tree, gumbo-limbo, turpentine tree, buttonwood tree, black olive, sea grape, rubescens cactus, and several other varieties of cactus (National American Bonsai Federation, 2009).

All three Core Site towers would be 19 m tall and supported on individual cast-in-place concrete piers with a diameter of 1.4 m. Each of the tower locations would consist of an AP, placed near the existing power source, and an IH. Each AP would have its own power service to support the IH and related tower and arrays. A standby generator would be placed at the proposed Advanced Tower Core Site location to continue operation in the event of extended power loss as a result of tropical storms. The power company service entrance, automatic transfer switch, and would be located at the AP for easy access, service, and refueling of the generator. At the proposed Core Site Advanced Tower, a 35-kW propane standby generator would be placed at the AP. In addition, one offsite PCS would be powered by a photovoltaic system and would support all three Core Site towers and Relocatable Tower R-08 in Ponce Metro. A second PCS would support Relocatable Tower R-07 and the Aquatic Array (A-09).

Electrical and communication service for Advanced Tower C-10 would originate on Highway 334 and be extended along the side of the road in surface conduits approximately 2.0 km east-northeast to the AP on an existing unnamed road. From the AP, service would be supplied by surface level conduits paralleling a 1.2-m wide path. The Commonwealth of Puerto Rico Department of Natural and Environmental Resources does not allow placement of new transmission poles and overhead lines through the Guánica Forest. Therefore, power would be extended parallel to, but 20 m off of, the road in conduits placed on the ground surface. The surface level conduit would extend 100 m south from the AP to the IH. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the base of the tower. The boardwalk for the Advanced Tower would extend approximately 156 m east-northeast from the IH.

Electric and communication service for the Basic Tower C-11 would originate on Highway 334 and be extended along the side of the road in surface conduits approximately 1.3 km east-northeast to the AP along an existing cleared path. From the AP, service would be supplied by surface level conduits paralleling a 1.2-m wide path. The surface level conduit would extend 24 m south from the AP to the IH. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the base of the tower. The boardwalk for the Basic Tower (C-11) would extend approximately 195 m southeast from the IH.

Electric and communication service for the Basic Tower C-12 would originate on Highway 334 and be extended along the side of the road in surface conduits approximately 5.2 km southeast to the AP along an existing cleared path. From the AP, service would be supplied by surface level conduits paralleling a 1.2-m wide path. The surface level conduit would extend 23 m east from the AP to the IH. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the base of the tower. The boardwalk for the Basic Tower (C-12) would extend approximately 140 m northeast from the IH.

#### Relocatable Sites

Relocatable Sites proposed for Domain 4 include the Lajas Agricultural Experimental Station (R7, Figure 2.D04-2) and Ponce Metro (Ponce) (R8, Figure 2.D04-3). Both sites are in Puerto Rico.

The Lajas Agricultural Experiment Station, managed by the University of Puerto Rico, was created in 1946 and comprises 232 ha. The station is approximately 30 m above sea level. Rainfall averages 830 mm/yr and the average annual temperature is about 25 $^{o}$C. Agricultural production at the station includes dairy, chickens, hogs, rice, annual vegetable crops, orchards of mangoes and citrus, and plantations of mahogany and leguminous forestry species. A perennial first-order stream flows through the station to the U.S. Fish and Wildlife Service (USFWS) Refuge at Laguna Cartagena. The Lajas Agricultural Experiment Station comprises most of the stream’s watershed area and this stream would be the site of an Aquatic Array. Facilities include a weather station, wireless and Digital Subscriber Line (DSL) internet, and power.

Relocatable Tower R-07 would be approximately 11 m tall and would be placed on individual cast-in-place concrete piers with diameters of 1.1 m. Electric and communication service would originate on an unnamed road and be supplied by separate and parallel underground lines approximately 100 m southeast from the AP to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electric and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R-07 would extend approximately 152 m from the IH. In addition, there would be an offsite PCS which would be powered by a photovoltaic system. It would be placed away from ecologically sensitive habitats, possibly near the side of the road and painted prior to delivery to minimize visual impacts.

Ponce is approximately 20 km from the Core Site in the Guánica Forest and has a similar dry life zone climate and seasonal rainfall pattern. Ponce currently has a population of about 200,000, with more than 33 percent of the land area urbanized. Increased housing and industrial growth would be expected in Ponce as the Port of the Americas, a large trans-shipment port, will be completed over the next 5 years. The Relocatable Site would be located on the campus of the Pontifical Catholic University in a forested area near the Rio Portugues. Vegetation in this area is typical of coastal dry forests, but there are encroachments of non-native species from the surrounding urban development. The proposed Relocatable Tower location would be subject to surge from tropical storms and hurricanes.

Relocatable Tower R-08 would be approximately 27 m tall and would be placed on individual cast-in-place concrete piers with diameters of 1.4 m. Electric and communication service would originate at an existing radio tower area located approximately 92 m southwest of the proposed tower site. Electric and communication service would be supplied by separate and parallel underground lines approximately 81 m from the AP to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electric and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R-08 would extend approximately 140 m from the IH.

#### Aquatic Array

An Aquatic Array (A-09, Figure 2.D04-2) is proposed at the Lajas Agricultural Experiment Station. This Aquatic Array would use the portal for the Relocatable Tower at the station. The proposed Aquatic Array would be located on Quebrada Plantina between Calle Piedras Blancas (upstream) and Highway 303 (downstream). The stream flows through cropland and eventually to the Caribbean Sea.

#### STREON Site

The STREON Site (S-10, Figure 2.D04-4) proposed for Domain 4 is along Rio Cupeyes in southern Puerto Rico. The proposed Rio Cupeyes STREON Site would be placed at the interface between the State Forest of Puerto Rico (upstream) and developed private lands (downstream). Rio Cupeyes flows into Rio Guanajibo, approximately 5.7 km downstream from the proposed STREON Site.

The STREON hut would measure 2.4 m by 2.4 m. It would connect to the existing power and communications system at the nearest local utility connection. The electric and communication service would be supplied by underground lines in trenches separated 1.5 m from each other.

### 2.2.3.5 Ecological Domain 5

Domain 5 is the Great Lakes region of the United States. Domain 5 includes northeast Minnesota, northern Wisconsin, Michigan, and the northern regions of Indiana and Ohio. Annual precipitation rates and temperatures throughout much of Domain 5 are influenced by the Great Lakes. Weather fronts in this region move predominantly from west to east and southwest to northeast, with heavy snowfall in the winter for most of the region.

Domain 5 lies mostly upon the Central Lowland physiographic province, but also includes the Superior Upland and a sliver of the Appalachian Plateau (USGS, 2009l). The Great Lakes region of the United States is stable from the standpoint of seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 0 % pga to 6 % pga for long wave motion and 0 % pga to 20 % pga for short wave motion (USGS, 2009m).

### Core Site

The Core Site proposed for Domain 5 is within the University of Notre Dame Environmental Research Center (UNDERC) located on the northern border of Michigan and Wisconsin and the Ottawa National Forest in Michigan. The UNDERC, which covers approximately 3,035 ha of land and water, was established for researchers and students engaged in environmental studies at the University of Notre Dame. The Trout Lake Biological Station would be used as a base of operations to support NEON studies in the region, but no NEON field instrumentation would be placed at this site.

All three towers associated with the Core Site and both Relocatable Towers would be approximately 31 m tall and would be placed on concrete pads measuring 3.0 m by 3.7 m. The Core Site tower and Aquatic Array A-11 locations are close enough to each other that one offsite PCS powered by a photovoltaic system would support all four sites. Additionally, one PCS would be required for both Relocatable Towers (R-09 and R-10) as well as Aquatic Array A-12. The PCSs would be placed away from ecologically sensitive habitats, possibly near the side of the road and painted prior to delivery to minimize visual impacts.

An Advanced Tower (C-13, Figure 2.D05-1) and a Basic Tower (C-14, Figure 2.D05-1) would be placed on UNDERC. The Advanced Tower would be located in a young aspen-sugar maple forest (approximately 60 years since previous clearing). The UNDERC Basic Tower (C-14) would be placed in a forested wetland consisting mostly of tamarack, black spruce, Northern white-cedar, leatherleaf, sundew, pale laurel, sedges, common pitcher plant, sphagnum moss, and cranberries. The portal serving this tower would be placed outside the wetland and a boardwalk would be constructed to access the tower location.

Electrical and communication service for the Advanced Tower (C-13) would originate on an unnamed private road. Service would be extended in separate trenches 1.2 km south along an existing trail until reaching the AP. From the AP, service would be supplied by underground lines approximately 186 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 140 m from the IH.

A similar design would be implemented for Basic Tower C-14. Electrical and communication service would originate at the AP on an unnamed private road and be supplied by underground lines approximately 220 m southwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 140 m from the IH.

A Basic Tower (C-15, Figure 2.D05-2) would be placed in the Ottawa National Forest and would be part of the Core Site. Basic Tower C-15 would be in old growth northern forest (more than 200 years old) approximately 800 m from a main road and just outside a wilderness area boundary. Typical vegetation in this forest includes quaking aspen, Eastern white pine, red pine, paper birch, red maple, and eastern hemlock. The Ottawa Forest Site has been part of the Ameriflux Network for approximately 7 years and has an existing tower and line power. Both tower and power supply would be upgraded for NEON instruments.

Electrical and communication service for the Basic Tower (C-15) would originate on Thousand Island Lake road and would be extended along the side of the road in separate trenches for approximately 1.2 km to the AP. From the AP, service would be supplied by underground lines approximately 392 m southeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Basic Tower C-15 would extend approximately 140 m from the IH.

### Relocatable Sites

Relocatable Sites (R-09 and R-10, Figure 2.D05-3) proposed for Domain 5 include the Steigerwaldt Land Services property (Steigerwaldt) and Treehaven, both in northeast Lincoln County, Wisconsin. Steigerwaldt is a private timber company that manages this land for pulpwood production on short rotation. The principal tree produced is aspen. Treehaven manages its land for timber production on a long rotation with conifers as the dominant overstory trees.

Electrical and communication service for Relocatable Tower R-09 would originate at the AP on County Road H and be supplied by underground lines approximately 117 m east to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R-09 would extend approximately 169 m from the IH.

Electrical and communication service for Relocatable Tower R-10 would originate at the AP on Tree Haven Road and be supplied by underground lines approximately 131 m northeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R-10 would extend approximately 171 m from the IH.

### Aquatic Arrays

Aquatic Arrays (A-11, Figure 2.D05-4 and A-12, Figure 2.D05-3) are proposed at Kickapoo Creek on UNDERC and at Pickerel Creek on Treehaven. The Kickapoo Creek Aquatic Array (A-11) would be located in an area predominantly surrounded by wetlands. The portal at this location would be placed in uplands between the stream and Plum Lake to minimize potential impacts to wetlands. A boardwalk may be constructed to reach the aquatic sensors. Kickapoo Creek (Aquatic Array A-11) meets its designated use and is not included on the CWA 303(d) list of impaired waters (Michigan DEQ, 2009). The Aquatic Array would be placed within 82 m of available electric and communication service. Service would be extended in separate trenches to the Aquatic Array along an existing unnamed road. Once services can no longer be co-located with the existing road, a new 1.4-m wide corridor would be utilized.

The Treehaven Aquatic Array would use the same portal as the Treehaven Relocatable Site. Pickerel Creek meets its designated use and is not on Wisconsin's CWA Section 303(d) list of impaired waters (Wisconsin DNR, 2008). Electric and communication services would originate on Pickerel Circle Road and would be extended south along a new 1.5-m wide corridor for 218 m. Service lines would be placed in separate trenches extending to the Aquatic Array.

## 2.2.3.6 Ecological Domain 6

Domain 6 is the prairie peninsula in the Midwestern United States. Iowa and Illinois comprise the center of Domain 6. Also included are southern Minnesota, southern Wisconsin, southeast South Dakota, southeast Nebraska, eastern Kansas, and northern Missouri. Research in Domain 6 would focus on tallgrass ecosystems and the effects of fires and grazing on its natural components.

The climate throughout Domain 6 is variable. Mean annual precipitation ranges from 54 to 150 cm, primarily during spring and summer as a result of frontal storms. These large frontal thunderstorms are major weather features in the late spring and early summer and occasionally produce tornados (Sakai, 2008a). Water deficits during the growing season are common, and long-term droughts are prominent in the history of the region. Snowfall events with accumulation occur sporadically in the winter (Sakai, 2008b).

Domain 6 follows boundaries similar to those of the Central Lowlands physiographic province (USGS, 2009n). The Central Lowlands is characterized by gently rolling hills, except where land has become deeply incised near major rivers and streams (USGS, 2009n). The Midwestern United States is stable from the standpoint of seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 0 % pga to 6 % pga for long wave motion and 8 % pga to 12 % pga for short wave motion, with the exception of an area at the southern tip of Illinois where seismic activity is becoming increasingly more likely (USGS, 2009o).

### Core Site

The Core Site proposed for Domain 6 is within the Konza Prairie Biological Station (KPBS) located in Kansas. It was established as part of the LTER network in 1982 (KPBS, 2009). The 3,487-ha KPBS is owned and managed by The Nature Conservancy and Kansas State University. KPBS has electric power throughout its Headquarters area, with separate transformers and meters used to supply electricity to experimental facilities in this area.

The three Core Site towers, Aquatic Array A-14, and Relocatable Tower R-12 are close enough to each other that one offsite PCS powered by a photovoltaic system would support all five sites. Additionally, one PCS would be required for Relocatable Tower R-11. The PCSs would be placed away from ecologically sensitive habitats, possibly near the side of the road and painted prior to delivery to minimize visual impacts. Each tower would have an IH, measuring 3.05 m by 4.87 m by 2.9 m, located within 15 m of the base of the tower. Electrical and communication services would originate on Highway 177. Lines would be placed in separate trenches co-located with existing roads and paths for approximately 2.6 km where they would connect to a power selector switch. From the power selector switch, service lines would extend north to Advanced Tower C-16 and Basic Tower C-17. Service lines would also extend northwest to Basic Tower C-18. The two extensions would also be placed in separate trenches along existing roads until they connect with the APs.

Advanced Tower (C-16, Figure 2.D06-1) would be placed in native tallgrass prairie habitat. The proposed tower location is near a gravel road to provide access. Common tallgrass species found in the area include big bluestem, Indian grass, switchgrass, little bluestem, Kentucky bluegrass, and Junegrass. Other herbaceous non-grass species include heath aster, dotted gayfeather, ironweed, and several goldenrods.

Advanced Tower C-16 would be approximately 11 m tall and would be supported by individual 1.1-m diameter piers. From the power selector switch, electrical and communication services for the Advanced Tower (C-16) would extend north in separate trenches for approximately 2.6 km along an unnamed road until connecting with the AP. From the AP, service would be supplied by underground lines approximately 49 m west-southwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 162 m from the IH.

Basic Tower C-18 (Figure 2.D06-1) would be located to the south of the Advanced Tower in a lowland topographic position in the same watershed as the Advanced Tower. This tower would be placed in a grassland area that is burned every 2 years, generally during spring. This site would allow comparison of data with data from an upland site (Advanced Tower) and from a riparian (gallery) forest (second Basic Tower). Common vegetation would be similar to that surrounding the Advanced Tower (C-16).

Basic Tower C-18 would be approximately 31.1 m tall and would be placed on a concrete pad measuring 3.1 m by 3.7 m. From the power selector switch, electrical and communication services for Basic Tower C-18 would extend north in separate trenches for approximately 1.6 km along an unnamed road until connecting with the AP. From the AP, on the same unnamed private road as the Advanced Tower, service would be supplied by underground lines approximately 201 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Basic Tower C-18 would extend approximately 163 m from the IH.

Basic Tower C-17 (Figure 2.D06-1) would be placed in a riparian forest that abuts an open agricultural area to the south. The riparian forest is a continuation of the riparian forest near the proposed location of Basic Tower C-18. Woody vegetation in unburned areas includes smooth sumac, dogwood, and eastern red cedar (USGS, 2000a; KEEP, 2004).

Basic Tower C-17 would be approximately 11 m tall and would be supported by cast-in-place concrete piers with a diameter of 1.1 m. From the power selector switch, electrical and communication services for Basic Tower C-17 would extend northwest in separate trenches for approximately 3.1 km along an unnamed road until connecting with the AP. From the AP, service would be supplied by underground lines approximately 169 m north to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Basic Tower C-17 would extend approximately 309 m from the IH.

### Relocatable Sites

Relocatable Sites proposed for Domain 6 include the University of Kansas Field Station (KFS) (R-11, Figure 2.D06-2) and the KPBS Agricultural Lowland Site (R-12, Figure 2.D06-1). Both sites are in Kansas.

The University of Kansas Field Station Relocatable Site would be located in an upland area now dominated by woodlands with extensive tree cover. This area was largely tallgrass prairie prior to settlement by people of European origin in the early to middle 19th Century, but with suppression of fire, cultivation, and other agrarian activity the prairie was destroyed and ultimately replaced by woody vegetation. Plant species associated with these areas are represented largely by early-successional species including smooth sumac, dogwood, and eastern red cedar. Woodlands in the vicinity of the proposed tower location developed on areas that were fenced to exclude livestock in the 1930s that were not subject to cultivation and on areas that were in cultivation and abandoned prior to 1948, when the station was established.

Relocatable Tower R-11 would be approximately 31.1 m tall and would be placed on a concrete pad measuring 3.1 m by 3.7 m. Electrical and communication services for Relocatable Tower R-11 would originate at the AP on Snake Farm Road, and be supplied by underground lines approximately 456 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R-11 would extend approximately 140 m from the IH.

KPBS Agricultural Lowland Site would be located in an area that has been in row crop agriculture for more than 50 years that would be converted to native perennial grasses after establishment of the NEON Relocatable Site. The KPBS Agricultural Lowland Site is near the Headquarters area of KPBS.

Relocatable Tower R-12 would be approximately 11 m tall and would be supported by cast-in-place concrete piers with a diameter of 1.1 m. Electrical and communication services for Relocatable Tower R-12 would originate at the intersection of CR-901 and Konza Prairie Lane. From the intersection to the AP on Konza Prairie Lane, service would be extended south along the side of the road in separate trenches for approximately 390 m. From the AP, service would be supplied by underground lines approximately 201 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R-12 would extend approximately 163 m from the IH.

#### Aquatic Array

The McDowell Creek Aquatic Array (A-14, Figure 2.D06-1) would be located on a fifth order stream approximately 1,600 m north of the KPBS Relocatable Site. Streamflow is intermittent, generally occurring from March to April. McDowell Creek is a tributary of the Kansas River. McDowell Creek meets its designated use and is not included on the CWA Section 303(d) list (KDHE, 1996). The portal for the Aquatic Array would be placed outside of any wetlands associated with the stream. Electric and communication service would originate at the intersection of CR-901 and West 32nd Avenue. Service would be extended north along the eastern side of West 32nd Avenue in separate trenches for approximately 1.0 km. At this point, service lines would turn east along a new 1.5-m wide corridor for approximately 600 m until reaching the Aquatic Array.

#### STREON Site

The STREON Site (S-15, Figure 2.D06-1) proposed for Domain 6 is Kings Creek, an intermittent stream, which is associated with the Konza Prairie LTER program in Kansas. Kings Creek originates on KPBS and flows for 10 km through it. Kings Creek is a USGS Benchmark monitoring station which integrates hydrologic and biogeochemical processes over several watersheds. Kings Creek meets its designated use and is not included on the CWA Section 303(d) list (KDHE, 1996). The Kings Creek STREON Site would be near Basic Tower C-17 on KPBS and would use the same communication and energy portal. Electric and communication service would be extended from the Relocatable Tower AP to the STREON by separate underground lines for 1.4 km. Service would be co-located with Konza Prairie Lane for the majority of the extension; however, a new 1.5-m wide pathway would be required from Konza Prairie Road east to the STRON hut.

### 2.2.3.7 Ecological Domain 7

Domain 7 encompasses the Appalachian/Cumberland Plateaus. It includes central and southern Ohio, southern Indiana, southwest West Virginia, the western tip of Virginia, the northeast corner of Georgia, the northwest corner of South Carolina, eastern and central Tennessee, and all but the western tip of Kentucky. The research focus for this domain is the contiguous forest habitats of the Smoky Mountains and Appalachian

Mountains. The climate in this region varies, as the weather is unpredictable. Spring-time conditions can occur at any time between January and April, and the peak rainfall typically occurs during the summer months. Temperatures in the summer months can range between 12 and 29°C, depending on the elevation. Winter temperatures range between 4 and 15°C, but have been recorded as low as -26°C (Climate of the Appalachian [CofA], 2009).

The major physiographic provinces included within Domain 7 are the Central Lowland in the north of the domain, the Interior Low Plateau, the Appalachian Plateau, the Valley and Ridge, the Blue Ridge, and the Piedmont (USGS, 2009p). Domain 7 is somewhat stable in terms of seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 2 % pga to 7 % pga for long wave motion and 12 % pga to 40 % pga for short wave motion (USGS, 2009q).

### Core Site

The Core Site proposed for Domain 7 is within the Oak Ridge Reservation (ORR) at the Oak Ridge National Laboratory (ORNL) in Anderson County in east Tennessee. ORNL is a science and technology laboratory managed by UT Battelle, LLC for the U.S. Department of Energy (ORNL, 2009). Studies and advancements at ORNL are applied toward clean energy, environmental protection, and national security (ORNL, 2009). Aquatic research in the Walker Branch watershed would be a focus of the Core Site research. All three Core Site tower locations (C-19, C-20, and C-21; Figure 2–D07-01) on ORR would be placed in deciduous forest habitat with different ages or topographic positions. The dominant forest types are oak-hickory, pine-hardwood, and pine. There are also minor, smaller areas of other forest types, such as hemlock and white pine. ORR also contains seminatural grasslands in maintained fields and forest edge habitat (ORNL, 2006).

All three towers associated with the Core Site would be approximately 37 m tall and would be placed on concrete pad measuring 1.83 m by 2.44 m. The Core Site towers would be close enough to each other to utilize one AP. Each Core Site tower would have an IH, measuring 3.05 m by 4.87 m by 2.9 m, located within 15 m of the base of the tower. There would be one offsite PCS powered by a photovoltaic system supporting the Core Site towers, Relocatable Tower R-13, and STREON Site S-18. The PCS would be placed away from ecologically sensitive habitats, possibly near the side of the road and painted prior to delivery to minimize visual impacts.

Electrical and communication services for all three Core Site towers would originate at the existing source on Bear Creek Road and be supplied by underground lines to the AP which would be located adjacent to Bear Creek Road. From the AP, the lines would be placed parallel to an existing path that would require modifications and additional clearing prior to use. From the AP, the electrical and communication lines would extend nearly 640 m connecting each Core Site tower and eventually terminating at the furthest southeast tower, Basic Tower C-20. Each Core Site tower would be similar in design. The electric and communication lines would split from the main path southeast toward each IH for 15 - 70 m until they reach each IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated soil arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk associated with each Core Site tower is estimated to extend approximately 140 - 288 m from the IH, with the longest at Basic Tower C-21.

### Relocatable Sites

Relocatable Sites proposed for Domain 7 include the Twin Creeks area (R-14, Figure 2.D07-2) of the Great Smoky Mountains National Park (GSMNP) in Tennessee and the Mountain Lake Biological Station (MLBS) (R-13, Figure 2.D07-3) in southwest Virginia.

The Twin Creeks Relocatable Site would be near the Twin Creeks Science and Education Center on the lower portion of Mount LeConte in GSMNP. The tower would be placed on a north-facing slope in mixed hardwood forest in Sevier County, Tennessee. The proposed Relocatable Tower would be in pine and oak forest. Typical species in this forest type include red oak, black oak, scarlet oak, chestnut oak, table mountain pine, pitch pine, and white pine (NPS, 2006e).

Relocatable Tower R-14 would be approximately 37 m tall and would be on a concrete pad measuring 1.83 m by 2.44 m. Electrical and communication services for Relocatable Tower R-14 would originate at the AP on an unnamed private road and be supplied by underground lines approximately 270 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R-14 would extend approximately 140 m from the IH.

The MLBS is a field research and teaching facility owned by the University of Virginia. It is surrounded by the Jefferson National Forest in eastern Giles County, Virginia. The proposed Relocatable Site is within mature regrowth hardwood forest at MLBS. The MLBS Relocatable Site (R-13) would be within a second growth oak-hickory forest consisting of oak, post oak, blackjack oak, chestnut oak, scarlet oak, and white oak. (Nagy, 2008 personal communication).

Relocatable Tower R-13 would be approximately 37 m tall and would be on a concrete pad measuring 1.83 m by 2.44 m. Electrical and communication services for Relocatable Tower R-13 would originate at the AP on Biological School Road and be supplied by underground lines approximately 150 m southeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R-13 would extend approximately 140 m from the IH.

### Aquatic Array

An Aquatic Arrays is proposed for the Twin Creeks Relocatable Site (A-17, Figure 2.D07-2). The Aquatic Array would be placed on a tributary of LeConte Creek near the Twin Creeks Relocatable Site, just upstream of its confluence with LeConte Creek. The Aquatic Array would use the same portal as the Twin Creeks Relocatable Site. Electric and communication service would originate along Biological School Road in GSMNP.

Service lines would be extended in separate trenches co-located with Twin Creeks for approximately 120 m and then would connect to the Aquatic Array.

### STREON Site

The STREON Site (S-18, Figure 2.D07-2) proposed for Domain 7 is the Walker Branch watershed on ORR. This watershed has been extensively studied in the past and S-18 would share a portal with the Core Site towers. Walker Branch is a tributary to Melton Hill Lake, a dammed segment of the Clinch River. The ORR is located within the Tennessee River drainage system.

The STREON hut would measure 2.4 m by 2.4 m. It would connect to the existing power and communications system at the Core Site. The electric and communication service would be supplied by underground lines in trenches for approximately 529 m.

## 2.2.3.8 Ecological Domain 8

Domain 8 is the Ozarks Region, which extends from southeast Kansas to the southeast into Alabama. Domain 8 encompasses much of the lower Mississippi River valley, extending from central Alabama, Mississippi, and Louisiana north to southern Missouri and also includes Arkansas and much of west Tennessee.

The climate in Domain 8 varies between areas in the lowlands and those at higher elevations. Typically the lowlands are warmer and more humid than the hilly or mountainous regions. Likewise, precipitation levels are typically greater in the higher elevations than in the lowlands. Strong storms, with intense wind, hail, and lightning, may occur in association with tropical storms moving up from the Gulf of Mexico, as strong fronts move through or as isolated severe summer storms (FEMA, 2008).

The main physiographic provinces that make up the majority of Domain 8 include the Central Lowland, the Ozark Plateau, the Interior Lowland Plateau, the Coastal Plain, the Quachita, and the Mississippi Alluvial Plains (USGS, 2009r). Rolling, dissected open hills, with gently sloping to strongly sloping side-slopes are characteristic of this region. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 6 % pga to 14 % pga for long wave motion and 12 % pga to 28 % pga for short wave motion (USGS, 2009s). An exception is the region where the Ohio River joins the Mississippi River. Long wave motion probability can reach greater than 80 % pga and short wave motion can reach greater than 320 % pga (2 percent probability of occurrence in 50 years) (USGS, 2009s).

### Core Site

The Core Site proposed for Domain 8 is within the Oakmulgee District of the Talladega National Forest (TNF) in western Bibb County, Alabama. The proposed Core Site has been under USFS ownership since the 1930s. The University of Alabama has maintained a cooperative agreement with the USFS for the past 15 years for access to the area for research and education purposes. This area, where the Core Site towers (C-22, C-23, and C-24, Figure 2.D08-1) would be located, is lightly populated and dominated by forest cover, primarily pine (longleaf, loblolly, and shortleaf) with some oaks, tulip poplar, sweetgum, and hickory.

The existing power grid would be extended to reach the three towers via overhead transmission lines along the USFS road. All three towers associated with the Core Site would be approximately 27 m tall and would be supported by cast-in-place concrete piers with diameters of 1.5 m. The Core Site towers would be close enough to each other to utilize one AP. Each Core Site tower would have an IH, measuring 1.52 m by 3.05 m by 2.9 m, located within 15 m of the base of the tower. There would be two offsite PCSs powered by a photovoltaic system supporting the Core Site towers, Relocatable Tower R-15, the STREON (S-22), and Aquatic Array A-20. The PCSs would be placed away from ecologically sensitive habitats, possibly near the side of the road and painted prior to delivery to minimize visual impacts.

Electrical and communication services for all three Core Site towers would originate at the existing source on Road 723 and be supplied by underground lines to the AP which would be located adjacent to Road 723. From the AP, the lines would be placed parallel to an existing path that would require modifications and additional clearing prior to use. From the AP, the electrical and communication lines would branch off from one another, providing services to each tower site. Each Core Site tower would be similar in design.

Electrical and communication services for Advanced Tower C-24 would branch off of the Basic Tower C-23 service line, and be supplied by underground lines approximately 32 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Advanced Tower C-24 would extend approximately 169 m from the IH.

Electrical and communication services for Basic Tower C-23 would branch off of the main service line originating at Road 723, and be supplied by underground lines approximately 297 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Basic Tower C-23 would extend approximately 131 m from the IH.

Electrical and communication services for Basic Tower C-22 would originate at Road 723, and be supplied by underground lines approximately 175 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Basic Tower C-22 would extend approximately 177 m from the IH.

#### Relocatable Sites

Relocatable Sites proposed for Domain 8 include the Armistead Selden Lock (R-15, Figure 2.D08-2) and the Choctaw National Wildlife Refuge (NWR) (R-16, Figure 2.D08-3). Both sites are in Alabama.

The proposed Armistead Selden Lock Relocatable Site would be located in bottomlands 1.8 km east of the Black Warrior River in west-central Hale County. The Armistead Selden Lock and Dam was completed in 1962.

Relocatable Tower R-15 would be approximately 11 m tall and would be supported by cast-in-place concrete piers with a diameter of 1.1 m. Electrical and communication services for Relocatable Tower R-15 would originate at the AP on County Road 15 and be supplied by underground lines approximately 90 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R-15 would extend approximately 150 m from the IH.

The Choctaw NWR is managed by the USFWS. It contains a mix of bottomland hardwood forests typical of the Tombigbee River Basin and wetlands associated with sloughs and backwater areas from the Tombigbee River. The Relocatable Tower would be placed outside of wetlands, approximately 0.4 km west of the river in southeast Choctaw County.

Lowland hardwoods that dominate the areas surrounding both Relocatable Sites include the post oak, southern red oak, scarlet oak, chestnut oak, and blackjack oak (BLM, 2009b). These forests also likely include overstory species such as the southern magnolia, pignut hickory, and sweetgum along with understory species such as flowering dogwood, hophornbeam, and American holly (FNAI, 1990).

Relocatable Tower R-16 would be approximately 27 m tall and would be supported by cast-in-place concrete piers with diameters of 1.5 m. Electrical and communication services for Relocatable Tower R-16 would originate at the AP on an unnamed road and be supplied by underground lines approximately 52 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for Relocatable Tower R-16 would extend approximately 150 m from the IH.

### Aquatic Array

Each of the Relocatable Sites in Domain 8 would have an Aquatic Array. The Armistead Selden Lock Aquatic Array (A-20, Figure 2.D08-2) would be on the east bank of the Black Warrior River near the Relocatable Tower, approximately 55 river km north of the river's confluence with the Tombigbee River near Demopolis, Alabama. Electric and communication service would originate at the nearby unnamed road and would be extended by underground lines for approximately 140 m southwest. A new 1.5-m wide corridor would be required from the road to the Aquatic Array.

The Aquatic Array at Choctaw NWR (A-21, Figure 2.D08-3) would be on the west bank of the Tombigbee River and would use the portal from the Relocatable Tower. It would be located in southeast Choctaw County, about 12 km north of Coffeeville, Alabama. Electric and communication service would originate at the same unnamed road as Relocatable Tower R-16 and would be extended by underground lines for approximately 422 m southeast. A new 1.5-m wide corridor would be required from the road to the Aquatic Array.

### STREON Site

The proposed STREON Site (S-22, Figure 2.D08-1) for Domain 8 is along an unnamed tributary of South Sandy Creek in the TNF in Alabama. The STREON site would be approximately 3.3 km northwest of the Core Site towers in western Bibb County, between the Cahaba River (approximately 32 km to the east) and the Sipsey River (approximately 64 km to the north and west) (Ward and Ward, 2007). The Mayfield Creek watershed, proposed as the STREON Site, drains to Sandy Creek and ultimately to the Black Warrior River.

The STREON hut would measure 2.4 m by 2.4 m. It would connect to the existing power and communications system at the Core Site. The electric and communication service would be supplied by underground lines in trenches for approximately 229 m.

## 2.2.3.9 Ecological Domain 9

Domain 9 is the Northern Plains, including the Prairie Pothole Region. It covers portions of Minnesota, Montana, Nebraska, and Wyoming, a very small eastern portion of Iowa, the majority of South Dakota, and all of North Dakota. The research focus for this domain is the diverse ecology of the Prairie Pothole Region.

Domain 9 has an interior continental climate with hot summers and frigid winters. High winds are from the northwest. The area is susceptible to severe weather in the spring and summer that is known to produce intense lightning, damaging winds, hail, and tornados.

There are two major physiographic regions that make up Domain 9: the Central Lowlands and the Great Plains. The characteristic topography in this region is level to gently rolling plains and rolling continental glacial till plains and rolling hills (USGS, 2009t). The region is stable in terms of seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 0% pga to 9 % pga for long wave motion and 4 % pga to 28 % pga for short wave motion, where the higher % pga is a result of the proximity to the Rocky Mountains (USGS, 2009u).

### Core Site

The Core Site proposed for Domain 9 is within Woodworth Field Station (WFS) in northwest Stutsman County, North Dakota. The WFS is a 1,072-hectare (ha) waterfowl protection area that is managed and owned by the USFWS. The WFS is within the northwestern glaciated plains ecoregion and consists of prairie grassland uplands with a mosaic of wetland basins of varying types, sizes, and shapes. The mixed-grass prairie vegetation provides a combination of tallgrass and shortgrass prairie plant species such as western wheat grass, needle and thread grass, green needlegrass, and blue gramma (USFS, 2009b). The vegetation in the area of the proposed towers would range from 0.3 to 1.0 m tall (Starr and Kao, 2008a). Over 500 natural wetland basins occur within the boundaries of the WFS, representing multiple wetland classes with chemical characteristics ranging from fresh to slightly brackish.

The Advanced and Basic Towers (C-25, C-26, and C-27, Figure 2.D02-1) proposed for WFS would be able to use the existing power grid. The locations for the Advanced and Basic Towers have been selected to avoid any of the known Native American historic sites on WFS.

All three towers associated with the Core Site would be approximately 11 m tall and would be supported by cast-in-place concrete piers with diameters of 1.1 m. Each tower would have one AP. The APs would be located near the existing electric and communication service lines. Each Core Site tower would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, located within 15 m of the base of the tower. Given the proximity of the three Core Site towers, Relocatable Tower R-17, and Aquatic Array A-23, there would be an offsite PCS powered by a photovoltaic system supporting these sites. The portal container set would be placed away from ecologically sensitive habitats, possibly near the side of the road on Highway 36, and painted prior to delivery to minimize visual impacts.

Electrical and communication services for the Advanced Tower (C-25) would originate at the AP on 59th Avenue SE and be supplied by underground lines approximately 744 m east to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 140 m from the IH.

Electrical and communication services for the Basic Tower (C-26) would originate at the AP on 59th Avenue SE, approximately 1 km north of the Advanced Tower's AP, and be supplied by underground lines approximately 212 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 140 m northwest from the IH.

Electrical and communication services for the Basic Tower (C-27) would originate at the AP on a private unnamed road and be supplied by underground lines approximately 701 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 140 m northwest from the IH.

#### Relocatable Sites

Relocatable Sites proposed for Domain 9 include the Dakota Coteau Field School (DCFS) (R-17, Figure 2.D02-2) in Stutsman County and the Northern Great Plains Research Laboratory (NGPRL) (R-18, Figure 2.D02-3) in Morton County. Both sites are located in North Dakota. Each of the Relocatable Towers would be 11 m in height and would be supported by 1.1-m diameter concrete piers. Each tower would have one AP. The APs would be located near the existing electric and communication service lines. Each tower would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, located within 15 m of the base of the tower. There would be an offsite PCS powered by a photovoltaic system supporting Relocatable Tower R-18. The portal container set would be placed away from ecologically sensitive habitats, possibly near the side of the road and painted prior to delivery to minimize visual impacts.

DCFS is located approximately 10 km east of the Domain 9 Core Site, and would be a Relocatable Site. DCFS is located on a 259-ha section of state school land that has no history of tilling and has been leased for grazing since the 1950s. The landforms are rolling to moderately steep areas with several small seasonal wetlands and one larger, more permanent wetland. Vegetative communities within the DCFS are similar to those in the WFS, where western wheat grass, needle and thread grass, green needlegrass, and blue gramma appear dominant.

Electrical and communication services for Relocatable Tower (R-17) would originate at the AP on Highway 36 and be supplied by underground lines approximately 857 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 140 m northwest from the IH.

The NGPRL is a National Soil Repository managed by the U.S. Department of Agriculture, with nearly 90 years of soil and plant data on native rangelands. The NGPRL is centrally located in the Northern Great Plains and represents a transitional area between intensely cropped and intensely grazed zones. The site comprises multiple land uses and is on the fringe of the state capital metropolitan area. Existing vegetation communities include mixed-grass prairie similar to that found at DCFS with the addition of buffalo grass (USFS, 2009b). Additionally, shrub lands, annual crops, bio-fuel crops, and perennial grass monocultures are common.

Electrical and communication services for Relocatable Tower (R-18) would originate at the AP on County Road 138/45th Street and be supplied by underground lines approximately 719 m north to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 140 m northwest from the IH.

#### Aquatic Array

Aquatic Arrays are proposed at WFS (A-23, Figure 2.D02-1) and DCFS (A-24, Figure 2.D02-2). The Aquatic Array proposed for WFS would be located on a prairie pothole wetland. The WFS Aquatic Array would be able to use the portal for the Advanced Tower. The location for the Aquatic Array on WFS was selected to avoid any of the known Native American historic sites on WFS. Electric and communication service would originate on 59th Avenue SE and would be extended underground 114 m west to the Aquatic Array. A 1.5-m wide corridor would be required from the power source to the Aquatic Array.

The Aquatic Array proposed for DCFS would be located on a prairie pothole wetland. The DCFS Aquatic Array would be able to use the portal for the Relocatable Tower.

Electric and communication service would originate at the Relocatable Tower (R-17) AP. Service would be extended along a 1.5-m wide improved path for approximately 306 m southwest from the portal to the Aquatic Array.

Both Aquatic Array locations are characterized by depressional wetlands formed by glaciers scraping the landscape. Many of the prairie potholes are closed as basins and receive irregular inputs of water from their surroundings through rain and winter snowmelt (LandScope America, 2008 and USFS, 2009b). The Prairie Pothole Region has hydrologic outputs through evaporation and subsurface drainage (Starr and Kao, 2008b). The NEON infrastructure would be located in the Pipestem watershed (USEPA, 2009e).

#### 2.2.3.10 Ecological Domain 10

Domain 10 is the Central Plains, which covers a broad geographic area from the Rocky Mountains eastward to central Nebraska and south through Kansas, Oklahoma, and the Panhandle of Texas. The research focus for this domain is centered on the analysis of contrasting land uses within urban, suburban, and exurban fringe areas.

The climate within Domain 10 is characterized by periodic drought and significant climatic fluctuations throughout the year. Moisture from the Pacific Ocean reaches this region with little precipitation due to the rain-shadow effect of the Rocky Mountains. Most precipitation is derived from the Gulf of Mexico and falls between April and September. Much of Domain 10 is within "Tornado Alley" where peak tornado activity occurs between May and early June (NOAA, 2009). Tornados frequently form in this area due to the warm moist air from the Gulf of Mexico meeting the cool, dry air from the north in an area known as the "dryline" (NOAA, 2009). Tornados are typically products of severe thunderstorms which may produce strong winds, heavy rain, lightning, and hail.

The Great Plains physiographic region makes up the majority of Domain 10 (USGS, 2009v). The Great Plains is characterized by moderately flat to somewhat rolling land. Domain 10 is relatively stable from the standpoint of seismic risk. Across the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 2 % pga to 6 % pga for short wave motion and 8 % pga to 16 % pga for long wave motion (USGS, 2009w). The higher ranges occur near the western edge of the domain.

##### Core Site

The Core Site proposed for Domain 10 is within the Central Plains Experimental Range (CPER) located in north-central Colorado in Weld County and encompasses 6,798 ha. The site is owned by the U.S. Department of Agriculture (USDA) – Agricultural Research Service and has been an LTER site since 1982.

The Advanced Tower would be placed between the two Basic Towers (C-28, C-29, and C-30, Figure 2.D10-1). The three towers would be spaced approximately 2.4 km apart, with one of the Basic Towers approximately 1.2 km south-southwest of the CPER Headquarters and the other located 1 km south-southeast of Pawnee National Grassland Research Center. The proposed Core Site is dominated by open prairie steppe species. The dominant species are blue gramma and, to a lesser extent, buffalo grass. Other characteristic plant species of open steppe habitat are threeawn, fringed sage, gray rabbitbrush, snakeweed, ring muhly, prickly pear cactus, western wheatgrass, scurf pea, and scarlet globemallow (Hazlett, 1998).

All three towers associated with the Core Site would be approximately 11 m tall and would be supported by cast-in-place concrete piers with diameters of 1.1 m. Each tower would have one AP. The APs would be located near the existing electric and communication service lines. Each Core Site tower would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, located within 15 m of the base of the tower. Given the proximity of the three Core Site towers, only one offsite PCS powered by a photovoltaic system would be necessary. The portal container set would be placed away from ecologically sensitive habitats, possibly near the side of the road on County Road 114, and painted prior to delivery to minimize visual impacts.

Electrical and communication services for the Advanced Tower (C-28) would be extended from County Road 114 up an existing, well maintained service road for 564 m. Lines would be placed in separate trenches co-located with the road. From the service road, electric and communication lines would tie in to the AP and be supplied by underground lines approximately 280 m east-southeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 140 m northwest from the IH.

Electrical and communication services for the Basic Tower (C-29) would be extended from County Road 37 down an existing, well maintained service road for 2.2 km. Lines would be placed in separate trenches co-located with the road. From the service road, electric and communication lines would tie in to the AP and be supplied by underground lines approximately 597 m northeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 140 m northwest from the IH.

Electrical and communication services for the Basic Tower (C-30) would be extended from County Road 114 down an existing service road for 463 m. Lines would be placed in separate trenches co-located with the road. From the service road, electric and communication lines would tie in to the AP and be supplied by underground lines approximately 671 m southeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 140 m north from the IH.

The Core site towers, guy wires, and soil arrays would be surrounded with electric fencing because of active livestock grazing in the area. The electric fencing would protect both NEON infrastructure and livestock.

### Relocatable Sites

Locations proposed for Relocatable Sites in Domain 10 include the Sterling Relocatable Site (R-19, Figure 2.D10-2), just west of the Kelly Community Center in the southeast corner of Logan County, and the Tahosa Valley Site (R-20, Figure2.D10-3) in southwest Larimer County, Colorado at an elevation of approximately 2,750 m. Each relocatable tower would have one AP. The APs would be located near the existing electric and communication service lines.

The proposed location of the Sterling Relocatable Site (R-19, Figure 2.10-2) is near the southeast corner of Logan County, Colorado at an elevation of approximately 1,400 m. The proposed Relocatable Site was converted to agricultural use from native shortgrass species in the past and is now privately owned tilled farmland that is considered prime farmland when irrigated. The town of Sterling, Colorado, is approximately 23 km northwest of the Relocatable Site. With a population of nearly 14,000, Sterling is one of the largest towns in Colorado east of Pueblo (City of Sterling, 2009). Relocatable Site R-19 would be placed in tilled farmland and no native vegetation would occur at this location.

Relocatable Tower R-19 would be 11 m in height and would be supported by four 1.1-m diameter cast-in-place concrete piers. Electrical and communication services for R-19 would originate at the AP on County Road MM and be supplied by underground lines approximately 229 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 155 m south from the IH.

Relocatable Site R-20 (Figure 2.D10-3) would be in an open meadow in Tahosa Valley on a disjunct parcel that is part of Rocky Mountain National Park (RMNP). The property is surrounded by private land and is near the Roosevelt National Forest and the main part of RMNP. R-20 would be on an open moraine in Tahosa Valley at an elevation of approximately 2,743 m. It would be located approximately 1.2 km east-northeast of Longs Peak Ranger Station and less than 0.5 km west of State Highway 7 (south of Lily Lake and the Twin Sisters Trailhead) at the southern boundary of Larimer County, Colorado. Relocatable Site R-20 includes subalpine forest, riparian forest and wetlands, and tundra (GES, 2003) with abundant variations depending upon slope and aspect. Most sensitive habitats are riparian areas and tundra, where management and restoration are particularly challenging.

Relocatable Tower R-20 would be approximately 18 m in height and would be placed on a concrete pad measuring 2.74 m by 3.96 m. Electrical and communication services for Relocatable Tower (R-20) would originate at the AP on Goblins Castle Road and be supplied by underground lines extending approximately 57 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 216 m south from the IH. The FIU associated with R-19 would be kept within the NPS property.

### Aquatic Array

One Aquatic Array (A-25, Figure2.D10-3), is proposed for Domain 10. The Aquatic Array would be placed on Glacier Creek in RMNP, approximately 0.3 km upstream of Sprague Lake. Glacier Creek is a perennial stream that flows eastward before joining the Big Thompson River, which flows into the South Platte River in Domain 10. Due to the high elevation of the Aquatic Array on Glacier Creek, upstream processes that are typically associated with reduced water quality are nearly non-existent. Glacier Creek exhibits high water quality and meets its designated uses as identified by the State of Colorado. Electrical and communication services for A-25 would originate at the intersection of Sprague Lake Road and Bear Lake Road. Electric and communication lines would then be placed in separate trenches 1.4 m apart and co-located within the Sprague Lake Road shoulder. Service would be extended for approximately 497 m to the Aquatic Array and would be located within previously disturbed areas to the maximum extent possible.

## 2.2.3.11 Ecological Domain 11

Domain 11 is the Southern Plains, which extends from the Osage Plains in southern Kansas and central Oklahoma through the Oaks and Prairies region in central Texas, continuing into the South Texas Brushlands and Coastal Prairies to the U.S.-mexico border. The research focus for this domain is the transition zone between the eastern deciduous forests and the central plains to the west.

The climate in Domain 11 changes from humid to subhumid from the south to the north due to moisture coming in from the Gulf of Mexico. The humid southern region is known for hot and humid summers, while the subhumid northern region is known for humid summers and dry winters (TDWR, 1983). Peak rainfall for Domain 11 occurs between April and July, with the western portions being somewhat drier. Thunderstorms are common throughout the year and bring with them heavy rainfall, destructive winds, tornadoes, and hail.

Domain 11 includes physiographic provinces such as the Central Lowland and a small section of the Great Plains and Coastal Plains (USGS, 2009x). The topography of Domain 11 is characterized by low rolling hills. The Southern Plains is relatively stable from the standpoint of seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 4% pga to 12% pga for short wave motion and 0% pga to 4% pga for long wave motion, with the exception of an area in south-central Oklahoma where seismic activity is higher (USGS, 2009y).

### Core Site

The proposed Core Site for Domain 11 is within the Caddo-Lyndon B. Johnson National Grassland of Texas (LBJ). The LBJ is located on gently rolling hills at the southern end of the Cross Timbers Forest ecoregion, approximately 65 km north-northwest of Fort Worth in Wise County, Texas. LBJ is managed by the USDA and provides visitors the opportunity for camping, hiking, wildlife viewing, fishing, and hunting (USDA, 2009). The Advanced Tower (C-32, Figure 2.D11-1) and Basic Tower C-33 (Figure 2.D11-1) would be located near the prairie-woodland interface. Basic Tower C-31 (Figure 2.D11-2) would be located in grassland. Dominant tree species within forested areas of the LBJ include post oak and blackjack oak, with shin oak, Spanish oak, live oak, Texas ash, mesquite, Osage orange, and Ashe juniper also being common (TPWD, 2009a).

Grasslands in the LBJ are dominated by little bluestem, big bluestem, Indian grass, and switchgrass (Hallgren, 2008).

All three towers associated with the Core Site would have APs located near the existing electric and communication service lines. Each Core Site tower would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, located within 15 m of the base of the tower. Given the proximity of the three Core Site towers, only one offsite PCS powered by a photovoltaic system would be necessary. The portal container set would be placed away from ecologically sensitive habitats, possibly near the side of the road, and painted prior to delivery to minimize visual impacts.

Advanced Tower C-32 would be 26 m in height. It would be supported by four 1.5-m diameter concrete piers. Electric and communication service would originate at the AP on an unnamed USFS road and be supplied by underground lines approximately 407 m northwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 162 m south from the IH.

Basic Tower C-33 would be 11 m in height and would be supported by four 1.1-m diameter concrete piers. Electric and communication service would originate at the AP on an unnamed USFS road and be supplied by underground lines approximately 107 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 156 m south from the IH.

Basic Tower C-31 would be 27 m in height. It would be supported by four 1.5-m diameter concrete piers. Electric and communication service would originate at the AP on USFS Road 936 and be supplied by underground lines approximately 280 m northwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 163 m south from the IH.

### Relocatable Sites

Relocatable Sites proposed for Domain 11 include the Klemme Range Research Station (KRRS) and the University of Oklahoma Biological Station (UOBS). Both sites are located in Oklahoma.

The proposed KRRS Relocatable Tower (R-21, Figure 2.D11-3) would be placed in grassland in Washita County in west-central Oklahoma. KRRS, a 631-ha research station, was donated in 1988 to Oklahoma State University's Division of Agricultural Science and Natural Resources by Marvin Klemme (OSU, 2009). KRRS is located in the Rolling

Red Plains Resource Area of the Central Great Plains Ecological Region, an area historically defined by expansive grasslands and prairie communities. The natural vegetation is this area consists of mixed grass plains, shin oak grasslands, and mesquite grassland plains. Oak mottes are common throughout the various grasslands as well. The majority of this area is now used primarily for cropland and grazing, with wheat, sorghum, alfalfa, and cotton being the major agricultural commodities. Fragmentation and overgrazing are major factors in the loss of natural communities in the region (BLM, 2009b).

Relocatable Tower R-21 would be 33 m in height and would be placed on a concrete pad measuring 3.1 m by 3.1 m. Electric and communication service would originate at the AP on N2200 Road and be supplied by underground lines approximately 410 m east to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 156 m south from the IH.

The location of the proposed UOBS Relocatable Site (R-22, Figure 2.D11-4) is on a peninsula near the shore of Lake Texoma on the north side of the Oklahoma-Texas border in Marshall County, Oklahoma. UOBS was established in 1949 for study and advancements in ecology, evolutionary biology, and field biology (UO, 2009). The OUBS is located within the Cross Timbers Ecological Region. The Relocatable Tower (R-22) would be on a previously disturbed area within the facility. The proposed site is currently vegetated with planted grasses and scattered trees and is regularly maintained.

Relocatable Tower R-22 would be 11 m in height and would be supported by four 1.1-m diameter concrete piers. Electric and communication service would originate at the AP on Lakeview Road and be supplied by underground lines approximately 99 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 156 m south from the IH.

### Aquatic Array

Aquatic Arrays are proposed for LBJ (A-26, Figure 2.D11-5) and the KRRS (A-27, Figure 2.D11-3) near R-21. A-27 would be located on a tributary of Boggy Creek and A-26 would be located on Pringle Creek, a main tributary to Big Sandy Creek.

A-27 would share an AP with R-21. Power and communication services would be extended from the AP to A-27.

The proposed Aquatic Array at the LBJ (A-26) would be located on Pringle Creek, 14 km northwest of the proposed Advanced Tower. Pringle Creek flows in a southeasterly direction for approximately 14 km, before draining into Big Sandy Creek just northwest of Alvord, Texas (TSHA, 2009). Big Sandy Creek is on the Texas CWA Section 303d list of impaired waters due to elevated concentrations of bacteria (TCEQ, 2008). Electrical and communication services for A-26 would originate 581 m north of the proposed site on Buckner Road (CR-1590). Electric and communication lines would be placed together in a trench and extended underground along a new 1.4-m wide corridor to the Aquatic Array.

#### 2.2.3.12 Ecological Domain 12

Domain 12 is the Northern Rocky Mountains. Domain 12 encompasses western Wyoming (Yellowstone National Park area), western Montana, and nearly all of central and northern Idaho extending to the border with Canada. The research focus for this domain is ecological responses to global change in suburban areas and areas where little human activity has occurred.

The Rocky Mountains have variable weather patterns that are continuously changing. The climate changes as the altitude increases. Summers are typically mild and winters are cold, with significant snowfall. The average winter temperature is 2.2°C and the average summer temperature is 15°C, with the warmest days occurring in July, sometimes reaching as high as 27°C.

The majority of Domain 12 lies within the Rocky Mountain Division physiographic province (USGS, 2009z). The topography consists of high rugged mountains at elevations up to 4,400 m. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 12 % pga to greater than 160 % pga for short wave motion and 6 % pga to 80 % pga for long wave motion (USGS, 2009aa).

**Core Site**

The proposed Core Site for Domain 12 is located on the Wyoming and Montana border and encompasses 9,592 ha. This site is owned by the NPS (Yellowstone National Park, 30.5 percent), and the USFS (Gallatin National Forest, 63.5 percent), with private inholdings accounting for 6.0 percent of the area. The proposed Core Site is situated along a portion of the Yellowstone Northern Range (YNR) and, in combination with the surrounding Greater Yellowstone Ecosystem (GYE), comprises the largest intact wildland ecosystem in the lower 48 states.

The YNR encompasses the Yellowstone caldera at the head of the Snake River Plain, as well as the fault-block mountain ranges that wrap around the caldera to the northeast and southwest. This large area of mountains and valleys, including the 2,400-m high Yellowstone Plateau, intercepts winter storms from the west and becomes progressively drier to the east.

Constraints that must be met for a successful site location include year-round access, available permitting, land tenure secure for 30 years, air space unimpeded for regular air survey, and the sites must be minimally managed wildland representative of the domain in terms of vegetation, soils, landforms, climate, and ecosystem performance. YNP meets all the restraint criteria where multiple use reserves (e.g. National Forests) only fulfill some of the criteria and may be greatly modified over a 30 year period.

Two Basic Towers and one Advanced Tower (C-34, C-35, and C-36, Figure 2.D12-1) would be located less than 0.8 km west of Phantom Lake in Yellowstone National Park. The proposed towers (C-34, C-35, C-36) would be in a Douglas-fir and snowberry forested community surrounded by big sagebrush, Idaho fescue, and sticky geranium moist non-forested community. Douglas-fir mixed with steppe communities typically occur at elevations up to 2,300 m. Public electric and telephone lines are near the site.

All three towers associated with the Core Site would be self-supporting, approximately 20 m in height, and would be placed on concrete pads measuring 3.1 m by 4.6 m The AP would be placed near the existing electric and communication service lines and constructed so as not to be visible from the Blacktail Plateau Road. Electric and communication services for the Core Site would originate on Grand Loop Road. Service lines would be extended underground, or in aboveground conduits, and co-located with Blacktail Plateau Road for approximately 0.5 km, thereby reaching the AP. Each Core Site tower would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, located within 15 m of the base of the tower. Given the proximity of the three Core Site towers, only one offsite PCS powered by a photovoltaic system would be necessary. The portal container set would be placed away from ecologically sensitive habitats, just outside of Yellowstone National Park, between the Core Site and Relocatable Tower R-24. It would be painted prior to delivery to minimize visual impacts.

Electrical and communication services for the Advanced Tower (C-34) would originate at the AP and be supplied by underground lines, or aboveground lines in conduits, approximately 232 m west-northwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The Advanced Tower would be located approximately 140 m northwest of the IH.

Electrical and communication services for the Basic Tower (C-35) would originate at the AP and be supplied by underground lines, or aboveground lines in conduits, approximately 145 m southwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 179 m northwest from the IH.

Electrical and communication services for the Basic Tower (C-36) would originate at the AP and be supplied by underground lines, or aboveground lines in conduits, approximately 320 m southwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 203 m northwest from the IH.

### Relocatable Sites

Relocatable Sites proposed for Domain 12 include Bozeman (R-23, Figure 2.D12-2) and Loch Leven (R-24, Figure 2.D12-3); both in south-central Montana.

The Bozeman site is 0.8 km south of the Montana State University Campus in central Gallatin County. It is in an area of increasing development on the south side of the City of Bozeman. The proposed Tower R-23 site is in an agricultural field managed by

Montana State University. The city of Bozeman, with an estimated population of nearly 38,000 in 2007, is the fourth largest city in Montana (City of Bozeman, 2009). Gallatin County is the fastest growing county in the state (City of Bozeman, 2009).

Relocatable Tower R-23 would be 11 m in height and would be supported by four 1.1-m diameter concrete piers. Electric and communication service would originate at the AP on South 7th Avenue and be supplied by underground lines, or aboveground lines in conduits, approximately 47 m east to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 251.5 m from the IH.

The Loch Leven Relocatable Site (R-24) is a camping and fishing area managed by the Montana Department of Fish and Wildlife. The proposed tower location is just north of the Loch Leven Recreation Area near the east bank of the Yellowstone River in central Park County. The proposed Tower R-24 site is located in Paradise Valley, a nearly treeless valley of the Yellowstone River. Trees are typically confined to the banks of the Yellowstone River and riparian areas along smaller streams. Paradise Valley vegetation is dominated by grasses and forbs. Typical forbs include sticky geranium, wheatgrass, bedstraw, and yellow bean and typical grasses include fescue, Parry's oatgrass, and Junegrass (WWF, 2009).

Relocatable Tower R-24 would be 11 m in height and would be supported by four 1.1-m diameter concrete piers. Electric and communication service would originate at the AP on an unnamed, well maintained, dirt road and be supplied by underground lines, or aboveground lines in conduits, approximately 40 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 201 m from the IH.

### Aquatic Array

Two Aquatic Arrays are proposed for Domain 12. Aquatic Array A-28 (Figure2.D12-4) would be located on Blacktail Deer Creek, approximately 6.2 km upstream from the Yellowstone River, in the Yellowstone Northern Range of Wyoming. The proposed Aquatic Array on Blacktail Deer Creek (A-28) would be placed in a scrub-shrub wetland where temporary flooding frequently occurs National Wetland Inventory [NWI], 2009). This riparian zone consists primarily of willows and aspen, within the big sagebrush and Idaho fescue non-forested sagebrush community. Electric and communication service would originate on an unnamed road, approximately 94.5 m southwest of the Aquatic Array. Service would be supplied by underground lines buried in a shared trench along a new 1.4-m wide corridor.

Aquatic Array A-29 (Figure 2.D12-2) would be located on Bozeman Creek, approximately 0.8 km east of Montana State University in Bozeman. Bozeman Creek is within the Upper Missouri River basin. It is a cold mountain stream that originates in the Gallatin National Forest and flows through the City of Bozeman. Bozeman Creek fully supports agricultural, drinking water, and industrial uses and partially supports primary contact recreation but has been assessed as not supporting aquatic life and cold water fisheries below its confluence with Limestone Creek. The section of Bozeman Creek below the confluence with Limestone Creek is on the Montana CWA Section 303(d) list of impaired waters (MDEQ, 2006) and the proposed Aquatic Array (A-29) would be in this impaired section of Bozeman Creek. Electric and communication service would originate toward the eastern end of East Garfield St., approximately 21 m north of the Aquatic Array. Service would be supplied by underground lines buried in a shared trench along a new 1.4-m wide corridor.

#### 2.2.3.13 Ecological Domain 13

Domain 13 is the Southern Rocky Mountains-Colorado Plateau Domain. The Domain includes southern and eastern Utah, western Colorado, southeast Nevada and northeast Arizona, and much of New Mexico. The research focus for this domain is the alpine tundra ecosystem with a focus on urban, suburban, exurban, and rural land use intensities and contrasts.

Annual precipitation ranges from less than 20 mm in desert areas of the Colorado Plateau to more than 1,250 mm in the Rocky Mountains; annual maximum temperatures range from -7 ºC to 32 ºC.

There are two main physiographic provinces within Domain 13: the Colorado Plateau and the Basin and Range (USGS, 2009bb). The Middle Rocky Mountains provinces and the southern-most region of the Wyoming Basin province are also here (USGS, 2009bb). Topography in Domain 13 is characterized by large gradients, both west to east and south to north. Elevation ranges from below 1,000 m to over 4,000 m. Domain 13 is relatively stable from the standpoint of seismic risk, except for its northwestern portion. The maximum percent peak % pga with a 2 percent probability of occurrence in 50 years ranges from 12 % pga to 160 % pga for short wave motion and 4% pga to 40 % pga for long wave motion (USGS, 2009cc). The higher probability areas are near Provo and Salt Lake City in Utah.

#### Core Site

The location of the Core Site proposed for Domain 13 is within the Niwot Ridge (NWT) LTER Site in Colorado and is owned by several governmental entities and directly affiliated with the University of Colorado, Boulder. NWT encompasses 5,591 ha and includes an Ameriflux site in the Front Range of the Colorado Rocky Mountains. The proposed Core Site encompasses two adjacent watersheds, which are both gauged: Como Creek is a first-order stream with a 501-ha watershed and North Boulder Creek is a second-order stream with an 839-ha watershed. The area is high-elevation, ranging from 2,900 m to more than 4,100 m and is bounded on the west by the Continental Divide.

The proposed site includes alpine tundra, tree line ecotone, oligotrophic alpine lakes, high-elevation streams, and extensive forested areas with seasonal snowpacks. The three towers (C-37, C-38, and C-39, Figure 2.D13-1) would be located along Niwot Ridge in the Roosevelt National Forest, approximately 2.5 km west of Niwot Mountain. Common vegetation occurring at the proposed Core Site for Domain 13 includes subalpine forest, riparian forest and wetlands, and tundra (GES, 2003) with abundant variations depending upon slope and aspect. Natural runoff tends to be low to medium, with a low probability of landslides, debris flows, or avalanches except where steep slopes and unstable geology suggest increased landslide potential. The most sensitive habitats are riparian areas and tundra, where management and restoration are particularly challenging. Major uses are research, recreation, and wildlife habitat (USFS, 1996; USFS, 1997a).

Each tower associated with the Core Site would have a dedicated AP. The APs would be located near the existing electric and communication service lines. Each Core Site tower would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, located within 15 m of the base of the tower. Given the proximity of the three Core Site towers, only one offsite PCS powered by a photovoltaic system would be necessary. The PCS would be placed away from ecologically sensitive habitats, possibly near the side of the road, and painted prior to delivery to minimize visual impacts.

Advanced Tower C-37 would be 11 m in height and would be supported by four 1.1-m diameter concrete piers. Electrical and communication services for the Advanced Tower would be extended from County Road 116 up an existing, well maintained service road. From the service road, electric and communication lines would tie in to the AP and be supplied by underground lines approximately 169 m north to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 140 m west from the IH.

Basic Tower C-38 would be 51 m in height and it would be placed on a concrete pad measuring 3.05 m by 4.57 m. Electrical and communication services for the Basic Tower (C-38) would be extended from County Road 116 up an existing, well maintained service road. From the service road, electric and communication lines would tie in to the AP and be supplied by underground lines approximately 331 m northeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 140 m west from the IH.

Basic Tower C-39 would be 11 m in height and would be supported by four 1.1-m diameter concrete piers. Electrical and communication services for the Basic Tower would be extended from County Road 116 up an existing, well maintained service road. From the service road, electric and communication lines would tie in to the AP and be supplied by underground lines approximately 123 m north to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 140 m west from the IH.

### Relocatable Sites

Relocatable Sites proposed for Domain 13 include the Canyonlands Research Station (CRS) in Utah (R-25, Figure 2.D13-3) and the Fraser Experimental Forest (FEF) in Colorado (R-26, Figure 2.D13-2).

The CRS Relocatable Tower would be placed 3.2 km north of North Six-Shooter Peak at an elevation of approximately 1,525 m in San Juan County. CRS is a 400,000-ha site, affiliated with the USGS, the NPS, and the Bureau of Land Management (BLM) (CRS, 2009). The CRS also has close ties with Brigham Young University, Denver University, Colorado State University, the University of Colorado (Boulder), and Oregon State University (CRS, 2009). Plant communities at the proposed Moab Relocatable Site are representative of the Colorado Plateau and include:

- Lowland, alkaline flats dominated by greasewood, salt bush, and rabbitbrush.
- Grassland steppes dominated by native bunchgrasses, such as Indian ricegrass.
- Riparian zones with willow and cottonwood.
- Upland sites covered by blackbrush and sagebrush shrub.
- Piñon-juniper woodland dominated by Piñon pine and junipers.
- Farmland dominated by crops and pasture grasses.

Relocatable Tower R-25 would be 11 m in height and would be supported by four 1.1-m diameter concrete piers. Electric and communication service would originate at the AP, housing a 130-kW propane primary generator, on SR (State Road) 211 and would extend through underground lines approximately 37 m southwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 140 m west from the IH.

A 130-kW propane-powered primary generator would provide power to R-25. Three storage containers would be located at the AP. It is expected that two 3,785–liter and one 1,893-liter interconnected tanks would store approximately a 1-week supply of propane. The tanks would be refueled weekly through surface transport delivery.

The FEF Relocatable Tower would be placed along the St. Louis Trail at an elevation of approximately 3,525 m. The FEF is managed by the USFS and was established in 1937. A total of 9,324 ha are utilized as an outdoor research laboratory to study the effects of management practices on water yield and quality (USFS, 2009c). Common vegetation is representative of subalpine and alpine regions of the Colorado Rocky Mountains, not unlike that at the proposed Core Site for this domain. Native vegetation consists primarily of Engelmann spruce and also subalpine fir at higher elevations, on north slopes, and along streams. Lodgepole pine is the predominant tree at lower elevations and on drier upper slopes (Popovich, 1993).

Relocatable Tower R-26 would be 51 m in height and would be placed on a concrete pad measuring 3.05 m by 4.57 m. Electric and communication service would originate at the AP on an unnamed USFS road and would extend through underground lines approximately 37 m west to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 140 m northwest from the IH.

#### Aquatic Array

Two Aquatic Arrays (A-30 and A-31) are proposed for Domain 13. Aquatic Array A-30 (Figure 2.D13-1), would be located adjacent to the Core Site in the Roosevelt National Forest at North Boulder Creek just upstream of Silver Lake on property owned by the City of Boulder. The headwaters of North Boulder Creek (including Silver Lake) provide more than 40 percent of the city of Boulder's water supply (City of Boulder, 2007). The area is closed to public access and surrounding lands are in nearly natural conditions. These factors result in good water quality in surface waters. The North Boulder Creek watershed was mined intensively in the past for gold, silver, tungsten, and other metals. The ore deposits in the greater North Boulder Creek watershed usually contain small amounts of sulfides, so runoff from old mines and tailings piles is typically not acidic or metal-rich. Metal concentrations in North Boulder Creek, such as mercury and lead, are usually low (Murphy et al., 2003). North Boulder Creek is within the "airshed" of the Denver metropolitan area and receives atmospheric deposition of air pollutants, such as nitrates and sulfates (Williams and Tonnessen, 2000). Currently, North Boulder Creek meets all designated uses as defined by the USEPA (CDPHE, 2005). Electric and communication service would originate at the intersection of Highway 72 and County Road 116. Service lines would be placed in trenches separated by 1.4 m and co-located with CR-116. From the point of origin to the proposed Aquatic Array, service would be extended for approximately 2,190 m northwest.

Aquatic Array A-31 (Figure 2.D13-2) would be located on Fool Creek in the FEF. The water quality of Fool Creek is influenced by the same factors as discussed for North Boulder Creek. Even though this watershed is on public lands, the influence of land use activities, such as mining, clear-cutting, and grazing, on water quality have altered the condition of this watershed. Fool Creek is a headwater tributary to St. Louis Creek. The St. Louis Creek watershed, downstream of the proposed Fool Creek Aquatic Array, is considered at risk (Class II). The Class II designation by USFS means: "the watershed is functional, but condition is only fair. The watershed condition may be in a downward trend, or at risk of degradation, or not yet fully recovered from past damage. Recovery is considered feasible through natural processes with added protection or with minimal capital investments" (USFS, 1997b). Electric and communication service would originate on County Road 730, approximately 190.5 m northwest of the Aquatic Array. Service would be supplied by underground lines buried in separate trenches along a new 1.4-m wide corridor.

### 2.2.3.14 Ecological Domain 14

Domain 14 is the Desert Southwest (DSW) and extends north from the Mexico border across the states of New Mexico, Arizona, and California. It is defined by its seasonality of precipitation, which results in differential periods of water availability that define the three DSW deserts (the Mojave, the Chihuahuan, and the Sonoran). The Mojave is dominated by winter precipitation, the Chihuahuan by summer precipitation, and the

Sonoran is intermediate. The research focus for this domain is the desert ecosystem and impacts from urbanization.

All of the proposed Domain 14 NEON Sites are within the physiographic region known as the Basin and Range (USGS, 2009dd). Topography in Domain 14 is characterized by long mountain ranges separated by long, flat valleys (USGS, 2009dd). Much of the Basin and Range Province is fairly unstable in terms of seismicity. The maximum percent peak % pga with a 2 percent probability of occurrence in 50 years ranges from 4 % pga to 80 % pga for short wave motion and 8% pga to 320 % pga for long wave motion with the highest percentages occurring within and near California (USGS, 2009ee).

### Core Site

The Core Site proposed for Domain 14 is within the Santa Rita Experimental Range (SRER) in Arizona. The SRER encompasses 21,008 ha and is located mid-way within the domain approximately 50 km south of the rapidly developing Phoenix-Tucson Megapolitan area. The SRER was the first USDA facility dedicated to conducting research on dryland vegetation dynamics and land use impacts such as grazing. The advanced and both Basic Towers (C-40, C-41, and C-42, Figures 2.D14-1 and 2.D14-2) would be located within the SRER.

The SRER has winter and summer precipitation inclusive of both Mojave and Chihuahuan ecosystems. It includes both desert scrub and grassland vegetation, which together account for 90 percent of DSW vegetation. The SRER spans a gradient that extends from riparian/desert floor to coniferous forest. It is situated across multiple soil series and on geomorphic surfaces including fluvial bajadas, mountain fronts, and sky island mountains.

All three towers associated with the Core Site and both Relocatable Towers would be approximately 11 m in height and would be supported on four 1.1-m diameter concrete piers. All three towers associated with the Core Site, as well as both Relocatable Towers, would have an AP. The AP would be placed near the existing electric and communication service lines. Each Core Site tower and Relocatable Tower would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, located within 15 m of the base of the tower. Given the proximity of the three Core Site towers, only one offsite PCS powered by a photovoltaic system would be necessary. The portal container set would be placed away from ecologically sensitive habitats, possibly near the side of the road, and painted prior to delivery to minimize visual impacts.

Electrical and communication services for the Advanced Tower (C-40) would originate at the AP on Kolb Road and be supplied by underground lines approximately 256 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 151 m southeast from the IH.

Electrical and communication services for the Basic Tower (C-41) would originate at the AP on Road 411 and be supplied by underground lines approximately 581 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 151 m southeast from the IH.

Electrical and communication services for the Basic Tower (C-41) would originate at the AP on S. Helvetia Road and be supplied by underground lines approximately 500 m northwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 151 m southeast from the IH.

### Relocatable Sites

Relocatable Sites proposed for Domain 14 include the Jornada Basin (JB LTER) site in New Mexico and The Central Arizona - Phoenix Long-Term Ecological Research (CAP LTER Urban site in Arizona.

The JB LTER (R-27, Figure 2.D14-4) site is highly representative of the domain, has large spatial extent, a long-term history of research, existing sensor networks, baseline monitoring, and experimentation. The JB LTER is managed by the USDA and New Mexico State University. It is located approximately 25 km northeast of Las Cruces, New Mexico in north-central Doña Ana County. The vegetative composition in the JB LTER is similar to that of SRER. Typical vegetation for this region of the Chihuahuan Desert includes whitethorn acacia, viscid acacia, lechuguilla, New Mexico agave, desert marigold, stingleaf, Christmas cactus, desert rosemallow, and desert poppy (UTEP, 2009).

Electrical and communication services for the Relocatable Tower (R-27) would originate at the AP on County Road E080 and be supplied by underground lines approximately 183 m east to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 91 m southwest from the IH.

R-28 (Figure 2.D14-3) would be located on the CAP LTER in northwest Pinal County less than 325 m south of Weekes Wash. This location is on the eastern outskirts of metro-Phoenix. The City of Phoenix is currently home to over 1.5 million people and is one of the fastest growing cities in the U.S. (City of Phoenix, 2009). The CAP LTER is managed by Arizona State University (ASU) and was established to monitor the effects of urbanization on desert ecology by ASU students and researchers. Much of the CAP LTER is covered by exposed soil (CAP LTER, 2009a). Vegetation found near the proposed R-28 site at CAP LTER includes typical Sonoran Desert communities of creosote bush, triangle-leaf bursage, and brittle brush (CAP LTER, 2009a, 2009b, 2009c, 2009d). In riparian communities along perennial streams, common vegetation includes a thick cover of species such as Fremont cottonwood, Goodding's willow, Arizona sycamore, and saltcedar, an aggressive invasive species (CAP LTER, 2009e).

Electrical and communication services for the Relocatable Tower (R-28) would originate at the AP on North Ironwood Road and be supplied by underground lines approximately 133 m east to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 140 m east-southeast from the IH.

#### STREON Site

The STREON Site (S-33, Figure 2.D14-5) proposed for Domain 14 is Sycamore Creek, approximately 1 km upstream from Otero Canyon in Maricopa County, Arizona. Sycamore Creek is associated with the Lower Verde watershed in the Verde River Basin. The STREON Site is located in the southwest region of the Tonto National Forest, which is the fifth largest forest in the United States and is managed by the USFS. Sycamore Creek is a perennial stream and a major tributary of the Verde River (UofA, 2009a). Because of the limited amount of rainfall in the region, snowmelt from the northern mountains is a major source of water in Sycamore Creek. Sycamore Creek is not included on the Arizona CWA Section 303(d) list of impaired waters (ADEQ, 2004). Typical vegetation in Sycamore Creek's riparian corridor includes mesquites, acacias, saltcedar, foothills palo verde, Fremont cottonwood, Goodding's willow, and Arizona sycamore (UofA, 2009b). Beyond the riparian corridor, the vegetation is more typical of the desert communities described above (UofA, 2009b).

The STREON hut would measure 2.4 m by 2.4 m. It would connect to the existing power and communications system on Highway 87. The electric and communication service would be supplied by underground lines in trenches for approximately 487 m.

### 2.2.3.15 Ecological Domain 15

Domain 15, the Great Basin, ranges from southern Nevada extending to the east into Utah and Wyoming, west to the California/Nevada border, and north through southeastern Idaho, eastern Oregon, and eastern Washington to the border with Canada.

The climate characteristic of Domain 15 is cool moist air flowing westerly from the northern Pacific Ocean where it is intercepted by the Sierra Nevadas and the Cascades. These mountains create very dry conditions for the Intermountain Region. The overall climate of the Intermountain Region is arid to semiarid, with cool, moist winters and hot, dry summers. In the extreme northern and western parts of the domain, nearly all precipitation occurs from fall through spring. In southern and eastern parts of the domain, equal amounts of precipitation may fall in the winter and summer.

The Great Basin is located in the Intermountain Region between the Cascade and Sierra Nevada Mountains on the west and the Rocky Mountains on the east. Two main physiographic provinces are included in Domain 15: the Basin and Range and the Columbia Plateau (USGS, 2009ff). The topography of the Great Basin can be described as a series of parallel, alternating basins and mountain ranges that have no outlet to the sea. Scattered low mountains are key topographic characteristics of the Columbia Plateau. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 3% pga to 40% pga for short wave motion and 6% pga to 80%

pga for long wave motion, with the exception of small areas along the Nevada-California border where seismic activity is higher (USGS, 2009gg).

### Core Site

The proposed Core Site for Domain 15 is within the Onaqui-Benmore Experiment Station in southeast Tooele County, Utah. The proposed Core Site is 100 km southwest of Salt Lake City, Utah and is owned and managed by the BLM.

The Onaqui-Benmore site is characteristic of the Great Basin Domain climate, landforms, vegetation, disturbance regimes, and fauna. The Great Basin Domain climate is controlled by the mountains that surround most of the domain and is among the driest regions of the U.S. The climate of the Intermountain Region is arid to semiarid, with cool, moist winters and hot, dry summers. The three Core Site towers (C-43, C-44, and C-45, Figure 2.D15-1) for the Onaqui-Benmore site would be located in Rush Valley, north of the Pony Express Overland Stage Route, and near East Faucet Creek. The Advanced Tower would be approximately 2.4 km east of the Faucet Pony Express Station Historic Marker, and the two Basic Towers would be located 3.2 km east of the Advanced Tower.

The Core site has sagebrush steppe habitat that transitions into juniper woodland. The Advanced Tower (C-43) would be within the Wyoming big sage ecological type (NRCS 2009), which is dominated by sagebrush with a cheatgrass understory. Basic Tower C-44 would be located in an area burned at least once in the past that has been planted with crested wheatgrass. The predominant vegetation type in the area proposed for Basic Tower C-45 is juniper woodland with some sagebrush.

The Advanced Tower (C-43) and Basic Tower C-44 would be 11 m in height and Basic Tower C-45 would be 15 m in height. All three Core Site towers would be supported on four 1.1-m diameter concrete piers. All three towers associated with the Core Site, as well as both Relocatable Towers, would have an AP. The AP would be placed near the existing electric and communication service lines. Each Core Site tower and Relocatable Tower would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, typically located within 15 m of the base of the tower. Given the proximity of the three Core Site towers, only one offsite PCS powered by a photovoltaic system would be necessary. The portal container set would be placed away from ecologically sensitive habitats, possibly near the side of the road, and painted prior to delivery to minimize visual impacts.

Electrical and communication services for the Advanced Tower (C-43) would originate at the intersection of Faust Road and Highway 36. From the point of origin, the electric and communication lines would be placed in separate trenches underground and co-located to an existing unnamed road for approximately 2,333 m until reaching the AP. From the AP, service would be supplied by underground lines approximately 320 m southwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk to the Advanced Tower would extend approximately 140 m northwest from the IH.

Electrical and communication services for the Basic Tower (C-44) would continue for another 3,018 m west from the AP associated with the Advanced Tower (C-43) until reaching the Basic Tower (C-44) AP. From the AP, service would be supplied by underground lines approximately 102 m to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower (C-44) would extend approximately 318 m from the IH.

Electrical and communication services for the Basic Tower (C-45) would continue for another 3,589 m west from the AP associated with the Advanced Tower (C-43) until reaching the Basic Tower (C-45) AP. From the AP, service would be supplied by underground lines approximately 184 m southwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower (C-45) would extend approximately 140 m northwest from the IH.

#### Relocatable Sites

Relocatable Sites proposed for Domain 15 include Murray City, Utah (R-29, Figure 2.D15-2), a suburb of Salt Lake City, and the Red Butte Canyon site (R-30, Figure 2.D15-3) in northeast Salt Lake County, approximately 2.6 km northeast of the edge of the city.

The proposed Murray City Tower would be placed north of the Murray Parkway Golf Course and Riverview Park in an urban area that is wedged between an electric substation and a TV station. The site is privately owned and located less than 60 m north of a residential neighborhood. Murray City is a suburb of Salt Lake City. It was established by Morman pioneers in 1847 and in 2005 reported a population of 46,300 (Murray City, 2009). There is no native vegetation remaining at this location. Based on the most recent aerial imagery available, the existing vegetation at this location appears to be maintained grass, shrubs, and ornamental trees planted for privacy (GoogleEarth, 2009).

Relocatable Tower R-29 would be 15 m in height and supported by four 1.1-m diameter concrete piers. Electrical and communication services for the Relocatable Tower (R-29) would be extended from an existing source on Bullion Street, 99 m south to the AP. From the AP, service would be supplied by underground lines approximately 29 m east to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 34 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 55 m from the IH.

Red Butte Canyon is a fully protected USFS watershed with a history of ecological, aquatic, and climatic studies. This site contains both a stream and reservoir. Red Butte Canyon spans a 1,600-m to 2,300-m elevation gradient and is characteristic of Great Basin watersheds. The site is located along Red Butte Creek, northeast of Red Butte Reservoir. The Red Butte Canyon Relocatable Tower would be placed in the Red Butte Canyon Research Natural Area (RNA) of Utah. The lower canyon, where the proposed Relocatable Site (R-30) would be located, is dominated by cheatgrass and sagebrush, which transitions into a shrub woodland dominated by gamble oak and bigtooth maple (Ehleringer et al., 1992).

Relocatable Tower R-30 would be 26 m in height and supported by four 1.5-m diameter concrete piers. Electrical and communication services for the Relocatable Tower (R-30) would originate at the AP on Red Butte Canyon Road and be supplied by underground lines approximately 20 m northwest to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 292 m from the IH.

#### Aquatic Array

The Aquatic Array (A-35, Figure 2.D15-3) proposed for Domain 15 would be co-located with the Red Butte Canyon Relocatable Tower along Red Butte Creek. Common vegetation includes cheatgrass and sagebrush, which transitions into shrub woodland dominated by gamble oak and bigtooth maple in the immediate vicinity of the proposed Aquatic Array (A-35) site. The riparian zone is dominated by bigtooth maple, box elder, and water birch (Ehleringer et al., 1992). Water quality in Red Butte Creek meets Utah water quality standards for its designated uses. The water is strongly buffered from weathering of carbonate minerals. Concentrations of inorganic nitrogen species in stream water tend to be lower than those observed in precipitation, indicative of the pristine condition of the basin (USGS, 2000b). Electric and communication service would originate on Red Butte Canyon Road, approximately 35 m east of AP associated with Relocatable Tower R-30. From the road, service would be extended south by underground lines buried in a shared trench along a new 1.4-m wide corridor for approximately 32 m.

### 2.2.3.16 Ecological Domain 16

Domain 16 is the Pacific Northwest, which extends from northern California to southeast and southern Alaska. Warm, dry summers and mild, wet winters are common and strong west-to-east gradients of precipitation and temperature are controlled by the mountainous terrain, extending from the coastal fog belt to the dry east side of the mountains where conifer forests give way to drier vegetation types. The research focus for this domain is the ecologies of the west-side Pacific Northwest forests and impacts from silviculture.

Within the continental U.S., Domain 16 is within the Pacific Border physiographic province (USGS, 2009hh). The long peninsula of southwest Alaska lies within Domain 16. The Aleutian Range, an extension of the Alaska Range, extends southwestward along the peninsula. Some areas along the upper slopes of these southwestern mountain ranges are covered in glaciers (USGS, 2009hh).

Domain 16 is relatively unstable with regard to seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 12% pga to 260% pga for short wave motion and 10% pga to 165% pga for long wave motion, where the highest activity is expected along the California and Alaska coastlines (USGS, 2009ii, Wesson et al., 2007).

### Core Site

The proposed Core Site for Domain 16 is within the Wind River Experimental Forest (WREF) in Skamania County in southern Washington. The site was formally dedicated to scientific and educational use in 1932 and ecological research on WREF dates to 1908. The WREF totals 4,280 ha and is managed by the USFS Gifford Pinchot National Forest and Pacific Northwest Research Station for research and education in cooperation with the University of Washington.

The Advanced Tower (C-46) and Basic Towers (C-47 and C-48) would be placed west of the Wind River Information Center on the Gifford Pinchot National Forest. Advanced Tower C-46 (Figure 2.D16-1) would be approximately 0.8 km north of the Trout Creek Trailhead. Basic Tower C-47 (Figure 2.D16-1) would be approximately 1.0 km south of this trailhead. Basic Tower C-48 (Figure 2.D16-1) would be approximately 3.0 km west of this trailhead near the proposed location of Aquatic Array A-36, at Planting Creek in the Gifford Pinchot National Forest. The locations proposed for Advanced Tower C-46, and Aquatic Array A-36 would be in a protected research forest with a natural undisturbed old growth forest ecosystem in transition from Douglas-fir to western hemlock. Basic Tower C-47 would be in 100-year old forest naturally regenerating from fire. Basic Tower C-48 would be located in 40-year old second-growth forest. The dominant common vegetation on WREF includes Douglas-fir and western hemlock. Other common species include: Pacific silver fir, grand fir, western red cedar, and western white pine (Loescher, 2008). The understory at WREF is composed primarily of salal, Oregon grape, huckleberry, vine maple, bracken fern, vanilla leaf, queencup beadlily, beargrass, and twinflower (USFS, 2007). Proposed Advanced Tower C-46 would be in a 500-year-old forest stand dominated by Douglas-fir and western hemlock, with the tallest trees reaching 67 m (Organization of Biological Field Stations, 2009).

All three towers associated with the Core Site, as well as both Relocatable Towers, would have an AP. The AP would be placed near the existing electric and communication service lines as possible. Each Core Site tower and Relocatable Tower would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, typically located within 15 m of the base of the tower. Given the proximity of the three Core Site towers and both Relocatable Towers, only one offsite PCS powered by a photovoltaic system would be necessary. The portal container set would be placed away from ecologically sensitive habitats, possibly near the side of the road, and painted prior to delivery to minimize visual impacts.

The Advanced Tower (C-46) would be placed on the existing Canopy Crane, an 87-m tall research crane which is a research tool operated by the USFS and the University of Washington. No new tower would be constructed at the Advanced Tower site; however, an IH and AP would be placed at this site. Electric and communication services for the Advanced Tower would originate at the AP on National Forest Development Road 400 and be supplied by underground lines approximately 616 m north to the IH. The improved corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a new 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Advanced Tower would extend approximately 218 m from the IH.

Basic Tower C-47 would be 90 m in height and would be placed on a concrete pad measuring 8 m by 8 m. Electrical and communication services for the Basic Tower (C-47) would originate at Hemlock Road. From the point of origin, the electric and communication lines would be placed in separate trenches underground and co-located with National Forest Development Road 412 for approximately 4.8 km until reaching the AP. From the AP, service would be supplied by underground lines approximately 137 m north to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 140 m northwest from the IH.

Basic Tower C-48 would be 90 m in height and would be placed on a concrete pad measuring 8 m by 8 m. Electrical and communication services for the Basic Tower (C-48) would originate at the intersection of National Forest Development Roads 4306 and 4309. From the point of origin, the electric and communication lines would be placed in separate trenches underground and co-located with National Forest Development Road 4309 for approximately 2.6 km until reaching the AP. From the AP, service would be supplied by underground lines approximately 186 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Basic Tower would extend approximately 140 m northwest from the IH.

### Relocatable Sites

Relocatable Sites proposed for Domain 16 include Thyme Unit 1 (R-32, Figure 2.D16-3) and Good Seed Unit 2 (R-31, Figure 2.D16-2). Thyme Unit 1 is located 2.6 km south of Elkhorn Mountain and Good Seed Unit 2 is approximately 2.9 km east-southeast of Dole, Washington. Both of these locations are in maturing forest between 50 and 60 years of age, within the Gifford Pinchot National Forest. Both proposed Relocatable Towers would be in stands dominated by Douglas-fir, with small components of western red-cedar, western hemlock, Pacific silver fir, red alder, and big leaf maple occurring in natural openings and along larger streams. The understory is composed primarily of salal, salmonberry, blackberry, sword fern, huckleberry, vine maple, bracken fern, maidenhair fern, Oregon oxalis, and vanilla leaf (WDNR, 2006 and WDNR, 2001).

Relocatable Tower R-31 would be 90 m in height and would be placed on a concrete pad measuring 8 m by 8 m. Electrical and communication services for Relocatable Tower (R-31) would originate on Forest Road L1210. From the point of origin, the electric and communication lines would be placed in separate trenches underground and co-located with a cleared path for approximately 6 m until reaching the AP. From the AP, service would be supplied by underground lines approximately 61 m northeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 140 m east-northeast from the IH.

Relocatable Tower R-32 would be 90 m in height and would be placed on a concrete pad measuring 8 m by 8 m. Electrical and communication services for the Relocatable Tower (R-32) would originate at the AP on NE Vinemaple Road and be supplied by underground lines approximately 1.6 km southeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 140 m northwest from the IH.

#### Aquatic Array

The proposed Aquatic Array (A-36, Figure 2.D16-1) would be south of the proposed location of Basic Tower C-48 on Planting Creek, a tributary to Trout Creek in the Gifford Pinchot National Forest. Trout Creek is on the Washington CWA Section 303(d) list of impaired waters for elevated levels of fecal coliform bacteria, elevated temperature, low concentrations of dissolved oxygen, and pH (NRCS, 2006).Vegetative communities surrounding A-36 would be similar to those identified near the Core Site tower locations. The Aquatic Array would require a dedicated offsite PCS powered by a photovoltaic system because it is not near any of the towers. The portal container set would be placed away from ecologically sensitive habitats, possibly near the side of the road, and painted prior to delivery to minimize visual impacts. Electric and communication service would originate at the IH associated with C-48. From the IH, service would be extended southeast by underground lines buried in a shared trench along a new 1.4-m wide corridor for approximately 162 m.

#### STREON Site

The location of the proposed STREON Site (S-37, Figure 2.D16-4) for Domain 16 is in Watershed 2 of the H.J. Andrews Experimental Forest in northeast Lane County, Oregon, approximately 1.2 km northeast of the H.J. Andrews Monument. The Andrews Forest contains a fifth-order stream network that feeds into the McKenzie River, which forms a neatly increasing gradient of stream size to the Pacific. The sequence of stream and riparian conditions and processes here is representative of many mountain-to-lowland river gradients across the western U.S.

The STREON hut would measure 2.4 m by 2.4 m. It would connect to the existing power and communications system on National Forest Development Road 1506. The electric and communication service would be supplied by underground lines in separate trenches for approximately 1,000 m. Lines would be co-located with National Forest Development Road 300.

### 2.2.3.17 Ecological Domain 17

Domain 17 is the Pacific Southwest and is entirely within the state of California. It extends from the Baja California border to the Shasta National Forest, excluding the southeastern desert and the northwestern mountains. There are significant contrasts in the climate of Domain 17, largely due to the physiographic diversity within this region. The domain includes the California Coastal Range, the Central Valley, and the Sierra

Nevada Mountains. It also includes the California Trough and the Lower California Province (USGS, 2009jj).

The climate of central coastal California is Mediterranean, characterized by wet, cool winters and dry, hot summers (USGS, 2009jj). Along the Pacific Border, the climate is considered Temperate-Oceanic: adequate annual precipitation and mostly cloudy conditions with moderate summers and mild winters (USGS, 2009jj). The final major climatic division in Domain 17 is the Highland-Altitude. It is characteristic of the Sierra Nevadas and the Cascades. Highland-Altitude climate brings heavy rain and snow to the mountains and accounts for significant temperature ranges between day and night (USGS, 2009jj).

Domain 17 is unstable with regard to seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 32% pga to 320% pga for short wave motion and 14% pga to 80% pga for long wave motion, where the highest activity is expected along the coastline (USGS, 2009kk).

### Core Site

Proposed Basic Tower C-51 (Figure 2.D17-1) would be 1.6 km south-southwest of Courtright Reservoir, in the Sierra National Forest in central Fresno County, less than 20 km from the proposed Basic Tower C-50. Proposed Basic Tower C-50 (Figure 2.D17-2) would be within the Kings River Experimental Watershed (KREW) in the San Joaquin Experimental Range of California (SJER). The SJER was established in 1934 for the study of land management in Fresno County. After multiple land expansions, the SJER now encompasses approximately 1,839 ha and is managed cooperatively by the Pacific Southwest Research Station, the Regents of the California, Division of Agriculture and Natural Resources, and the Agricultural Foundation of California State University, Fresno (USFS, 2009c). Proposed Advanced Tower C-49 (Figure 2.D17-3) would be located 1.1 km southwest of Glen Meadow Creek in the Sierra National Forest in western Madera County.

Vegetation at the proposed Core Site tower locations (C-49, C-50, and C-51) is characterized as a mosaic of grasslands, oak-pine woodland, and chaparral shrubs. The canopy cover is sparse and the climate results in an open understory. Dominant tree species include blue oak, interior live oak, and foothill pine. Chaparral shrub species grow either individually or in thick clumps. Common species include wedgeleaf ceanothus, chaparral whitethorn, holly-leaf coffeeberry, hoary coffeeberry, and Mariposa manzanita. Grasslands generally dominate areas with thin overstory and consist primarily of perennial grasses, annual grasses, rushes and sedges, and native forbs (Purcell et al., 2007).

All three towers associated with the Core Site, as well as both Relocatable Towers, would have an AP. The AP would be placed near the existing electric and communication service lines as possible. Each Core Site tower and Relocatable Tower would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, typically located within 15 m of the base of the tower. Given the proximity of the three Core Site towers and both Relocatable Towers, only one offsite PCS powered by a photovoltaic system would be necessary. The portal container set would be placed away from ecologically sensitive habitats, possibly near the side of the road, and painted prior to delivery to minimize visual impacts.

Advanced Tower C-49 would be 20 m in height and would be supported on four 1.5-m diameter cast-in-place concrete piers. Electrical and communication services for C-49 would originate at the intersection of Road 8063 and an unnamed road. From the point of origin, the electric and communication lines would be placed in separate trenches underground and co-located with the unnamed road for approximately 1.86 km until reaching the AP. From the AP, service would be supplied by underground lines approximately 30 m northeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Tower (C-49) would extend approximately 140 m northwest from the IH.

Basic Tower C-50 would be 40 m in height and would be placed on a concrete pad measuring 3.05 m by 3.66 m. Electrical and communication services for C-50 would originate at the intersection of Dinky Creek Road and Providence Creek Road. From the point of origin, the electric and communication lines would be placed in separate trenches underground and co-located with Providence Creek Road and an unnamed road for approximately 2.9 km until reaching the AP. From the AP, service would be supplied by underground lines approximately 69 m south to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for C-50 would extend approximately 140 m northwest from the IH.

Basic Tower C-51 would be 40 m in height and would be placed on a concrete pad measuring 3.05 m by 3.66 m. Electrical and communication services for C-51 would originate at the intersection of Courtwright Way and an unnamed access road. From the point of origin, the electric and communication lines would be placed in separate trenches underground and co-located with the unnamed road for approximately 2.6 km until reaching the AP. From the AP, service would be supplied by underground lines approximately 38 m northeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for C-51 would extend approximately 140 m northwest from the IH.

### Relocatable Sites

The Relocatable Sites proposed for Domain 17 are also in Fresno County within the Sierra National Forest. One Relocatable Site (R-33, Figure 2.D17-4) would be placed in the KREW -Providence 400 m north of Soaproot Saddle in the Shaver Lake Quadrangle, less than 7 km southwest of proposed Basic Tower C-50

Relocatable Tower R-33 would be 51 m in height and would be placed on a concrete pad measuring 3.05 m by 4.57 m. Electrical and communication services for the Relocatable Tower (R-33) would originate on Big Creek Road. From the point of origin, the electric and communication lines would be placed in separate trenches underground and co-located with Big Creek Road and an existing access path for 3.2 km until reaching the AP. From the AP, service would be supplied by underground lines approximately 32 m northeast to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 140 m east-northeast from the IH.

The second Relocatable Site (R-34, Figure 2.D17-5) would be placed at Patterson Mountain in the Teakettle Experimental Forest (TEF), Sierra National Forest. TEF is a 1,300-ha experimental forest that was established in the 1930s for the purpose of studying watershed management issues (USFS, 2009d). The TEF is located at higher elevations in the Sierra National Forest where the vegetation community is predominantly coniferous. Dominant species include red fir, white fir, sugar pine, Jeffery pine, Western white pine, California incense-cedar, mountain hemlock, and Western juniper. Isolated wet and dry meadow habitats are also present. Common wet meadow species include California false hellebore, arrowleaf ragwort, and bigleaf lupine. Dry meadows are dominated by Bolander's milkvetch (USDA, 1990; Griffin, 1975).

Relocatable Tower R-34 would be 60 m in height and would be placed on a concrete pad measuring 3.05 m by 4.57 m. Electrical and communication services for the Relocatable Tower (R-34) would originate at a power pole on McKinley Grove Road. From the point of origin, the electric and communication lines would be placed in separate trenches underground and co-located with McKinley Grove Road and an unnamed access road for approximately 10.8 km until reaching the AP. From the AP, service would be supplied by underground lines approximately 104 m east to the IH. The corridor would be approximately 1.2 m wide. Electric and communication lines would then be co-located with a 1.5-m wide boardwalk, which would be installed for access from the IH to the tower and associated arrays. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The boardwalk for the Relocatable Tower would extend approximately 140 m east-northeast from the IH.

### Aquatic Array

The proposed Aquatic Array (A-39, Figure 2.D17-2) for KREW is on Providence Creek in the Sierra National Forest, which flows into Big Creek, a tributary of the Kings River. The Aquatic Array would be approximately 2 km south-southwest of the proposed Advanced Tower (C-50). Big Creek flows into the Kings River at the Pine Reservoir. The streams in this area meet their designated uses and none are included on the California CWA Section 303(d) list of impaired waters. Electric and communication service would originate at the AP associated with Core Site Tower C-53. From the AP, service would be extended southwest by underground lines buried in separate trenches and co-located with an unnamed road for approximately 6.9 km.

### STREON Site

The proposed STREON Site (S-40, Figure 2.D17-5) for Domain 17 is on Teakettle Creek in the TEF near Shaver Lake, California, which is located in the Kings River drainage of the Sierra National Forest. The STREON Site would be approximately 2 km south-

southeast of the proposed Relocatable Tower (R-34). The streams in this area meet their designated uses and none are included on the California CWA Section 303(d) list of impaired waters.

The STREON hut would measure 2.4 m by 2.4 m. It would connect to the existing power and communications system on McKinley Grove Road. The electric and communication service would be supplied by underground lines in separate trenches. Electric lines would extend approximately 8.7 km and communication lines would extend approximately 5.5 km. Lines would be co-located with McKinley Road and an unnamed access road.

#### 2.2.3.18 Ecological Domain 18

Domain 18 is the Tundra of northern Alaska. It is typically referred to as "arctic tundra" because it lies above the Arctic Circle. It includes western and northern Alaska. This domain is characterized by areas of poorly drained, treeless plains interspersed with thaw ponds, lakes, rolling hills, and plateaus grading from the coastal plain to the uplifted sedimentary rock of the Brooks Range to the south. This area receives so little precipitation that it is described as a cold desert. The arctic tundra is underlain by permafrost.

Domain 18 has a low Arctic climate with an average annual temperature of -8°C. During warmer summer months, the temperature may reach 10°C; and, in the coldest months of winter, temperatures average -20°C. Snow accumulations may reach depths of 30 cm (Arctic LTER Project at Toolik Lake, 2007).

The topography and geology of Domain 18 are uniform from west to east because the Lisburne Limestone Formation appears at the surface along the front of the Brooks Range from the Beaufort Sea on the west to the Canadian Border on the east (Arctic LTER Project at Toolik Lake, 2007). The Brooks Range is the northern terminus of the Rocky Mountains. The arctic tundra is much more stable in terms of seismicity than the remainder of Alaska. Throughout Domain 18 the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 3% pga to 29% pga for short wave motion and 3% pga to 64% pga for long wave motion, where the highest activity is expected along the Brooks Range (Wesson et al., 2007).

#### Core Site

The proposed Core Site for Domain 18 is within the 31,335-ha Toolik Lake RNA. This BLM property was established for scientific research and is administered by the University of Alaska.

The University of Alaska Toolik Field Station (TFS) is located within the Toolik Lake RNA, and provides year-round infrastructure and logistics support for research, including laboratory space, housing, meal service, electric power, water, heat, communications, shipping, receiving and storage, and waste disposal (including hazardous materials disposal).

The Toolik Lake RNA supports a mixture of characteristic tundra vegetation types, including wet sedge tundra (characteristic of the coastal plain), riparian shrub tundra, and dry heath tundra (characteristic of the Brooks Range mountains) (Bret-Harte et al., 2008). This area includes both acidic and non-acidic tundra. Tussock tundra is widespread and occurs primarily on level or gently rolling lowlands (Walker et al., 1994).

The Advanced Tower (C-52, Figure 2.D18-1) would be located at the headwaters of the Kuparuk and Toolik Rivers, approximately 0.8 km north of the Trans-Alaska Pipeline and 1.6 km south of Winter Road. Tussock tundra occurs on older, more acidic soil profiles, such as at the proposed Advanced Tower (C-52) location. Tussock tundra sites are typically dominated by cottongrass with a mixture of dwarf shrubs, including dwarf birch, marsh Labrador tea, tealeaf willow, blueberry, and mosses (Walker et al., 2003). Non-acidic vegetation grows on the youngest soils, which lack dwarf birch and tussocks (Arctic LTER Project at Toolik Lake, 2007).

The Advanced Tower would be 11 m in height and would be supported by galvanized helical piers. A 1.5-m wide boardwalk would be installed for access from Highway 11 to the AP and continuing northeast to the IH, tower, and associated arrays. From the AP, the electrical and communication lines would extend approximately 15 m to the tower. The new boardwalk for the Advanced Tower would then extend another 140 m northeast from the IH. A 100-kW diesel powered primary generator, with automatic transfer switch, would be provided at the AP, providing power to the Advanced Tower. Three containers would be provided at the associated AP. A double-walled 9,500-liter diesel storage tank would be provided at the associated AP. The tank would be refueled approximately every 2 weeks through surface transport delivery.

Basic Tower C-54 (Figure 2.D18-2) would be approximately 1 km northeast of Toolik Lake. More diverse vegetation occurs on non-acid soils, such as those occurring at the proposed location of C-54, where sedges and dwarf shrubs (prostrate shrub tundra) would typically dominate with a variety of other species also present, including Bostock’s minerslettuce, weasel snout, glacier avens, naked-stem wallflower, two-flowered cinquefoil, and narrowleaf saw-wort (Walker et al., 1994).

Basic Tower C-53 (Figure 2.D18-2) would be approximately 1 km south of Toolik Lake. Proposed Basic Tower C-53 would be placed on an intermediate-aged glacial substrate with acidic soils, which primarily supports a moist or wet low shrub community, also called shrub tundra. Shrub tundra typically supports resin birch, Labrador tea, American green alder, mountain alder, and grayleaf willow (Tape et al., 2006).

Basic Towers C-53 and C-54 would both be 11 m in height and would be supported by galvanized helical piers. Electrical and communication services for the Basic Towers would originate at an AP located between the two towers that would receive power from the generator at the Advanced Tower. From the AP, the electric and communication lines would be pole mounted and co-located with a new 1.5-m wide boardwalk. Service lines would extend from the AP 1,414 m south to Basic Tower C-53. Lines would also extend 2,836 m north to Basic Tower C-54.

From the IH associated with both Basic Towers (C-53 and C-54), the electrical and communication lines would extend approximately 15 m to the tower. The new boardwalks for the Basic Towers would then extend another 140 m east from their respective IHs.

### Relocatable Site

Domain 18 would have only one Relocatable Tower approximately 100 km northeast of the Core Site. The location of the proposed Relocatable Site (R-35, Figure 2.D18-3) for Domain 18 is along the Sagavanirktok River approximately 4 km southwest of its confluence with the Ivishak River in North Slope County. The proposed location for R-35 is within the Alaska State Forest on land managed by the USFS. The sea is approximately 95 km north of R-35. The landscape at this site is similar to that of the Core Site, consisting mainly of low-lying tundra and permafrost.

The Relocatable Tower would be 11 m in height and would be supported by galvanized helical piers. Electrical and communication service lines would be co-located with a new boardwalk used for accessing Tower features. The service lines and new boardwalk would stretch from the AP to the IH. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. The new boardwalk for the Relocatable Tower would then extend another 140 m east from the IH. A 100-kW diesel-powered primary generator, with automatic transfer switch, would be provided at the AP, providing power to the Relocatable Tower. A double-walled 9,500-liter diesel storage tank would also be located at the AP. The tank would be refueled approximately every 2 weeks through surface transport delivery.

### Aquatic Array

Toolik Lake is the proposed location for the Aquatic Array site (A-42, Figure 2.D18-2) for Domain 18. The Aquatic Array would be located on the lake between the two Basic Towers (C-53 and C-54). Any groundwater wells would be located within the Toolik Lake thaw bulb the area around the periphery of the lake where permafrost does not occur).

Primary productivity in coldwater aquatic systems is exceedingly low, and Domain 18 waters are no exception. Most photosynthesis occurs from diatoms attached either to the rocks of the stream bottom or other submerged substrates (The Arctic LTER Project at Toolik Lake, 2007). Toolik Lake has a maximum depth of 25 m and an area of 1.5 $km^2$. Numerous small lakes are located in moraines near Toolik Lake. All the lakes are ultra-oligotrophic, with both nitrogen and phosphorus at limiting concentrations (The Arctic LTER Project at Toolik Lake, 2007). Electric and communication service would originate at the Toolik Field Station and service lines shared by Core Site Towers C-53 and C-54 would also be extended to support this Aquatic Array. 1,404 m of pole mounted power and communication lines would be extended northwest to the Aquatic Array from the lines supporting C-53. Additionally, a new 1.5-m wide, 425-m long boardwalk would be extended from the existing boardwalk due north to the Aquatic Array.

### STREON Site

The proposed STREON Site (S-43, Figure 2.D18-1) for Domain 18 is the Kuparuk River of the Toolik LTER in Alaska, near the crossing of the Trans-Alaska Pipeline. Any groundwater wells would be located within the thaw bulb of the Kuparuk River.

The STREON Site would be approximately 2 km southwest of the Advanced Tower (C-52). The landscape around the proposed STREON Site is tussock tundra. Tussock tundra sites are typically dominated by cottongrass with a mixture of dwarf shrubs, including dwarf birch, marsh Labrador tea, tealeaf willow, blueberry, and mosses

(Walker et al., 2003). Non-acidic vegetation grows on the youngest soils, which lack dwarf birch and tussocks (Arctic LTER Project at Toolik Lake, 2007). No streams or lakes at or near proposed NEON infrastructure in Domain 18 are included on the Alaska CWA Section 303(d) list of impaired waters. All surface waters in these areas meet their designated uses (Alaska Division of Water Quality, 2008).

The STREON hut would measure 2.4 m by 2.4 m. The STREON site would utilize power from the AP associated with the Advanced Tower. The pole-mounted electric and communication lines would extend from the AP southwest for approximately 1,881 m. Additionally, due to the lack of existing access roads, a 1.5-m wide boardwalk would be constructed from Highway 11 south for 91 m to the STREON Site.

#### 2.2.3.19 Ecological Domain 19

Domain 19 is the Taiga in Alaska. Wildfire is prevalent throughout the domain, and produces a mosaic of successional communities, including herbaceous and scrub communities, broadleaf forest, coniferous forest, and mixed forest. The Upper Yukon Taiga-meadow Province has an average annual precipitation of 155 to 355 mm and an average air temperature between -10º C and -4º C.

There is a moderate risk of seismic activity within Domain 19. The maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 21% pga to 85% pga for short wave motion and 10% pga to 61% pga for long wave motion (Wesson et al., 2007). There is an isolated area with higher probability of seismic activity within proximity to the Alaska Range (Wesson et al., 2007).

##### Core Site

The proposed Core Site for Domain 19 is within the Caribou Flats-Poker Creek Watershed (CFPCW). The CFPCW is a nearly pristine, 104-km$^2$ basin used for meteorological, hydrologic, and ecologic research. Hydrologic data have been collected since 1969, with short-term ecological studies conducted on a variable schedule. Access is controlled by a gated bridge across the Chatanika River. At present, the State of Alaska owns the property, but the property will be transferred to the University of Alaska by the close of 2010 as part of a 102,000-ha land grant from the state.

Three Core Site Towers (C-55, C-56, and C-57, Figure 2.D19-1) would be placed at the confluence of Caribou Creek and Little Poker Creek spaced less than 0.8 km apart. The proposed Advanced Tower (C-55) is underlain by permafrost. This site is north of milepost 30 on the Steese Highway. The STREON Site for Domain 19 (S-46) is proposed for this same area, on Caribou Creek just above its confluence with Little Poker Creek. The proposed STREON Site also is underlain by permafrost.

The vegetation structure at the proposed Core Site and STREON Site on the Caribou-Poker Creek Research Watershed (CPCRW) is typical of interior Alaska. The major vegetation groups are closed and open coniferous forest, coniferous woodland, open and closed deciduous forest, closed mixed forest, closed tall shrub, shrub tundra, and tussock tundra (Jones et al., 2008). The majority of coniferous forest habitat is composed of black spruce. Scattered white spruce occurs on south-facing slopes with drier soils. Approximately one-third of the vegetation on the CFPCW, where the Core Site and STREON Site would be located, is black spruce forest, primarily on north-facing slopes (Jones et al., 2008). The majority of the area is dominated by birch and quaking aspen forests with areas of green alder. The level areas adjacent to streams are occupied by communities of tussock tundra dominated by stair-step moss, Schreber's feather moss, and sphagnum mosses.

The three Core Site towers and Relocatable Tower R-37 would receive power from one centrally located AP. The AP would receive power by extending an existing electrical transmission line originating at Highway 6, approximately 3.7 km south of the AP.

The Advanced Tower would be 18 m in height and would be supported by galvanized helical piers. Electrical and communication services for the Advanced Tower would originate at the AP. From the AP, 1,023 m of pole mounted electric and communication line would be extended west to the IH. Service lines would be co-located with a 1.5-m wide walkway; 288 m of this walkway would be new. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. A new boardwalk for the Advanced Tower would then extend 140 m northwest from the IH to allow access to the tower and associated arrays.

Basic Tower (C-56) would be 26 m in height and would be supported by galvanized helical piers. Electrical and communication services for the Basic Tower would originate at the AP. From the AP, 735 m of the pole mounted electric and communication line utilized for the Advanced Tower would also service Basic Tower C-56. An additional 192 m would be extended north, alongside a new 1.5-m wide path, to the IH. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. A new boardwalk for the Basic Tower would then extend 140 m northwest from the IH to allow access to the tower and associated arrays.

Basic Tower (C-57) would be 37 m in height and would be supported by galvanized helical piers. Electrical and communication services for the Basic Tower would originate at the AP. From the AP, the 1,023 m of the pole mounted electric and communication line utilized for the Advanced Tower would also service Basic Tower C-57. An additional 287 m would be extended south of the Advanced Tower, alongside a new 1.5-m wide path, to the IH. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. A new boardwalk for the Basic Tower would then extend 140 m northwest from the IH to allow access to the tower and associated arrays.

### Relocatable Sites

Four Relocatable Sites (R-36, R-37, R-38, and R-41) are proposed for Domain 19. R-36 (Figure 2.D19-2) would be placed in an area of well-drained black spruce forest south of the Fort Greely Military Reservation near Delta Junction on BLM land. Relocatable Tower R-36 would be 18 m in height and would be supported by galvanized helical piers. Electrical and communication services for the Relocatable Tower would originate at Golden Valley Electrical Association (GVEA). Electric and communication lines would be extended south 4.5 km, along an existing path, from the GVEA to the AP. From the AP, 966 m of pole mounted electric and communication line and a new 1.5-m wide pathway would be extended east to the IH. From the IH, the electrical and communication lines would extend approximately 15 m to the tower beneath the new boardwalk. A new boardwalk for the Relocatable Tower would extend approximately 140 m southeast from the IH to allow access to the tower and associated arrays.

R-37 (Figure 2.D19-1) is proposed for a black spruce forest site above Poker Creek in the CFPCW located north of Steese Highway and approximately 2 km northeast of the Core Site. Relocatable Tower R-37 would be 20 m in height and would be supported by galvanized helical piers. Electrical and communication services for the Relocatable Tower would originate at the AP. From the AP, 492 m of pole mounted electric and communication line would be extended north along an existing trail. Additionally, new service lines would be extended 1400 m east which would be co-located with a 1.5-m wide newly constructed walkway to the IH. From the IH, the electrical and communication lines would extend approximately 15 m to the tower. A new boardwalk for the Relocatable Tower would then extend 140 m northwest from the IH to allow access to the tower and associated arrays.

R-38 (Figure 2.D19-4) is proposed for an area of black spruce east of the City of Healy and just outside the Denali National Park on land managed by the USFS (Alaska State Forest) The R-38 site would be in an area interspersed with a series of creeks that drain into the Nenana River just north of Healy. Relocatable Tower R-38 would be 18 m in height and would be supported by galvanized helical piers. Electrical and communication services for the Relocatable Tower would originate approximately 1,450 m west on Stampede Trail Road. Electric and communication lines would be extended aboveground along a new 1,450 m corridor to the AP. From the AP, 2,254 m of pole mounted electric and communication line and a new 1.5-m wide pathway would be extended southwest to the IH. From the IH, the electrical and communication lines would extend approximately 15 m to the tower beneath the new boardwalk. A new boardwalk for the Relocatable Tower would extend approximately 140 m north from the IH to allow access to the tower and associated arrays.

R-41 (Figure 2.D19-3) would be approximately 500 km southwest of the Core Site and near the center of the Kenai Peninsula in the Kenai National Wildlife Refuge, which is managed by the USFWS. R-41 would be just north of a tributary to Pieuie Lake. R-41 is approximately 77 km south-southwest of Anchorage. Relocatable Tower R-41 would be 40 m in height and would be supported by galvanized helical piers. Electrical and communication services for the Relocatable Tower would originate at the intersection of Sterling Highway and Mystery Creek Road. Electric and communication service would be extended aboveground on pole mounted lines co-located with Mystery Creek Road, 2,730 m north, until reaching the AP. From the AP, 1,076 m of pole mounted electric and communication line and a new 1.5-m wide pathway would be extended east to the IH. From the IH, the electrical and communication lines would extend approximately 15 m to the tower beneath the new boardwalk. A new boardwalk for the Relocatable Tower would extend approximately 140 m southwest from the IH to allow access to the tower and associated arrays.

### STREON Site

The proposed STREON Site (S-46, Figure 2.D19-1) of Domain 19 would be at the confluence of Caribou Creek and Little Poker Creek in the CFPCW, less than 1 km southwest of the proposed Core Site tower locations. The proposed STREON Site also is underlain by permafrost. Vegetation characteristics at the proposed STREON Site are identical to those described at the Core Site. Any groundwater wells would be located within the thaw bulb of Caribou Creek and Little Poker Creek.

The STREON hut would measure 2.4 m by 2.4 m. Electrical and communication services for the STREON would originate at the Core Site AP. From the AP, 735 m of the pole mounted electric and communication line utilized for the Advanced Tower would also service the STREON. An additional 1,100 m would be extended west, then south alongside an existing path that would need to be extended 180 m south to the STREON hut.

#### 2.2.3.20 Ecological Domain 20

Domain 20 is the Pacific Neotropical in Hawaiʻi. The islands of the state of Hawaiʻi make up all of Domain 20. The Hawaiʻi Experimental Tropical Forest (HETF) is an overlay on state land designations of the Laupāhoehoe Natural Area Reserve (LNAR), the Laupāhoehoe Section of the Hilo Forest Reserve, the Puʻu Waʻawaʻa Forest Reserve, and the Puʻu Waʻawaʻa Forest Bird Sanctuary The Laupāhoehoe Experimental Tropical Forest (LETF) within HETF includes the Laupāhoehoe Section of the Hilo Forest Reserve (1,800.5 ha) and the Laupāhoehoe Natural Area Reserve (3,194.5 ha) administered by the Hawaiʻi Department of Land and Natural Resources. The Puʻu Waʻawaʻa Forest Reserve and the Puʻu Waʻawaʻa Forest Bird Sanctuary make up the Puʻu Waʻawaʻa Section of the HETF. The HETF was recently created through a cooperative agreement between the Department of Land and Natural Resources Division of Forestry and Wildlife (DLNR-DOFAW) and the USFS. The subject area is The LETF and PWETF are recently created State-owned properties. A Master Plan for these areas is being developed. Until the Master Plan is complete, specific conservation actions, trails and other public use, road improvements, and other aspects of forest management will not be defined. In developing the Master Plan, the State will consider the development and long-term operation of NEON projects.

The climate of the Hawaiʻian Islands is divided into seven regions. Of these seven regions, three are characteristic of the Island of Hawaiʻi.

- Windward Lowlands – Usually on the north or northeast side of the islands below 610 m, mild, uniform temperatures with frequent trade wind showers (WRCC, 2009).
- The Kona Coast of Hawaiʻiʻ – Specific to the island of Hawaiʻiʻ. Summer rainfall exceeds winter rainfall in this region. This region receives well developed land and sea breezes and during the summer there is a high frequency of late afternoon/early evening showers (WRCC, 2009).
- High Mountains – Climate region characteristic of elevations above 600 to 900 m. Rainfall decreases as elevations increase, skies are typically clear with low humidity, and temperatures have been known to dip below freezing at times (WRCC, 2009).

The islands of Hawaiʻi extend northwestward and become progressively older in that direction. The volcanoes form the Hawaiʻian Ridge over a hot spot in the earth's mantle where the earth's crust beneath the Pacific Ocean moves in a northwestward direction (USGS, 2009ll). The island of Hawaiʻiʻ was formed by five volcanoes whereas most of the eight main Hawaiʻian islands are composed of a single volcano (USGS, 2009ll). Due to their broad, flat dome, Hawaiʻi's volcanoes are called "shield volcanoes" (USGS, 2009ll). The probability of seismic activity decreases the further west the island is located. From the southeastern coast of the island of Hawaiʻiʻ to the northwestern coast of the island of Oʻahu, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 400% pga to 60% pga for short wave motion and 150% pga to 20% pga for long wave motion (USGS, 1998).

No Aquatic Arrays are proposed for Domain 20. The Core Site and Relocatable Sites proposed are described below.

### Core Site

Only an Advanced Tower (C-58, Figure 2.D20-1) would be placed in the LETF Core Site. No Basic Towers would be placed in the Domain 20 Core Site. The Advanced Tower would be on the northeast side of the island of Hawai'i' on the northern slopes of Mauna Kea Volcano. Advanced Tower C-58 would be placed in the Koa-'Ohi'a Montane Wet Forest.

Koa-'Ohi'a Montane Wet Forest occurs in areas from approximately 914-m to 1,372-m elevations. The koa and 'ohi'a trees grow to approximately 30 m tall and form a mixture of closed and open canopy. This community type differs from the Koa-'Ohi'a Lowland Wet Forest in the species composition of the subcanopy. Trees in the secondary tree layer include a well-developed subcanopy of tree ferns (*Cibotium glaucum, C. chamissoi*, and *C. Hawai'iense*) as well as 'olapa, kawa'u, kolea (*Myrsine lessertiana*), and pilo (*Coprosma rhynchocarpa* and *C. pubens*). The understory consists of native shrubs such as 'ohelo kau la'au, 'akala (*Rubus Hawai'insis*), *Cyrtandra* spp., *Clermontia parviflora*, mamaki (*Pipturus albidus*), manono, and saplings of 'olapa, 'ohi'a, pilo, and kawa'u. Ferns, including *Asplenium* spp., *Dryopteris wallichiana*, 'akolea (*Athyrium microphyllum*), *Ophioglossum pendulum* var. *falcatum*, and *Pleopeltis thunbergiana* are also prevalent. Mosses appear in areas with limited damage from feral pigs.

The mid-elevation area (between 1,220 m and 1,370 m) in the Laupāhoehoe unit contains several low-lying, poorly drained montane wet grassland communities that are dominated almost exclusively by *Carex alligata*. In some areas this community type contains a few species from the surrounding community such as 'ohi'a, 'olapa, and 'ohelo kau la'au.

Koa-'Ohi'a montane forest occurs above approximately 1,650 m and occupies the areas of lower annual rainfall (100 to 190 cm) in the Laupāhoehoe unit. The canopy is an open to scattered layer of 35-m tall koa above 25-m tall 'ohi'a. The taller trees are most prevalent along ridges. Open areas and swales are dominated by patches of 1- to 2-m tall 'akala (*Rubus Hawai'iensis*). The understory tree layer is similar to the Koa-'Ohi'a wet forest without the presence of hapu'u (*Cibotium glaucum*). Common species include olomea, mehame, 'olapa, and pilo with no single species being dominant. Other species found in the understory include *Cheirodendron trigynum*, *Coprosma* spp., *Ehrharta stipoides*, *Hedyotis terminalis*, *Holcus lanatus*, *Ilex anomala*, *Myoporum sandwicense*, *Myrsine lessertiana*, *Nothocestrum breviflorum*, *Pelea* spp., *Pittosporum* spp., *Ranunculus Hawai'iensis*, *Sophora chrysophylla*, *Leptechophylla tameiameiae*, and 'ohelo (*Vaccinium* sp.). Patches of non-native species occur and include banana poka (*Passiflora mollissima*), non-native pasture grass, and herb species, as well as a prominent stand of tropical ash (*Fraxinus uhdei*).

The Core Site tower would be 53 m in height and would be placed on concrete pads measuring 3.1 m by 4.0 m. The Core Site tower would receive power from an AP. Electric and communication lines to the AP would be extended 4,392 m southwest from an existing power pole on Spencer Road. Utility lines would be buried beneath the private road and encased in concrete. Beyond the AP, buried utility lines would extend southwest approximately 4.67 km and then extend approximately 343 m through aboveground surface conduits co-located with a new 1.5-m wide pathway leading to the IH. From the IH, the electrical and communication lines would extend approximately 15 m to the tower underneath a new boardwalk. The new boardwalk for the Advanced Tower would extend 140 m southeast from the portal to the IH to allow access to the tower and associated arrays.

The Core Site would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, typically located within 15 m of the base of the tower. An offsite PCS powered by a photovoltaic system would support the Core Site. The PCS would be placed away from ecologically sensitive habitats, possibly near the side of the road, and painted prior to delivery to minimize visual impacts.

### Relocatable Sites

No Relocatable Towers would be deployed in Domain 20. However, two Relocatable Sites (R-39 and R-40, Figure 2.D20-2) without towers would be placed in forested areas in the PWETF, which is located on the north Kona Coast of the island of Hawaiʻiʻ. The PWETF is approximately 15,740 ha in size and is positioned on the northern slope of Hualalai Volcano, Hawaiʻi's third most active volcano. PWETF is managed by the Hawai'i' Division of Forest and Wildlife and Hawai'i' Division of State Parks. Sites would be selected to include forest that is invaded by exotic species and forest that is uninvaded by exotic species. Koa-'Ohiʻa montane mesic forest occurs on the western side of Puʻu Waʻawaʻa in the montane forest zone. This forest type has a high diversity of plant species, and is best developed in the State Wildlife (Forest Bird) Sanctuary. The two Relocatable Sites (R-39 and R-40) are within this forest type. Koa and 'ohiʻa are the dominant tree species in the overstory, kolea (*Myrsine lessertiana*) dominates the mid-story, and native short-stature trees and shrubs occur in the understory. Invasive grasses such as kikuyu (*Pennisetum clandestinum*) and native ferns such as the shuttlecock-shaped laukahi (*Dryopteris* spp.) make up the ground layer in forest gaps. Ferns such as hoʻiʻo (*Athyrium sandwichianum*), ʻakolea (*Athyrium microphyllum*), and palapalai (*Microlepia setosa*) occur in wetter shaded areas within the mesic montane forest. Tree ferns (hapuʻu, *Cibotium glaucum*) are scattered throughout the forest, but do not make up a distinctive canopy layer.

The two Relocatable Sites would have solar-powered commercial off-the-shelf weather stations placed for data collection. The weather stations would be placed on concrete pads measuring approximately 1 m by 1 m and would be 2 to 3 m in height. The towers would each have an AP. Electric and communication lines to the APs would be extended east from an existing power pole on an unnamed road. The electric and communication lines would be co-located with existing un-named roads in surface conduits. Each weather station would have an IH, measuring 1.52 m by 4.88 m by 2.95 m, typically located within 15 m of the base of the tower. Given the proximity of the two Relocatable Sites, only one offsite PCS powered by a photovoltaic system would be necessary. The portal container set would be placed away from ecologically sensitive habitats, possibly near the side of the road, and painted prior to delivery to minimize visual impacts. Typical FSU data collection would occur at each Relocatable Site, but there would be no associated FIU.

### 2.2.4 Project Closure

NEON is projected to continue for 30 years. Although specific decommissioning and closure plans are undefined at this stage, NEON, Inc. would consider the interests of site owners in determining how project closure would proceed at each location. Some or all of the equipment and infrastructure may be retained. Additionally, the owner may choose to retain trails established to reach sampling locations. However, the discussion of project closure in the following sections is based on the presumption that the owner would choose to retain nothing and would want any access trails removed.

#### 2.2.4.1 Core Sites

Upon completion of NEON, all sampling infrastructure would be removed including towers, IHs, anchors, and pads. Any bridges or boardwalks would be removed. All surface and buried conduit and power lines would be removed. Any materials removed during these processes would be reused, recycled, or properly disposed of.

All disturbed ground, including power line trenches, would be stabilized with biodegradable materials and revegetated with species native to the area or propagules of such species. The vegetation selected also would be appropriate for the specific disturbed area, with riparian species planted near streams, hydrophytic plants in wetlands, and typical upland species planted in other areas.

Compacted soil along trails would be loosened and aerated and then revegetated with species native to the area. If needed, topsoil appropriate for the area would be brought in and spread over the loosened soil prior to revegetation.

#### 2.2.4.2 Relocatable Sites

Relocatable Sites would be closed approximately every 3 to 5 years. Site closure would be similar to that described for Core Sites, but because of the shorter project duration, it is more likely that viable topsoil could be stored and returned to the site.

#### 2.2.4.3 Aquatic and STREON Sites

All equipment would be removed. Conduits and power lines would be removed, as discussed for the Core Sites, with appropriate revegetation. Any stream banks disturbed would be stabilized with biodegradable materials and replanted with suitable native species.

## 2.3 No Action Alternative

Under the No Action Alternative, the NSF would not fund construction of the NEON network. If NEON is not constructed, the scientific community would not have the opportunity to address many of the nation's most pressing environmental challenges. Without NEON, the capability to conduct ecological research at regional and continental scales would be lost. Without this project, there would be inability to understand the impacts of land use and climatic change on living systems and loss of ability to provide a predictive understanding of ecological change.

Without the project, the current design and site locations described in this EA that were designed to have the highest potential for community and public impact would not be developed. NEON, Inc. would not develop the capability to address all the NRC-identified Grand Environmental Challenges in an integrated fashion across the continent. If the No Action Alternative were chosen, a significant resource for positively impacting multiple scientific, engineering, environmental education, land management, and conservation components of the research community and society at large would be lost.

CEQ regulations for implementing NEPA require consideration of the No Action Alternative (40 Code of Federal Regulations [CFR] 1502.14(d)); therefore, the No Action Alternative is evaluated in this EA. The No Action Alternative would not satisfy the need for the Proposed Action. Inclusion of the No Action Alternative serves as a benchmark for evaluating the potential effects of the Proposed Action.

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# 3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

## 3.1 Introduction

This section describes the existing environmental and socioeconomic conditions potentially affected by the Proposed Action, as well as the potential environmental and socioeconomic impacts of implementing the Proposed Action or alternative. This section also provides information to serve as a baseline from which to identify and evaluate environmental and socioeconomic changes likely to result from implementation of the Proposed Action. Baseline conditions represent current conditions. In compliance with NEPA, CEQ guidelines, and 45 CFR Part 640, et seq., the description of the affected environment focuses on those resources and conditions potentially subject to impacts from the Proposed Action. Five resource areas would have no potential for impacts and would not be a factor in the decision about whether to implement NEON. These resource areas (Land Use, Topography, Hydrogeology and Groundwater, Demographics, and Community Resources) are briefly discussed in Section 3.2.1 and are not further discussed in this document. Three resource areas would have similar impacts among all domains with no substantial variation as a result of domain-specific conditions. These resource areas (Hydrology, Hazardous and Toxic Substances, and Socioeconomic Impacts on the Local Economy) are discussed in 3.2.2. All other resource areas are considered under each location within each domain, as site-specific conditions could influence potential impacts.

Following the description of the components of the affected environment, this section presents the analysis of the direct, indirect, and cumulative environmental and socioeconomic effects that would likely occur with the Proposed Action and identifies any adverse environmental effects that cannot be avoided through project design.

NEON would be specifically designed and implemented such that NEON would not constrain existing research projects, ongoing experiments, or any currently planned projects other than within the immediate footprint of NEON infrastructure and plots.

### 3.1.1 Direct versus Indirect Effects

The terms “effect” and “impact” are synonymous as used in this EA. Effects may be beneficial or adverse and may apply to the full range of natural, aesthetic, historic, cultural, and economic resources within the project area and also within the surrounding area. Definitions and examples of direct and indirect impacts as used in this document are as follows:

- ***Direct Impact*.** A direct impact is one that would be caused directly by implementing an alternative and that would occur at the same time and place.
- ***Indirect Impact*.** An indirect impact is one that would be caused by implementing an alternative that would occur later in time or farther removed in distance but would still be a reasonably foreseeable outcome of the action. Indirect impacts may include

induced changes in the pattern of land use, population density, or growth rate, and indirect effects to air, water, and other natural resources and social systems.

- ***Relationship between Direct versus Indirect Impacts.*** For direct impacts to occur, a resource must be present. For example, if highly erodible soils were disturbed as a direct result of the use of heavy equipment during construction of a tower, there could be a direct effect on soils resulting from erosion. This could indirectly affect water quality if stormwater runoff containing sediment from the construction site were to enter a stream.

### 3.1.2 Short-Term versus Long-Term Effects

Effects are also expressed in terms of duration. The duration of short-term impacts is considered to be 1 year or less. For example, the construction of a building would likely expose soil in the immediate area of construction. However, this effect would be considered short-term because it would be expected that vegetation would re-establish on the disturbed area within a year of the disturbance. Long-term impacts are described as lasting beyond one year. Long-term impacts can potentially continue in perpetuity, in which case they would also be described as permanent.

### 3.1.3 Intensity of Effects

The magnitude of effects of an action must be considered regardless of whether the effects are adverse or beneficial. The following terms are used to describe the magnitude of impacts:

- No Impact: The action does not cause a detectable change.
- Negligible: The impact is at the lowest level of detection.
- Minor: The impact is slight but detectable.
- Moderate: The impact is readily apparent.
- Major: The impact is severely adverse or exceptionally beneficial.

### 3.1.4 Significance

In accordance with CEQ regulations and implementing guidance, impacts are also evaluated in terms of whether they are significant. Both short-term and long-term effects are relevant to the consideration of significance. "Significant," as defined in the CEQ regulations for implementing NEPA at 40 CFR 1508.27 requires consideration of context and intensity.

"Context" requires that significance may be considered with regard to society, the affected region, affected interests, and the locality. The scale of consideration for context varies with the setting and magnitude of the action. A small, site-specific action is best evaluated relative to the location rather than the entire world. "Potential" is defined above in Section 3.1.

### 3.1.5 Cumulative Effects

The most severe environmental degradation may not result from the direct effects of any particular action, but from the combination of effects of multiple, independent actions over time. As defined in 40 CFR 1508.7 (CEQ Regulations), a cumulative effect is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.

Some authorities contend that most environmental effects can be seen as cumulative because almost all systems have already been modified. Principles of cumulative effects analysis are described in the CEQ guide *Considering Cumulative Effects under the National Environmental Policy Act*. CEQ guidance on cumulative impacts analysis states:

> For cumulative effects analysis to help the decision-maker and inform interested parties, it must be limited through scoping to effects that can be evaluated meaningfully. The boundaries for evaluating cumulative effects should be expanded to the point at which the resource is no longer affected significantly or the effects are no longer of interest to affected parties. (CEQ, 1997)

The consideration of cumulative effects in this document is limited to those identifiable actions that have occurred, are occurring, or are reasonably foreseeable. While it is possible that future unknown research projects could interact with NEON projects if they were to occur in the same general area, only projects that are identifiable at this time are considered, as any other analysis would be speculative.

### 3.1.6 Mitigation

The Proposed Action considered in this EA could have environmental and socioeconomic impacts resulting from implementation that would require mitigation. Where potentially significant adverse impacts are identified, measures that could be implemented to mitigate the magnitude of impacts are discussed. Potential mitigation actions could include:

- Relocating the activity to avoid or minimize the impact
- Rectifying an impact by repairing, rehabilitating, or restoring the affected environment
- Reducing or eliminating an impact over time by preservation and maintenance operations during the life of the action
- Compensating for an impact by replacing or providing substitute resources or environments

Where no significant adverse impacts are identified, mitigation measures are not proposed. Absent mitigation, Best Management Practices (BMPs) and/or project design features would be applied to avoid impacts or minimize unavoidable impacts such that they are insignificant.

### 3.1.7 References

Council on Environmental Quality. 1997. *Considering Cumulative Effects under the National Environmental Policy Act.*

# 3.2 Resource Areas Considered But Not Addressed for Specific Domains

## 3.2.1 Resource Areas with No Potential for Significant Impacts

Preliminary analysis indicated that NEON has no potential to affect five resource areas including land use, topography, hydrogeology and groundwater, demographics, and community resources. Because there is no potential for impact, these resource areas would not influence the decision to be made regarding project implementation. The rationale for eliminating these resource areas from consideration is provided in the following sections.

### 3.2.1.1 Land Use

Less than 0.01 hectare (ha) of land would be occupied by NEON infrastructure at any site in a domain. No NEON land disturbing activity is proposed for land designated as prime or unique farmland. There would be no change of land use or land use designation for any of the proposed NEON locations. No impacts to land use would occur.

### 3.2.1.2 Topography

NEON, Inc. would not alter the gross topography of any of its proposed locations. Sites were selected in part to provide representative atmospheric conditions for recording climatic and other atmospheric data. Changes to the topography would alter air flow patterns and could compromise the integrity of the data collected. Minor earthmoving to create an approximately 2.5-$m^2$ level tower pad would not alter site topography. Final site restoration after 30 years would not result in changes to topography.

### 3.2.1.3 Hydrogeology and Groundwater

NEON, Inc. would not use groundwater resources in any domain and no infrastructure or sampling would impact any groundwater recharge or discharge area. Data collection would be limited to shallow hand-augured wells in the vadose zone (within 35 cm of the surface), and would not extend to permanent groundwater. There would be no potential for NEON to impact groundwater.

### 3.2.1.4 Wild and Scenic Rivers

Proposed NEON locations are not in proximity to any designated or proposed Wild and Scenic Rivers. Indirect impacts from implementation of NEON to surface waters would not extend downstream to any designated or proposed Wild and Scenic Rivers. There would be no potential for NEON to impact Wild and Scenic Rivers.

### 3.2.1.5 Demographics

No new permanent residents would be added to any community as a result of construction and operation of NEON infrastructure. Construction at any site would be limited to a crew of up to 10 contract workers plus oversight personnel from NEON, Inc. and would not exceed 6 months at any site. Final site decommissioning and restoration would be expected to require a comparable effort 30 years in the future. During operation, there would be a maximum of 25 people on any given site during 6-week periods of intensive sampling. During other times, no more than 10 people would be onsite at any time and it is expected that there would be an average of 3 people onsite for a full day twice per week during non-peak sampling periods. There would be no change in demographics in any domain related to implementation of NEON.

#### 3.2.1.6 Community Resources

No new permanent residents would be added to any community as a result of NEON. Construction at any site would last no longer than 6 months and would be limited to a maximum of 10 workers plus oversight personnel from NEON, Inc. Data collection and maintenance would result in a maximum of 25 people on any given site during 6-week periods of intensive sampling and an average of three people onsite for a full day twice per week during other times. Construction, data collection, maintenance, and site restoration would not result in a change in the level of service provided by community resources in any domain.

### 3.2.2 Resource Areas with Similar Impacts Across All Domains

For certain resource areas there would be comparable minor negative impacts across all domains and tower locations. The potential impacts to these resource areas projected for any of these sites are described in the following sections. Because of the wide spatial separation, no interaction effects among sites are anticipated for these resources.

#### 3.2.2.1 Hydrology

Construction of the tower pad and the IH would result in creation of up to 35 $m^2$ of impervious surface area at any given site as a result of the tower pads and IH. Because of the small amount of impervious surface created relative to the generally undisturbed surrounding areas, the landscape would be capable of accommodating the stormwater runoff from the new impervious area. There would be negligible impacts on hydrology at any given site. Additionally, NEON, Inc. would use BMPs as discussed in Section 2.2.2 to reduce the potential for hydrologic impacts from stormwater runoff.

#### 3.2.2.2 Hazardous and Toxic Substances

There would be limited onsite storage of hazardous or toxic substances at NEON Core Sites. Potential hazardous and toxic substances stored onsite would include methane and carbon dioxide stored in pressurized gas cylinders and preservatives including alcohols.

Carbon dioxide and methane are potential asphyxiants. Personnel would follow appropriate handling procedures when working with methane to minimize the risk of exposure to potentially harmful concentrations.

Methane would be a potential fire and explosive hazard and would be stored away from any potential ignition source. Personnel would follow appropriate handling procedures when working with methane to minimize the risk of accidental ignition.

Small quantities of preservatives (typically alcohols) would be maintained for preventing deterioration of detritus or leaf litter samples collected. These preservatives would be stored in appropriate containers with secondary containment and would be stored away from any potential ignition source. NEON, Inc. would develop and implement a spill prevention, control, and countermeasures (SPCC) plan at Core Sites to minimize the potential for indirect impacts from a spill of preservatives.

#### 3.2.2.3 Socioeconomic Impacts on the Local Economy

Because NEON would be spread across the United States and Puerto Rico and be implemented over a long time span (30-year planned operation), any impacts on local economies would be minor.

Project construction and routine sampling would result in secondary spending within the local economy. The cost of construction and routine data collection would be similar across all proposed domains, with relatively greater costs and duration of construction associated with sites that receive towers.

Secondary spending as a result of construction would be a minor temporary benefit to the local economy. Each site would have up to 10 construction workers plus NEON, Inc. oversight personnel for approximately 6 months. This spending would stop at the end of construction.

It is expected that data collection and maintenance would result in an average of three people onsite for a full day twice per week during non-peak sampling periods and up to 25 scientists and technicians onsite for a 6-week period during peak data collection. This would result in secondary spending approximately equivalent to that of one new local resident for the expected 30-year operation of NEON Core Sites and for 5 years at relocatable and aquatic sites. This would be a minor long-term benefit to the local economy.

### 3.2.3 References

Charles Machine Works, Inc. Undated. Ditch Witch 1820, 1330, 1230, 1030 Pedestrian Trenchers: Specifications.

## 3.3 Resource Areas Considered in Detail for Domains

### 3.3.1 Geology

Geology takes into account how the materials of which the Earth is made, the structure of those materials, and the processes acting upon them may influence or be influenced by the Proposed Action. The processes acting upon the Earth cause hazards such as landslides, earthquakes, and volcanism (geology.com, 2009).

Earthquake hazard is measured as a combination of the probable intensity of ground movement combined with the probability of that movement occurring (USGS, 2009a). Ground movement is measured as ground acceleration, which decreases with distance from an earthquake. Ground acceleration is determined relative to the acceleration due to gravity (980 cm per second per second) and is expressed as a percent of gravitational acceleration (%g). The largest value of the acceleration likely to occur at a given location is the peak ground acceleration as %g (% pga). The approximate threshold of damage for older (pre-1965) buildings is 10%g, whereas recent buildings constructed to earthquake standards have undergone severe shaking at 60%g with minor structural damage (USGS, 2009b).

Because proposed NEON, Inc. activities would have no potential for impacting underlying geology, the analysis focuses on identifying geological features or conditions that may place constraints on NEON activities.

### 3.3.2 Soils

Soils and soil horizons differ depending on how and when they formed. Factors influencing soil formation include the underlying parent material, climate, topography, biological factors, and time. Within areas of similar soil forming factors, soils are further classified based on their physical and chemical properties such as color, texture, and structure (NRCS, 2009).

Analysis of soils focuses on the relationships between this resource and various elements of the environment, including hydrology, vegetation, and wildlife. Further, this analysis identifies areas where soil conditions, such as erosion susceptibility or low compaction potential, may constrain placement of NEON infrastructure.

### 3.3.3 Climate

Climate encompasses the sum total of the meteorological elements that characterize the average and extreme conditions of the atmosphere, including temperature, precipitation, and wind speed. Climate is determined from conditions over a long period of time in a given area (North American Lake Management Society [NALMS], 2009). This information is used to help predict future weather conditions, including extreme weather events.

Because proposed NEON, Inc. activities would have no potential for impacting climate, the analysis focuses on identifying climatic conditions that may place constraints on NEON activities.

### 3.3.4 Air Quality

The CAA requires the U.S. Environmental Protection Agency (USEPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. NAAQS include primary and secondary air quality standards. Primary standards protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings (USEPA, 2009a). USEPA has established NAAQS for six principal pollutants, which are called "criteria pollutants" (Table 3.3.4-1).

Areas that meet the air quality standard for the criteria pollutants are designated as being "in attainment." Areas that do not meet the air quality standard for one of the criteria pollutants may be subject to the formal rule-making process and designated as being "in nonattainment" for that standard.

Nonattainment areas for some pollutants, including ozone, are further classified as regulated under Subpart 1 or Subpart 2 of the USEPA 2004 Phase I Rule for implementing the CAA, based on the magnitude of the problem. Subpart 1 (basic nonattainment) is applied to those areas where the problem is less severe and contains general requirements for nonattainment areas. Subpart 2 is applied to areas

**TABLE 3.3.4-1**
NAAQS for Criteria Pollutants
*National Ecological Observatory Network (NEON) EA*

| Pollutant | Primary Standards[a] | Averaging Times | Secondary Standards |
|---|---|---|---|
| Carbon Monoxide | 9 ppm (10 $mg/m^3$) | 8-hour[b] | None |
| | 35 ppm (40 $mg/m^3$) | 1-hour[b] | None |
| Lead | 0.15 $\mu g/m^3$ | Rolling 3-month Average | Same as Primary |
| | 1.5 $\mu g/m^3$ | Quarterly Average | Same as Primary |
| Nitrogen Dioxide | 0.053 ppm (100 $\mu g/m^3$) | Annual (Arithmetic Mean) | Same as Primary |
| Particulate Matter (PM) | | | |
| $PM_{10}$ | 150 $\mu g/m^3$ | 24-hour[bc] | Same as Primary |
| $PM_{2.5}$ | 15.0 $\mu g/m^3$ | Annual[d] (Arithmetic Mean) | Same as Primary |
| | 35 $ug/m^3$ | 24-hour[e] | Same as Primary |
| Ozone | 0.075 ppm (2008 std) | 8-hour[g] | Same as Primary |
| | 0.08 ppm (1997 std) | 8-hour[f] | Same as Primary |
| Sulfur Dioxide | 0.03 ppm | Annual (Arithmetic Mean) | |
| | 0.14 ppm | 24-hour[b] | |
| | | 3-hour[b] | 0.5 ppm (1300 $\mu g/m^3$) |

[a] ppm = parts per million, $\mu g/m^3$ = micrograms per cubic meter

[b] Not to be exceeded more than once per year.

[c] 3-year average of the weighted annual mean $PM_{10}$ concentration at each monitor within an area must not exceed 50 µg/m.

[d] 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m.

[e] 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 65 µg/m.

[f] 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

[g] 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm.

Source: U.S. Environmental Protection Agency. 2009a. Air and Radiation: National Ambient Air Quality Standards (NAAQS). http://www.epa.gov/air/criteria.html. Accessed January 15, 2009.

with severe problems and establishes a classification scheme for ozone nonattainment areas with more specific requirements. An area would be classified under Subpart 2 as marginal, moderate, serious, or severe based on the most recent 3 years of data. All other 8-hour ozone nonattainment areas are covered under Subpart 1 (USEPA, 2008).

Federal regulations at 40 CFR 81 delineate certain air quality control regions (AQCRs), based on population and topographic criteria closely approximating each air basin. The potential influence of emissions on regional air quality would typically be confined to the air basin in which the emissions occur.

The analysis focuses on potential emissions and generation of fugitive dust from proposed NEON construction and operation, and whether there would be any deterioration of air quality. The analysis also will identify whether local air quality issues would constrain NEON activities. The analysis will identify whether any permits would be required in advance of proposed NEON, Inc. activities.

Designated Federal Class 1 Wilderness Areas have been determined to have high scenic value associated with user experiences. Under the Clean Air Act, states are required to protect and improve visibility in national parks and wilderness areas. There are 156 national parks and wilderness areas designated as mandatory federal Class 1 areas (WDE, 2009).To protect the visual quality of these designated areas, potential emission sources within 161 km of designated Class 1 Wilderness Areas must not contribute to deterioration of visibility through air quality impacts. The analysis identifies designated Class 1 Wilderness Areas within 161 km of any proposed NEON location and whether proposed NEON, Inc. activities would contribute to deterioration of air quality at those sites.

### 3.3.5 Airspace

U.S. airspace is regulated by the Federal Aviation Administration (FAA), which controls the areas and altitudes open for aviation purposes. Certain aircraft operations are restricted either on a temporary or permanent basis through the use of Temporary Flight Restrictions, Air Defense Identification Zones, and Flight Restriction Zones. These restrictions include areas such as the airspace over natural disaster areas, sporting events, parts of cities, and military installations (Brown, 2003).

This analysis focuses on proposed locations that are within or near restricted airspace areas and whether any airspace restrictions would constrain proposed AOP deployment. The analysis identifies permits that may be required in advance of proposed NEON, Inc. activities.

### 3.3.6 Noise

For determination of impacts to human receptors, noise measurements are weighted to increase the contribution of noises within the normal range of human hearing and decrease the contribution of noises outside that range. Human hearing is best approximated by using an A-weighted decibel scale (dBA). When sound pressure doubles, the dBA level increases by 3 (The Engineering Toolbox, 2007). Psychologically, most humans perceive a doubling of sound as an increase of 10 dBA (USEPA, 1974). Sound pressure decreases with distance from the source. Typically, the sound measured from a point source decreases at a rate of 6 dBA per doubling of distance from the source and sound from a continuous source decreases at a rate of 3 dBA per doubling of distance from the source. However, factors such as the ground type, atmospheric conditions, and shielding by vegetation and structures further affect the amount of decrease in sound over distance (Federal Highway Administration [FHWA], 2007).

Where the distance from a sound source is greater than 100 m, the atmospheric conditions that affect sound travel the most are temperature variations, wind, and humidity. Sound waves typically bend toward cooler temperatures. In summer, afternoon temperature decreases with increasing altitude and sound waves tend to bend upward, creating what is known as a shadow zone where a sound source may be visible at distance but the sound would not be heard. Shadow zones can decrease sound levels by up to 20 dBA at distances greater than 160 m from a source. Shadow zones may develop when sound travels against the wind. The situation is reversed when temperatures are lower closer to the ground, such as morning or over calm water. In these cases, sound waves tend to bend toward the ground, bounce off of the ground, and travel farther than expected. Sound also tends to travel farther than expected when it is traveling with the wind (Cowan, 1999).

Noise levels are often expressed as Ldn, which is the dBA sound level over a 24-hour day and night period. The Ldn also applies a 10-dBA penalty to nighttime sounds occurring between 10 pm and 7 am to account for the desirability of a quieter night than day in order to avoid sleep interruption. A noise level considered low is less than 45 dBA, a moderate noise level is 45-60 dBA, and a high noise level is above 60 dBA. In busy urban areas, noise levels are typically near 75 dBA, and can reach 85 dBA near airports and major freeways (California State Lands Commission, 2005). Sound levels in rural residential areas typically average 40 dBA. In business and commercial areas, sound levels typically range from 50 dBA to 60 dBA (The Engineering Toolbox, 2007).

The analysis of potential impacts focuses on how noise from construction and operation of NEON infrastructure could impact nearby human receptors and wildlife.

### 3.3.7 Water Quality

"Water quality" is a term used to describe the chemical, physical, and biological characteristics of water. Water quality is regulated primarily by the CWA, which establishes designated uses for given waterbodies (such as public water supply, aquatic habitat, industrial supply, and recreation) and sets criteria or standards to protect those uses (Ohio Environmental Protection Agency, 1995; NALMS, 2009.) Standards are set for individual pollutants and are based on the different uses assigned to a waterbody.

Streams and lakes that are impaired (not meeting established water quality standards) for one or more pollutants are placed on a state's CWA Section 303(d) list of impaired waters. Total maximum daily loads (TMDLs) are developed and implemented for impaired waters that determine the maximum amount of a given pollutant that a waterbody can receive without violating water quality standards. Plans are developed and implemented to address sources of pollution within the watershed and how they will be reduced as part of a state's overall water quality management program.

The analysis focuses on whether proposed NEON, Inc. activities would have the potential to impact water quality during construction and operation. Impacts to water quality could result from sedimentation or transport of nutrients or other pollutants into wetland systems as a result of erosion following ground-disturbing activities or from spills of fuel or chemicals associated with NEON operations. The analysis identifies what permits may be required in advance of proposed NEON, Inc. activities.

### 3.3.8 Wetlands

Wetlands are transitional lands between aquatic and terrestrial systems. Plants present in wetlands are those that are adapted for life in standing water or in prolonged saturated soil conditions (Cowardin et al., 1979). Wetlands vary widely in size and type as a result of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and degree of human disturbance (USEPA, 2009b).

Activities in wetlands that would result in a dredge or fill are regulated under the CWA. Under that law the term "wetland" is more narrowly defined as "areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." (40 CFR 230.3(t)); USEPA, 2009b). Executive

Order (EO) 11990, Protection of Wetlands, directs federal agencies to avoid new construction in wetlands unless there is no practicable alternative.

The analysis focuses on the potential for direct and indirect impacts to wetlands from construction, operation, and removal of NEON infrastructure. Direct impacts would result from clearing or placement of structures in wetlands. Indirect impacts could result from sedimentation or transport of nutrients or other pollutants into wetland systems as a result of erosion following ground-disturbing activities or from spills of fuel or chemicals associated with NEON operations. The analysis identifies permits that may be required in advance of proposed NEON, Inc. activities.

### 3.3.9 Floodplains

Floodplains are strips of land bordering streams where overbank flow occurs during periods of high water. They typically contain sediments carried by the stream that are deposited in the slack water beyond the influence of the swiftest current. Within a floodplain, flood zones can be determined. A flood zone represents the land bordering a stream which is subject to floods of approximately equal frequency or probability (NALMS, 2009).

For insurance and safety purposes, some floodplains have been mapped and flood zones identified. Activities within mapped floodplains are regulated by the Federal Emergency Management Agency (FEMA) and local floodplain management agencies. FEMA defines flood zones according to level of flood risk. Identified flood zones are depicted on Flood Insurance Rate Maps (FIRM) or Flood Hazard Boundary Maps. Each zone reflects the predicted severity or type of flooding in the identified geographic area (FEMA, 2009). Under EO 11988, Floodplain Management, federal actions occurring on floodplains must consider alternatives, implement proper floodplain management, and use flood protection measures.

Analysis focuses on whether proposed actions would affect flooding as a result of displacement or obstruction from NEON infrastructure. Additionally, the analysis considers whether NEON sensors and structures would be placed in flood prone areas.

### 3.3.10 Common Vegetation and Plant Communities

Common vegetation and plant communities are the plant components of the environment that could be impacted by NEON. These resources are influenced by the spatial and chemical heterogeneity of the landscape and also by biotic factors (such as grazing).

Analysis focuses on whether vegetation would be altered or removed as a result of NEON activities. Impacts are discussed with regard to the amount of vegetation that would be disturbed and the length of time the disturbance would last.

### 3.3.11 Common Fauna

Common fauna represent the typical animals occupying or expected to occupy habitats at and around proposed NEON sites. These resources are influenced by the number, types, and sizes of habitat patches that occur in areas where NEON would be implemented.

Analysis focuses on whether common fauna would be displaced or killed as a result of NEON activities. Impacts are discussed with regard to magnitude and expected duration.

### 3.3.12 Sensitive Ecological Communities

A sensitive ecological community is a habitat type that is rare in the general area and one that may be at risk of being eradicated by development. Sensitive communities also would include any area designated by the USFWS under Section 4(a)(3)(A) of the ESA as critical habitat for a species listed as threatened or endangered under the ESA. Activities that may affect designated critical habitat require consultation with the USFWS (USFWS, 2008).State laws and regulations may offer protection for defined sensitive habitat types within a state.

For the purposes of this analysis, locations are reviewed for information on the presence of sensitive ecological communities. Where a sensitive ecological community is known to occur in the vicinity of proposed NEON infrastructure and the available data are not specific enough to determine whether the sensitive ecological community is near enough to the proposed infrastructure to be impacted, NEON, Inc. would conduct site-specific surveys in advance of any ground disturbance. If these site-specific surveys indicate that an impact is likely, NEON, Inc. would relocate the facility the minimum distance necessary to avoid impacts to the sensitive ecological community while maintaining scientific objectives for the site.

Analysis focuses on whether sensitive communities would be altered or damaged as a result of NEON activities. Impacts are discussed with regard to the magnitude of disturbance and the length of time the disturbance would last. If impacts to designated critical habitat could not be avoided, the analysis specifies that consultation with USFWS would be conducted prior to any disturbance of critical habitat.

### 3.3.13 Sensitive Species

A sensitive species is a species or a defined sub-population of a species that is naturally rare, declining in number, or at risk of becoming extinct over all or a substantial portion of its range within the governing political boundary. Sensitive species may be protected at the federal level by the ESA or at the state level by state laws and regulations. Another group of sensitive species are birds protected under the Migratory Bird Treaty Act (MBTA). Federal land management agencies, such as the BLM or the USFS, also typically have established protection for species deemed sensitive that occur on their lands. The purpose of the ESA is "to protect and recover imperiled species and the ecosystems upon which they depend." Activities that could interfere with the life history requirements of a listed species or affect designated critical habitat require consultation with the USFWS (USFWS, 2008).

For the purposes of this analysis, locations are reviewed for information on the presence of sensitive species within an area represented by a radius of 5 km from each proposed tower location. Where a sensitive species or its required habitat is known to occur in this area and the available data lack the specificity to determine whether the occurrence is near enough to be impacted, NEON, Inc. would conduct site-specific surveys in advance of any ground disturbance. These surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility the minimum distance necessary to avoid impacts to sensitive species while maintaining scientific objectives for the site.

Analysis is similar to that described for common vegetation and fauna, but focuses on those species identified as sensitive in a given area. If potential impacts to federally protected species could not be avoided at a proposed site, the analysis specifies that consultation with USFWS would be conducted prior to any action at that site.

### 3.3.14 Cultural Resources

Cultural resources that could be affected by construction and operation of NEON infrastructure include prehistoric and historic archaeological sites; standing historic structures, buildings, districts, and objects; locations of important historic events, and sites of traditional/cultural importance to various groups. Historic properties are protected through the National Historic Preservation Act (NHPA) of 1966 (16 USC 470f) and its implementing regulations, the Archaeological and Historic Preservation Act of 1974, and the Archaeological Resources Protection Act of 1979. Protection of Historic Properties (36 CFR Part 800) implements Section 106 of the NHPA and requires federal agencies, prior to implementing an "undertaking," to consider the effects of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation (ACHP) and the State Historic Preservation Office (SHPO) a reasonable opportunity to comment on any undertaking that would adversely affect properties listed or eligible for listing on the National Register of Historic Places (NRHP). Section 101(d)(6)(A) of the NHPA allows properties of traditional religious and cultural importance to a tribe to be determined eligible for inclusion on the NRHP.

While typical locations of previously unknown cultural resources are subsurface artifacts and sites located on undeveloped properties, developed sites with structures greater than 50 years old may be eligible for the NRHP. Historic districts, landscapes, or clusters of similar historic properties related to a common theme or locale may occur in prospective NEON site areas. Undocumented or unidentified traditional cultural sites or landscapes may also exist at or near prospective NEON sites. Visual, noise, atmospheric, and physical impacts must be considered during site evaluations near these resources.

Within this resource section, the terms "significant" and "significance" are used in the context of NEPA and the NHPA. When referring to structures, objects, or artifacts, the terms are used as defined in 36 CFR Part 800 for the NHPA. When referring to impacts, the terms are applied relative to their meaning under NEPA. Regulations implementing Section 106 of the NHPA, 36 CFR Part 800.8, encourage the coordination of two processes: (1) the review of possible impacts to the environment under NEPA and (2) the assessment of effects of undertakings required under the NHPA.

An archival cultural resources assessment was undertaken for NEON facilities within each of the 20 NEON domains. The assessment included a 1.6-km radius records search of the proposed project sites and surrounding areas, as well as a review of historic maps, geomorphologic history, settlement history, and aerial photographs.

The findings of this study are appropriate to meet the requirements of NEPA in assessing the potential for significant impacts to sensitive cultural resources. Information collected and described for each of the domains will provide the appropriate level of information to comply with NEPA relative to whether the potential impact to the human environment will be significant or not significant. The analysis is based on the findings of archival research, geomorphologic history, settlement history, and cartographic review within the study areas. This analysis also meets the provision described in Section 106 of the NHPA to conduct a phased approach to compliance (covered in 36 CFR § 800.4(b)(2)). The collected body of knowledge presented in this EA provides sufficient information to determine that there are no NEON features identified to date that will have a significant impact on known cultural resources reported from the literature and related other archival data reviewed for this EA.

The approach proposed and being implemented in this EA is based on a "phased approach" to compliance with Section 106 of the NHPA. The provision for such an approach is outlined in Part 800.4 – "Identification of Historic Properties." This portion of the regulation is applicable to actions that involve large land areas, such as the 20 domains proposed for NEON. The key components in the implementation of the phased approach are summarized below:

- Assess potential impacts from the proposed action to cultural, archeological, and historical resources using the results of archival research, geomorphologic history, settlement history, cartographic review, tribal consultation, and results of the NSF consultations and provide this assessment of potential impacts, including a range of potential mitigation measures, for the NEPA EA.
- Apply the provision in Section 106 of the NHPA to conduct a "phased approach" to compliance (covered in 36 CFR § 800.4(b)(2)), given the large amount of land that is under consideration (804 ha for each site) and the fact that site-specific footprints of facilities (less than 0.01 ha) may include minor relocations or micro-siting. This phased option allows NSF to address NEPA requirements in assessing potential impacts to these resources based on the archival and other desktop research, and separately complete its Section 106 obligations as required at the point in project development when site-specific footprints have been finalized for each component of NEON within each domain. This approach enables NSF to avoid potentially significant costs for surveys that might not be required.

As outlined in this EA, NSF has conducted archival research to identify the likely presence of historic properties within an 804-ha area encompassing proposed sites within each domain. Available information regarding potential effects on cultural, archaeological, and historic resources within this area is outlined for the Core and Relocatable Sites and Aquatic Arrays proposed within each domain. Because each domain contains multiple individual sites, there are more than 60 specific locations that were evaluated for the presence of historic properties. While NEON, Inc. has selected candidate preferred locations for the individual sites within each domain, there is the potential for some limited relocation of specific NEON sites. Part 800.4 allows for the identification and evaluation of historic properties (e.g., implementation of site-specific field surveys), once specific locations have been refined.

Should the project go forward for funding, NSF will provide funds to conduct site-specific surveys in domains indicating a high potential for cultural resources. At that point, there should be reasonable certainty that site locations will not change. NSF will mobilize the appropriate cultural resource professionals to conduct field surveys within each domain to address specific infrastructure locations and proposed intrusive sampling areas, conduct appropriate coordination with appropriate SHPOs, and conduct any necessary tribal consultation. Should any previously unknown historic properties be discovered at a proposed NEON location, appropriate mitigation would be developed and implemented if impacts to the discovered historic properties could not be avoided.

### 3.3.15 Utilities

Electric power transmission is the bulk transfer of electric power via a network that connects power plants to substations to individual locations. The transmission capacity of this infrastructure (e.g. lines, transformers) determines whether or not it must be upgraded to handle the additional demand from new or expanding users (National Council on Electricity Policy, 2004). Telecommunication is handled by a network of lines, transmitters, nodes, and receivers. As with electric power, the capacity of the infrastructure determines whether or not it must be upgraded to handle additional demand.

The analysis identifies whether the existing utility system in the vicinity of proposed NEON locations is sufficient to support proposed NEON infrastructure with minimal modifications and extensions. An AP would transition commercial power and communications to NEON systems. A single AP may serve multiple FIUs or other components, depending on the configuration of NEON infrastructure.

The analysis also determines what impacts to other resources could occur as a result of NEON work to extend utility service from the terminus of the existing utility infrastructure to proposed NEON locations.

### 3.3.16 Transportation

A transportation network represents the infrastructure that permits the conveyance of people and commodities. For a given area the transportation infrastructure may include roads, railroads, airports, and ports.

The analysis focuses on whether the existing transportation infrastructure is sufficient to meet the needs of NEON, whether improvements of modifications to existing infrastructure would be needed, and how construction and operation of NEON infrastructure could impact transportation and traffic near the proposed locations.

### 3.3.17 Human Health and Safety

Occupational health and safety addresses the risk factors and hazards of the workplace. Risk is managed by identifying potential hazards and implementing appropriate controls to promote a safe environment (Bird et al., 2003).

The analysis identifies the potential for injury to NEON workers and researchers during construction, data collection, and site closure. The analysis also identifies whether health and safety risks to the general public would be created as a result of NEON implementation.

### 3.3.18 Environmental Justice

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (CEQ, 1997). "Fair treatment" means that no group, including racial, ethnic, or socio-economic groups, should bear a disproportionate share of the adverse environmental consequences resulting from industrial, municipal, or commercial operations or the execution of federal, state, local, and tribal programs and policies.

In 1994, an "Executive Order on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (EO 12898, 59 FR 7629) was issued and was designed to focus on environmental and human health conditions in minority and low-income communities. EO 12898 requires federal agencies to achieve environmental justice "to the greatest extent practicable" by identifying and addressing "disproportionately high adverse human health or environmental effects of…activities on minority populations and low-income populations." The CEQ has issued guidance to federal agencies to assist them with their NEPA procedures so that environmental justice concerns are effectively identified and addressed (CEQ, 1997).

For the purposes of this analysis, the Region of Influence (ROI) to be considered for potential environmental justice impacts to minority/low-income population will be any areas where deployment of NEON infrastructure would restrict access for subsistence uses or where the proposed infrastructure would directly impact minority or low-income populations.

### 3.3.19 Protection of Children

EO 13045, Protection of Children from Environmental Health Risks and Safety Risk (FR: April 23, 1997, Volume 62, Number 78), specifies guidelines for the protection of children. This EO requires that federal agencies make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and to ensure that policies, programs, and standards address disproportionate risks to children that result from environmental health or safety risks. For the purposes of this analysis, the area to be considered for potential impacts to children is the immediate location where NEON infrastructure would be deployed. The analysis is further limited to those locations where routine access by children could occur.

### 3.3.20 Recreation

The analysis identifies the potential for disruption of recreational activities to the general public as a result of NEON implementation. With regard to National Historic Trails (NHTs) and National Scenic Trails (NSTs), a potential for impacts was considered to exist where these trails occur within 10 km of proposed NEON locations. At greater than 10 km, no potential for impact was presumed to exist. The 10 km was determined as perpendicular distance for potential visual impacts and distance along waterways for potential indirect impacts.

### 3.3.21 Aesthetics and Visual Resources

Impacts to aesthetic and visual resources are evaluated by analyzing project related changes to existing views, landscape character, land cover types, and land uses.

Important resources are inventoried to ensure that proposed activities conform with existing resources (Anderson, 1979). Federal agencies are responsible for ensuring that the visual and aesthetic values of public lands are considered before allowing uses that may have negative impacts (BLM, 2009; NPS, 2006). In addition, recognizing that activities proposed for adjacent lands may significantly affect park programs, resources, and values, NPS policies require park managers to work with managers of areas beyond park boundaries to seek solutions that protect park resources and values (specifically including scenic views, soundscapes, and lightscapes), provide for visitor enjoyment, and address mutual interests in maintaining the quality of life in the community, among traditionally associated peoples, and other interested groups. NPS views such cooperative conservation as essential to fostering decisions that are sustainable. Representatives from the NPS and BLM worked with NEON in siting or mitigating project facilities (for example, painting towers specified colors) in such a way as to minimize negative impact on aesthetic or visual resources at any of the NPS or BLM locations, and on adjacent NPS lands.

Analysis focuses on whether proposed actions would result in changes to the viewshed of identified visual resources and whether those changes would adversely those resources.

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## 3.4 Mobile Deployment Platforms

MDPs would be deployed in response to specific events, such as natural disasters. MDPs would be trailer- or vehicle-mounted and would be driven to deployment points. Potential deployment locations and durations are not known in advance. However, deployment would be to areas adjacent to existing roads.

NEON, Inc. would investigate a site proposed for a Mobile Observatory in advance of deployment. The equipment would not be parked in wetlands or surface waters. Equipment would not be located where sensitive species occur or within any designated critical habitat. The potential for any impacts would be minor, limited to the time the equipment would be deployed at a site. There could be minor temporary impacts to common vegetation from shading as the trailer is parked in an area, but no additional impacts would be expected.

## 3.5 Domains

The following sections are organized by domain. These sections discuss the affected environment in proximity to proposed NEON locations in each domain and the potential environmental consequences of construction, operation, and removal of NEON infrastructure within the domain. As discussed above, each proposed NEON location has been assigned a unique alphanumeric identifier consisting of an initial letter (C, R, A, S) designating whether it refers to a core, Relocatable, aquatic, or STREON Site and a two-digit number. The alphanumeric identifiers and proposed locations for NEON infrastructure in each domain are provided in Table 2.2.2-1.

## 3.5.1 Domain 1 Northeastern United States

### 3.5.1.1 Introduction

Domain 1 covers all of New England and New York, including northern New Jersey, northern and western Pennsylvania, and much of West Virginia (Figure 2-1). The domain is located within the Lower New England-Northern Piedmont and Northern Appalachian-Acadian ecoregions. Glacier activity has shaped much of this domain and has created a diverse geology with low-mountains and many lakes in the interior central and southern parts of the domain and glacially deposited sandy soils that form a broad plain with many ponds toward the Atlantic Ocean. The northern part of Domain 1 is more mountainous, with alpine peaks and many fast-flowing, cold water rocky rivers (LandScope America, 2009a; 2009b).

### 3.5.1.2 Resource Areas Considered But Not Addressed for Domain 1

Preliminary analysis indicated that there would be no potential to significantly impact three of the resource areas that were considered in Domain 1. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Environmental Justice: The proposed NEON sites would be located on unpopulated lands. All potential impacts would be confined to the project footprint and there would be no potential to disproportionately impact minority or low-income populations.
- Airspace: There is no special use airspace in Massachusetts or New Hampshire and the proposed NEON locations would not extend into restricted airspace (FAA, 2009). No potential for airspace constraints would be expected in this domain.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 1 are designated research areas that are not routinely viewed for aesthetic quality or urban lands where aesthetic quality is impaired. Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

### 3.5.1.3 Resource Areas Considered in Detail for Domain 1

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 1 where site-specific conditions would influence the anticipated environmental consequences.

#### Geology/Seismicity

***Affected Environment***

The Harvard Forest, Burlington, and Bartlett Experimental Forest are all within the New England Province. Harvard Forest is in the central New England upland section. Bedrock in this area is characterized by granites, gneisses, and schists typical of the region. Surficial deposits are predominantly glacial till of varying depths, with localized glaciofluvial deposits (Harvard Forest, 2008a). Burlington is in the Seaboard Lowland section, which is characterized by shallow soils, glacial till, and bedrock outcrops that formed during the last ice age. Geology in the Burlington area consists primarily of igneous and metasedimentary Paleozoic and Precambrian bedrock with surficial deposits of till, gravel, and sand (Plum Island LTER, 2008). Bartlett Experimental Forest is in the White Mountain section. The surface is a thin, stony Pleistocene till (USFS, 2009). The soil mantle is very shallow in many places with exposed rock and boulders prevalent (USFS, 2008).

The New England Province is relatively stable from the standpoint of seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 12% pga to 40% pga for short wave motion and 4% pga to 14% pga for long wave motion (USGS, 2009a, 2009b). The higher ranges are associated with northwest Vermont and northern New York near the border with Canada.

#### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact the underlying geology. The seismic hazard is low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

### Soils

#### *Affected Environment*

Soils within the general area of the proposed locations in the Harvard Forest consist mostly of loamy sands in the uplands and muck soils in the wetlands. The soil at the proposed location for the Advanced Tower (C-01, Figure 3.D01-1) and the upland Basic Tower (C-03, Figure 3.D01-1) consists of Becket-Skerry soil that is well drained and has slopes that range from 3 to 15 percent. The typical soil profile for this soil type consists of fine sandy loam from the surface to a depth of 34 cm and a gravelly sandy loam extending to about 165 cm. Becket-Skerry and other soils at and around the proposed locations are not considered highly susceptible to sheet or rill erosion by water (NRCS, 2009a; NRCS, 2009b).

A Basic Tower (C-02, Figure 3.D01-1) would be located in Black Gum Swamp. The soil at this location consists of Bucksport and Wonsqueak mucks that are very poorly drained. Slopes in these areas range from 0 to 3 percent. The typical soil profile for this soil type consists of muck to a depth of about 165 cm. This soil is not considered highly susceptible to rill or sheet erosion (NRCS, 2009a NRCS, 2009c).

The soils at Bartlett Experimental Forest (R-01, Figure 3.D01-2) consist of spodosols, which are well drained but typically moist. The top layer consists of humus, which is nutritionally rich, while lower mineral soil layers are deficient in nutrients. Soil depths can be very shallow where rocks and boulders are prevalent (USFS, 2008).

Soils within the general area of suburban Burlington consist of fine sandy loams in the uplands and muck soils in low-lying areas. The soil in the proposed location of the Relocatable Tower (R-02, Figure 3.D01-3) consists of Swansea muck and loamy Urdorthents. Swansea muck soils are very poorly drained and have slopes ranging from

0 to 1 percent. Swansea muck is not considered to be highly susceptible to sheet or rill erosion. The typical soil profile for Swansea consists of muck from the surface to 60 cm and stratified gravelly sand to loamy fine sand extends to 165 cm (NRCS, 2009e; NRCS, 2009h). Loamy Urdorthents consist of one or many of loamy alluvium deposits, sandy glaciofluvial deposits, loamy glaciolacustrine deposits, loamy marine deposits, and loamy lodgment fill (NRCS, 2009f).

The soil at the proposed location of the Harvard Forest Aquatic Array (A-01, Figure 3.D01-1) consists of Pillsbury-Peacham soil, a very poorly drained soil with slopes ranging from 0 to 8 percent. The typical soil profile for Pillsbury-Peacham is a gravelly fine sandy loam to 165 cm. Pillsbury-Peacham is not considered highly susceptible to sheet or rill erosion (NRCS, 2009a; NRCS, 2009g).

Soils in the area of the proposed Burlington Aquatic Array (A-02, Figure 3.D01-3) in Burlington are fine sandy loam and extremely stony. The soil at the proposed location of this Aquatic Array is Whitman fine sandy loam, a very poorly drained soil with slopes ranging from 0 to 5 percent. The typical soil profile for Whitman fine sandy loam soil consists of fine sandy loam to 25 cm, sandy loam to 46 cm, and gravelly sand loam extends to 165 cm. Neither of these soils are considered highly susceptible to sheet or rill erosion. These soil types are located along much of the corridor of the stream where the Aquatic Array has been proposed (NRCS, 2009a; NRCS, 2009h).

### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

At each of the proposed NEON locations in Domain 1, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would be approximately 0.13 ha at the location with C-01, C-02, and A-01, approximately 0.1 ha at C-03, approximately 0.17 ha at R-01, and approximately 0.04 ha at the location with R-02 and A-02 The greater disturbance would result from extension of utility lines to the sites. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are highly prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and also for indirect impacts to surface waters from transport of eroded materials into nearby waterbodies.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Two of the proposed tower locations, Black Gum Swamp (C-02) and Burlington (R-02), would be in or near wetlands. Specific measures that would be implemented to protect the sensitive wetland soils at these locations are discussed below.

The muck soils in Black Gum Swamp (C-02) could be impacted by trampling and compaction from personnel accessing the site for data collection and maintenance. To prevent this type of impact, a boardwalk would be constructed to the tower site. Also, to minimize the potential for disturbance and compaction of these sensitive muck soils, the IH would be placed outside the swamp in an upland area and the electric power extension through Black Gum Swamp would be placed in an aboveground conduit.

The proposed Relocatable Tower in Burlington (R-02) would be placed in an area with muck soils, which typically indicates a wetland. This proposed location is adjacent to Sawmill Brook. The Relocatable Tower, guy wire anchors, and IH would be placed outside of any wetland area and the stream to avoid disturbance to these sensitive resources. If necessary, a boardwalk would be constructed across sensitive areas to access the tower and sensors. If the electric utility line would cross a wetland to reach the tower, the line would be placed in an aboveground conduit, to minimize disturbance and compaction of muck soils.

### Climate

#### *Affected Environment*

Domain 1 is strongly seasonal, with average annual temperatures ranging from 4 to 13˚C and average annual precipitation ranging from 80 to 130 cm. Annual precipitation is distributed fairly even throughout the domain. Using the Fujita scale as reference, F1-level wind damage from hurricanes is minimal in the western and northern areas of the domain to F1-level damage every 10 years on average in eastern Long Island and southeastern New England (Boose and Foster, 2003). F1-level wind damage at Harvard Forest occurs on average every 20 years (Foster, 2007). Extreme temperatures are the main limiting factor for conducting field work at Bartlett Experimental Forest and other proposed locations in Domain 1 (USFS Bartlett Experimental Forest, 2008).

#### *Environmental Consequences*

Due to the potential for extreme wind conditions from hurricanes, the Relocatable Tower at Burlington would be designed and secured to minimize the risk of loss from high winds. The Harvard Forest and Bartlett Experimental Forest areas have a lower probability of wind damage from hurricanes. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind.

### Air Quality

#### *Affected Environment*

Bartlett Experimental Forest is located in an area designated as in attainment for criteria air pollutants (USEPA, 2009a). Worcester County, the location of Harvard Forest, and Middlesex County, the location of the Burlington Relocatable Tower and Aquatic Array, are both listed as nonattainment areas in Massachusetts due to moderate levels of 8-hr ozone (USEPA, 2009a). Both Massachusetts proposed sites would be in the Boston-Lawrence-Worcester, eastern Massachusetts area, a major metropolitan area.

Harvard Forest and Bartlett Experimental Forest are within 161 km of designated Class I Wilderness Areas. The Lye Brook Wilderness Area in southwest Vermont is approximately 97 km northwest of Harvard Forest (USEPA, 2009b). The Great Gulf Wilderness Area is located approximately 32 km north of Bartlett Experimental Forest and the Presidential Range Dry River Wilderness Area is approximately 5 km north of Bartlett Experimental Forest (USEPA, 2009c).

### *Environmental Consequences*

Short-term negligible direct and indirect impacts will occur to air quality during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because the proposed NEON locations in Domain 1 are separated in space and emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts to air quality. The construction area at any location would be less than 0.01 ha and no large earthmoving equipment would be used. BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions. Proposed instrumentation sites are located on private property with no surrounding development. Human health and human nuisance values would not be impacted from fugitive dust created during construction. Similar temporary impacts to air quality would be expected at the time of site closure as infrastructure is removed.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze and would not impact visibility at any of the Class I areas within 161 km of a proposed NEON location.

## Noise

### *Affected Environment*

Existing noise levels at the proposed Harvard Forest and Bartlett Experimental Forest locations would likely be approximately 40 dBA (USEPA, 1974), as both are in rural areas. Baseline noise levels at the proposed tower location in Burlington would be expected to range from 45 to 60 dBA due to the urban surroundings. The proposed Relocatable Tower at Burlington would be located in a community park containing ball fields and tennis courts that is within a larger residential area.

### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would have no impacts to residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Equipment and materials would be brought in by hand with as little impact as possible. No new roads would be constructed. During construction, noise levels would be elevated periodically only during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc. Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels after construction. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure.

The proposed location of the Relocatable Tower at Burlington (R-02) is at a community park with tennis courts and ball fields. The park also is adjacent to a powerline right-of-way (ROW). Residential areas surround this location. Noise levels inside nearby homes and at the community park could be elevated during construction. Absent intervening vegetation, the sound of the walk-behind trencher would be reduced to 82 dBA as a result of natural attenuation from traveling approximately 12 m to nearby homes (FHWA, 2007). Because of the short distance, persons inside the closest residences would not likely experience any noise reduction from the intervening vegetation. This level of noise would be comparable to that made by a gas-engine lawn mower (Cowan, 1999) and would interfere with conversations outdoors at nearby residences and at the park. Operation of the trencher would not prevent the conduct of recreational activities at the park. Persons inside of houses would experience a further reduction of 15 – 25 dBA (USEPA, 1974). Indoor noise levels during trenching would be expected to range from 57 and 67 dBA, which would be noticeable and may require that people increase the volume on televisions or radios to hear clearly. Any noise impacts at the proposed Burlington Relocatable Tower (R-02) would likely be temporary and minor.

Wildlife in the immediate construction areas at Bartlett Experimental Forest (R-01) and Harvard Forest (C-01, C-02, C-03) would be exposed to the elevated noise and would be expected to temporarily relocate from the active construction area. Following construction, any displaced animals would be expected to resume normal activity and return to use of the areas. Any construction-related noise impacts would be temporary and minor.

The atmospheric sampling equipment pumps on the FIU would operate continuously. Typically, these pumps produce noise of approximately 65 dBA. NEON, Inc. would place the pumps within noise shielding to reduce the sound to less than 60 dBA at 12 m. This would likely result in long-term minor impacts to residents in the neighborhood near the proposed tower in Burlington.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations, excluding Burlington. The proposed tower in Burlington would be in a residential area and impacts to wildlife would be negligible.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at Core Site tower locations and up to 5 years at Relocatable Sites).

Noise from the AOP would have potential to impact residents near the proposed Burlington Relocatable Site (R-02). No sensitive noise receptors live near the proposed Core Site or the Bartlett Experimental Forest Relocatable Site. AOP flights at 1,000 m above the canopy would be expected to have no impact on residents. AOP flights at 150 m above the canopy would be a short-term nuisance, but any impacts to residents would be negligible.

The potential for AOP flights to disturb wildlife is discussed below.

### Water Quality

#### *Affected Environment*

The proposed locations of Advanced Tower C-01 and Basic Tower C-03 at Harvard Forest are in upland areas, with the proposed location of Basic Tower C-03 less than 30 m from an unnamed tributary of Bigelow Brook (Table 3.5.1.3-1). The proposed location for Basic Tower C-02 at Harvard Forest is in Black Gum Swamp and Aquatic Array (A-01) at Harvard Forest would be located on the upper reaches of the unnamed tributary to Bigelow Brook near Basic Tower C-03.

The proposed Relocatable Tower (R-02) and Aquatic Array (A-02) in Burlington would be along Sawmill Brook in the Ipswich River watershed. Middle reaches of the Ipswich River typically are dry during summer because of municipal water withdrawals coupled with river flow being less than evapotranspiration (Plum Island LTER, 2008).

Bartlett Experimental Forest is located in an upland area and has no permanent rivers, lakes, or peat bogs (USFS, 2008). There are first-order intermittent and ephemeral

**TABLE 3.5.1.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 1, Northeastern United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-01 | 14 | 0 | 31 | 0 | 61 | 0 |
| C-02 | 14 | 0 | 34 | 1 | 62 | 1 |
| C-03 | 14 | 1 | 32 | 0 | 67 | 1 |
| R-01 | 15 | 0 | 6 | 0 | 25 | 0 |
| R-02 | 7 | 1 | 27 | 0 | 172 | 0 |
| A-01 | 14 | 1 | 31 | 0 | 70 | 0 |
| A-02 | 7 | 1 | 39 | 0 | 230 | 1 |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009c.

streams on the property (Table 3.5.1.3-1). These streams and their associated riparian corridors are used for research (USFS, 2008).

### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. AOP overflights would have no impacts to residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

During construction there would be potential for erosion and sedimentation should rain events occur while disturbed soils are exposed. NEON, Inc. would implement BMPs, as discussed in Section 2.2.2, would be used to minimize the potential for impacts to water quality, such as elevated turbidity and nutrient enrichment, as a result of erosion and sedimentation. Because the amount of disturbance would be small (less than 0.01 ha), the amount of new impervious area would be less than 35 $m^2$ at any location, and appropriate BMPs would be implemented, any impacts would be temporary and negligible. The potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. The potential for similar temporary impacts to water quality would be expected at the time of site closure during removal of infrastructure.

## Wetlands

### *Affected Environment*

The proposed locations of the Advanced Tower C-01 and Basic Tower C-03 at Harvard Forest are in upland areas with no nearby wetlands (Table 3.5.1.3-1). Basic Tower C-02 at Harvard Forest would be located in Black Gum Swamp, a forested wetland. The proposed Relocatable Tower and Aquatic Array in Burlington would be along Sawmill Brook, where forested/shrub wetlands are prevalent along the creek corridor (Table 3.5.1.3-1).

### *Environmental Consequences*

There would be minor long-term direct impacts to wetlands from installation of Basic Tower C-02, placement of fencing, and construction of boardwalks to access C-02. No other direct wetland impacts would occur. No indirect wetland impacts would be likely from implementation of NEON in Domain 1. No cumulative impacts to wetlands would be expected from this project.

Black Gum Swamp at Harvard Forest would be impacted by placement of the tower (C-02), guy wire anchors, and fencing around the tower. The amount of disturbance would be the minimum necessary to secure the tower and any facilities placed in the wetlands would be removed at the close of the project. To eliminate other potential disturbance to Black Gum Swamp, utility lines would be brought to the tower through an above-ground conduit. A boardwalk (approximately 100 m) would be constructed to minimize the potential for impacts from site access for maintenance and data collection. NEON, Inc. would evaluate the use of piers rather than a tower pad to support the tower (C-02) in Black Gum Swamp. Further, NEON, Inc. would implement and maintain appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for direct and indirect impacts to Black Gum Swamp. NEON, Inc. would obtain all required local, state, and federal permits regulating activities in wetlands prior to construction at this site and would comply with all permit conditions during construction activities (see Section 5 for a discussion of permits and approvals required).

Temporary minor impacts to Black Gum Swamp would also be expected at the time of site closure. However, site closure would result in removal of the NEON tower and boardwalk from Blackgum Swamp, which would then be a long-term benefit to Black Gum Swamp as the swamp returned to its pre-construction condition.

NEON infrastructure along Sawmill Brook in Burlington (A-02) would be placed outside of wetland areas. NEON, Inc. would implement and maintain appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for direct and indirect impacts to wetland areas along Sawmill Brook. Similar temporary impacts to wetlands could occur at the time of site closure during removal of infrastructure from the Sawmill Brook area.

## Floodplains

### *Affected Environment*

Floodplains in the Harvard Forest and at the proposed Burlington sites are confined to the immediate area of streams and wetlands. The Advanced Tower (C-01) and Basic Tower C-03 would not be located in floodplains. Basic Tower C-02, in Black Gum Swamp, would be in a floodplain (FEMA, 1979a). The proposed Aquatic Array in Burlington would be located in the Sawmill Brook floodplain (FEMA, 1984). Floodplain mapping is not available for Bartlett Experimental Forest; however, the proposed Relocatable Tower at Bartlett Experimental Forest would be located in steep gradient terrain on a mountain and would not be in any flood prone area.

### *Environmental Consequences*

There would be negligible direct impacts to flood prone areas as a result of implementation of NEON. One Basic Tower would be placed in areas prone to flooding. The minimal displacement of the proposed equipment would result in a negligible impact on flood storage, flood elevations, and flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected.

Placement of the Basic Tower C-02 in Black Gum Swamp would result in a negligible change in flood storage and flood elevations. The portion of Black Gum Swamp where the tower would be placed is not a flood conveyance area, so there would be no impact on flood conveyance. There would be no cumulative impacts to floodplains in Domain 1.

There would be the potential for equipment to be damaged during flood events.

### Common Vegetation and Plant Communities

#### *Affected Environment*

Harvard Forest is located in a transitional hardwood habitat, with white pine and hemlock. Harvard Forest has been conducting research at the site since the early 1900s (Harvard Forest, 2008a). Tree plantations, consisting of primarily non-native conifers planted at Harvard Forest in the early 1900s, are now between 60 and 90 years old and cover approximately 7 percent of the land (Harvard Forest, 2008b). Dominant native vegetation at Harvard Forest includes red oak, red maple, black birch, white pine, and eastern hemlock. Red spruce, black spruce, and larch are common dominant wetland trees in peatlands (Harvard Forest, 2008a). The proposed Advanced Tower C-01 would be in a mixed hardwood forest consisting of red oak and red maple. Proposed Basic Tower C-03 would be in a mixed conifer-hardwood forest dominated by hemlock and red oak. The proposed Black Gum Swamp location (Basic Tower C-02) would be in a mixed conifer-hardwood forested wetland dominated by red spruce, hemlock, red maple and black gum trees (Keller, 2008).

Burlington is a suburban area near Boston. Vegetative communities are fragmented and are situated between residential and commercial development. The vegetation near the proposed Relocatable Tower location has been largely replaced by development of houses with lawns. Remnant canopy trees of mixed hardwood species are scattered. The proposed Sawmill Brook aquatic location (A-02) is within an area where dominant overstory trees are mixed hardwood species (oaks and maples), with wetland species occurring along the margins of the stream in some locations.

Bartlett Experimental Forest land cover consists almost entirely of uneven-aged woodlands. Primary canopy dominants include sugar maple, American beech, and yellow birch. Spruce and fir occur at the higher elevations, while white pine is present mainly at lower elevations. Hemlock, balsam fir, and spruce are common and typically mix with hardwoods on cool steep slopes. Due to the cold climate of this area, many southern species are absent (USFS Bartlett Experimental Forest, 2008). Natural communities occurring within a 5-km radius of the proposed tower (R-01) include dry red oak-white pine forest, hemlock-beech-oak-pine forest, red oak-ironwood-Pennsylvania sedge woodland, rich mesic forest, rich red oak rocky woods, and sugar maple-ironwood-short husk floodplain forest (New Hampshire Natural Heritage Bureau). The montane cliff and sand plain basin marsh ecological systems also occur within a 5-km radius of the proposed NEON site (New Hampshire Natural Heritage Bureau). The area around proposed tower R-01 is currently managed as a research area focusing on silviculture, wildlife, and forest productivity measurements (USFS, 2005).

### *Environmental Consequences*

Tree removal along utility lines would be a minor long-term impact to vegetation and plant communities. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project activities, up to approximately 5 years at Relocatable Sites and 30 years at the Core Site. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate. Where overhead utility lines are extended, there could be limited removal of trees along the route. Because of the need to keep the utility lines clear of woody vegetation, these would be kept free of trees by hand removal of saplings, as necessary, until the end of the NEON project.

Tree removal along utility lines would be a minor long-term impact to vegetation and plant communities. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines.

NEON, Inc. would coordinate with the USFS and other researchers to resolve any conflicts between current research activities and the placement of proposed R-01 in the Bartlett Experimental Forest. A Special Use Permit would be required and is further discussed in Section 5. Current research activities near proposed R-01 in the Bartlett Experimental Forest would not be affected by proposed NEON studies.

Some minor clearing of vegetation, primarily along utility lines, would occur at site closure. However, areas kept clear of trees to maintain overhead transmission lines during the NEON project would be allowed to return to woody vegetation.

## Common Fauna
### *Affected Environment*

Harvard Forest contains a wide variety of habitats and supports most of the common wildlife species that occur in Massachusetts.

Common large mammals would include the white-tailed deer, black bear, coyote, and wild turkey (Bernardos et al., 1998). Moose occur locally in northeastern, central, and western Massachusetts and could occur in the area of Harvard Forest. Other mammals that may occur near NEON locations include the bobcat, striped skunk, opossum, fisher, ermine, long-tailed weasel, American mink, raccoon, gray fox, a variety of mice, rats, voles, and lemmings, porcupine, hoary marmot, and American beaver. A variety of squirrels, hares and rabbits, shrews, bats, and moles also would be expected to occur (Massachusetts Division of Fisheries and Wildlife [MDFW], 2009a).

There are 448 species of birds known to occur in Massachusetts, with 216 species known to nest in the state. Of the birds that occur in Massachusetts, 260 are neotropical migrants, while 40 species are considered permanent residents. Permanent residents include the ruffed grouse, house sparrow, black duck, and brown creeper. The wood-warbler family has the most species in the state (24 species known to breed regularly) (MDFW, 2009b).

Common amphibian species include the eastern newt, eastern red-backed salamander, spring peeper, green frog, and wood frog. Salamanders and newts would be more prevalent in or near riparian zones and streams. Common reptile species include the painted turtle, common garter snake, and ringnecked snake (MWFD, 2009c).

The proposed locations in Burlington are in an urban area with fragmented habitats, which would support fewer species than corresponding wildland habitats and would not provide habitat for bear or deer. At Sawmill Brook, 72 percent of the watershed has been developed residential, and only approximately 14 percent of the native vegetation remains (Plum Island LTER, 2003).

Approximately 15 species of amphibians and reptiles, 90 species of birds, and 35 species of mammals have been identified at Bartlett Experimental Forest since 1931. Mammal species occurring in the area include weasel, fisher, bobcat, a variety of bats, and snowshoe hare. Larger species, such as moose, black bear, and white-tailed deer are fairly common. Redbacked salamander, spring salamander, and two-lined salamander are common, as are wood frogs. Raptors, including the red-tailed hawk, goshawk, barred owl, and saw-whet owl, are common at Bartlett Experimental Forest. A variety of neotropical migratory birds and resident birds are known to occur (USFS Bartlett Experimental Forest, 2008). Proposed tower R-01 would be placed in an area currently used for wildlife research (USFS, 2005).

### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed Harvard Forest sites (C-01, C-02, C-03) and the proposed Bartlett Experimental Forest site (R-01) have adequate habitat surrounding the proposed locations, which could provide refuge during construction. Similar temporary disturbance-related displacement would be expected to occur at site closure.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

The Burlington area would not provide sufficient habitat to support a large population of wildlife and minimal wildlife disturbance would be expected at R-02 and A-02.

Towers and guy wires would pose a minimal risk to common birds and flying mammals. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because flights would be conducted after canopy leaf-out, visual stimuli would be minimal and the closed canopy could reduce airplane noise. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the New Hampshire Fish and Game Department and the Massachusetts Division of Fisheries and Wildlife prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

Because impacts would be separated in space and time, no potential for interaction among proposed NEON project or between NEON projects and other projects would be expected.

### Sensitive Ecological Communities

#### *Affected Environment*

No portion of Harvard Forest, Bartlett Experimental Forest, or the proposed NEON locations in Burlington have been designated as critical habitat by USFWS. A state-specified priority habitat is approximately 0.4 km south of the proposed Burlington Relocatable Tower site (R-02), in the electric transmission ROW adjacent to Rahanis Park.

Black Gum Swamp, the proposed location of C-02, is considered a sensitive habitat. This site was selected to monitor how this type of sensitive habitat might change in response to human activities.

#### *Environmental Consequences*

The priority habitat south of the proposed Burlington Relocatable Tower R-02 would not be impacted by placement and operation of NEON infrastructure at the site. There would be minor impacts to Black Gum Swamp from the construction of C-02, as discussed above, that would last for the 30-year duration of the NEON project. Site design would minimize the impacts that would result and implementation of appropriate BMPs, as described in Section 2.2.2, would minimize the potential for indirect impacts to this habitat. No other proposed NEON locations in Domain 1 would be in or near sensitive habitats. Black Gum Swamp would be restored at the time of site closure. No cumulative impacts to sensitive ecological communities would result.

### Sensitive Species

#### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 1 (Table 3.5.1.3-2). However, there are known occurrences of either state or federal protected species within 5 km of all proposed sites. In addition, potentially suitable habitat for protected species is present at or adjacent to the proposed locations of Relocatable Towers, Aquatic Arrays, and Core Site Basic Tower C-02 (Table 3.5.1.3-2). The following sections discuss the species with potential to occur at or adjacent to proposed NEON sites in Domain 1.

**TABLE 3.5.1.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 1, Northeastern United States
*National Ecological Observatory Network (NEON) EA*

| | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-01 | 0 | 0 | 0 | 2 | 0 | 0 |
| C-02 | 0 | 0 | 0 | 2 | 0 | 1 |
| C-03 | 0 | 0 | 0 | 2 | 0 | 0 |
| R-01 | 0-ESA<br>4-USFS | 0 | 0-ESA<br>6-USFS | 8 | 0 | 3 |
| R-02 | 0 | 0 | 0 | 1 | 0 | 1 |
| A-01 | 0 | 0 | 0 | 2 | 0 | 1 |
| A-02 | 0 | 0 | 0 | 2 | 0 | 1 |

Source: Appendix B Domain 1

### Federally Protected Species

There are no documented occurrences of species protected under the ESA within a 5-km radius of any of the proposed NEON locations in Domain 1 (Table 3.5.1-2; Massachusetts Division of Fisheries and Wildlife, 2008; New Hampshire Natural Heritage Bureau, 2008). There are four USFS species of concern that occur within 5 km of proposed R-01, and potentially suitable habitat for six USFS species of concern occurs at or adjacent to this site. Birds listed under the MBTA are known to occur in Harvard Forest and in Bartlett Experimental Forest. MBTA species also may occur in Burlington.

#### *USFS Species of Concern*

The six USFS species of concern potentially occurring at or adjacent to a proposed NEON location in Domain 1 include the Douglas' knotweed, American ginseng, Eastern small-footed bat, wood turtle, autumn coral-root, and nodding pogonia. The Douglas' knotweed and American ginseng are state protected species and are discussed in the State Sensitive Species section.

The Eastern small-footed bat prefers mountainous and hilly landscapes. The bat hibernates in mine shafts and caves during the winter and uses rock crevices and buildings to roost during the summer (ODNR, 2009). This species could occur at proposed Relocatable Site R-01.

The wood turtle typically inhabits forested areas near rivers or streams. The turtle hibernates in slow-moving streams, rivers, and some ponds, and spends summers usually near permanent streams in upland bogs, wet meadows, upland fields, farmland, and deciduous forest (USFS, 2007). This species could occur at proposed Relocatable Site R-01.

Autumn coral-root is found in open hardwood or mixed forests (MDFW, 1994). Nodding pogonia typically occurs in maple, beech, and eastern hemlock hardwood and mixed forests (NYNHP, 2009). Both species could occur at proposed Relocatable Site R-01.

#### State Sensitive Species

At Harvard Forest there are two state-listed species of dragonfly known to occur within 5 km of the proposed NEON locations (Table 3.5.1.3.2). The ebony boghaunter prefers wet sphagnum bogs and swampy northern wetlands, typically adjacent to coniferous or mixed coniferous and deciduous woodlands. This species could occur in and around Black Gum Swamp. The ski-tipped emerald inhabits small to medium streams with moderate to very slow flow with emergent vegetation (Table Domain 1. Appendix B). This species could occur along the unnamed tributary to Bigelow Brook at the proposed Aquatic Array.

The great blue heron is a state species of conservation interest that is protected under the MBTA. The great blue heron has been documented within 5 km of the proposed NEON locations at Harvard Forest (MDFW, 2008). Great blue heron forage in shallow waters and mudflats and nest near suitable foraging areas (NatureServe, 200b9). Great blue heron may occur in Black Gum Swamp.

The state-listed eastern box turtle is known to occur within 5 km of the proposed NEON locations in Burlington and could occur in the habitats near those locations. This turtle occurs in dry and moist forests, brushy fields, thickets, wet habitats, and well-drained bottomlands. This species could occur at either of the two proposed NEON locations and at Bartlett Experimental Forest (Table Domain 1, Appendix B).

There are four state-listed plant species known to occur within 5 km of the proposed Relocatable Tower at Bartlett Experimental Forest that could occur near the proposed NEON location. American cancer root, Douglas' knotweed, Fogg's Goosefoot, and ginseng may occur in the habitats at or adjacent to the proposed tower site (Table Domain 1. Appendix B). The state-listed small-footed bat was observed by researchers at Bartlett Experimental Forest during mist netting in 1999 and could occur at the proposed R-01 location (Yamasaki, personal communication, 2009).

### *Environmental Consequences*

Minor short-term and long-term impacts to sensitive species could result from installation of NEON infrastructure. No cumulative impacts to sensitive species would be expected.

NEON, Inc. would work with property owners and site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid any such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat.

Activity and noise associated with construction would likely temporarily displace great blue heron from the vicinity of the tower (C-02) in Black Gum Swamp. The birds do not nest in this area and would be able to relocate to other suitable foraging habitat nearby. Any impacts to great blue heron would be negligible and limited to the period of construction. Comparable minor disturbance to great blue heron would be expected during infrastructure removal at site closure.

The tower (C-02) and guy wires would pose a minimal risk to great blue heron at Black Gum Swamp. The tower and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower would be unlikely and any impacts would likely be negligible. This potential risk to great blue heron would not exist after site closure.

The two dragonfly species would not be expected to respond to construction activity noise. No impacts to protected dragonfly species would be expected from construction. Mosquito traps deployed at FSUs could impact these sensitive species through incidental capture. Because the traps would be deployed in vegetation and not in the aquatic habitats in which the dragonflies typically forage, any impacts would likely be negligible.

Proposed work areas at Burlington (R-02, A-02) would be examined for eastern box turtle and their nests. Any turtles found would be relocated to suitable habitat away from the construction areas. If determined to be necessary, exclusion fencing would be placed around active construction to prevent turtle entry. Potential impacts to the eastern box turtle would be avoided through the same process during site closure.

Clearing and fencing associated with construction of R-01 could impact sensitive plant species in Bartlett Experimental Forest. Clearing would be kept to the minimum necessary to install the NEON infrastructure and all areas proposed for clearing, trenching, and fencing would be inspected for the presence of sensitive plant species. Should a sensitive population of plants be found, the proposed activity would be relocated a short distance to avoid the plants, if possible. If relocation of the proposed infrastructure is not possible, plants would be transplanted to nearby suitable habitat if possible. No population-level impacts to sensitive plant species would be expected, although there could be limited direct loss of individuals.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the New Hampshire Fish and Game Department and the Massachusetts Division of Fisheries and Wildlife prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

MBTA listed birds would have the potential to be disturbed during construction and operation. Foraging or migrating birds would be expected to avoid areas adjacent to construction activity for the period of construction, but would likely resume use of the area following construction. Should nesting MBTA species be found in or adjacent to a planned construction area, work would be delayed until after the young have fledged. Similar impacts would be expected at site closure and work during the nesting and pre-fledging period would be avoided.

### Cultural Resources

#### *Affected Environment*

The proposed NEON locations for Domain 1 are within three areas: the White Mountain National Forest near Bartlett, New Hampshire, the Harvard Experimental Forest near Petersham, Massachusetts, and the town of Burlington, Massachusetts. The White Mountain National Forest spans New Hampshire and Maine and encompasses approximately 323,750 ha. The Harvard Experimental Forest encompasses 1,215 ha of undeveloped land, research facilities, and the Fisher Museum. Burlington, Massachusetts is located in eastern Massachusetts near Boston. The locations of the proposed NEON Relocatable facilities are in relatively developed areas of Burlington.

### Prehistoric Context

During the past several years, more evidence is being gathered that human occupation of North and South America began earlier than the Terminal Pleistocene ca. 12,000 before present (BP). The first peoples which left definitive evidence of occupation in the Northeast were small, highly mobile groups adapted to a floral and faunal environment that resulted from the retreat of the Wisconsin continental ice sheet. This Paleoindian Period lasted from approximately 10,000 until 8000 B.C. in the Northeast and is represented by a general hunter and gatherer strategy. Sites are generally located on hills or rises where good drainage resulted in dry living floors. The Archaic Period, which began approximately 10,000 years ago and lasted until 1300 B.C., is represented by small populations which continued to move about in mobile egalitarian groups, hunting smaller game and gathering an ever-widening variety of supplies (Funk, 1978).

These populations gradually grew, adapting to changing climatic conditions and becoming more sedentary by the Late Archaic. Along the coast of New England, marine resources were heavily exploited at the end of the Archaic by populations sometimes regarded as a distinct cultural group (Snow, 1978, Starbuck, 2006).

The Transition Period, or Terminal Archaic, lasted from 1300 to 1000 B.C. in New England. This short period between the Archaic and the rise of the Woodland Period is defined by the greater sedentism, continued hunting and gathering, and use of carved soapstone vessels, which predate true pottery, and cremation burials with "killed" artifacts (Starbuck, 2006). The Woodland Period dates from approximately 1000 B.C to approximately A.D. 1600 and refers to the rise of sedentary cultures of the extensive eastern United States woodlands. By the Woodland Period, people in New England had begun practicing horticulture and had started using pottery. By the end of the Woodland Period, palisaded villages, cemeteries, ceremonial dumps, and craft specialization are visible in the archaeological record (Starbuck, 2006). The Woodland Period ended with European contact. The Europeans introduced a range of diseases to the local native populations. Epidemics of smallpox throughout the 1600s killed thousands of Native Americans along the East coast (Brasser, 1978). The Contact Period dates from approximately 1600 A.D. to the present. At the beginning of the Contact Period, the Massachusett inhabited the shores and estuaries along Massachusetts Bay, while Nipmuck territory covered much of central Massachusetts (Simmons, 1986), bordering the Western Abenaki to the north (Salwen, 1978). Massachusetts Bay Colony Puritans attempted to convert the Massachusett and the Nipmuck to Christianity and moved them onto plantations referred to as praying towns. By the early 1800s, few were left. In New Hampshire, the location of the proposed NEON facility is in the White Mountain area of the Western Abenaki (Day, 1978). In 1884, a camp was established at Intervale, near the proposed NEON location, by several members of the Western Abenaki, who created crafts to sell to tourists (Starbuck, 2006).

### Historic Context

The first European known to have explored the New England coast was Italian explorer Giovanni Caboto in the late 1400s. Another Italian, Giovanni Verrazano, followed in the early 1500s. French and English explorers found their way to New England in the early 1600s, including John Smith and Henry Hudson. In 1620, the Pilgrims landed at Plymouth and established the second permanent English colony in the New World. The first permanent settlement in New Hampshire was founded in 1623 at Odiorne's Point in present day Rye, New Hampshire. King Philip's War, between the colonists of present day New England and Native Americans, lasted from 1675 to 1676. The brief war further negatively impacted declining Native American populations. In 1679, Massachusetts briefly gained control of the colony of New Hampshire. The two colonies were officially separated by the British crown in 1691. The late 1600s saw the start of the infamous witch trials in New England. From 1756 until 1763, the colonists of Massachusetts and New Hampshire fought alongside the British in the French and Indian Wars. Relations with the British deteriorated rapidly over the next decade with the passing of the Sugar Act, the Stamp Act, and other "Coercive Acts." New Hampshire was the first colony to declare itself independent from England and by 1776, Massachusetts and New Hampshire, two of the original 13 colonies, had entered the Revolutionary War. Massachusetts abolished slavery during this war, the first state to do so. In 1788, Massachusetts and New Hampshire became the sixth and ninth states, respectively, to ratify the U.S. Constitution (Tager, 2004).

The Industrial Revolution was strongly felt throughout New England. The textile industry in Massachusetts expanded and several planned factory towns, including Waltham and Lowell, were founded in 1813 and 1822, respectively. Irish immigrants flooded the state in 1846, primarily seeking work at the large textile mills throughout the state. Industry in New Hampshire consisted of processing forest products, stonecutting granite, and extensive brickyards. Textile mills were founded throughout New Hampshire as water power was harnessed at the many waterfalls in New Hampshire (Starbuck, 2006). During the years preceding the Civil War, Massachusetts was a stronghold of abolitionist activities. When the Civil War began in 1861, the state of Massachusetts raised the first all-black regiment. By the 1900s, the New England population had shifted from a rural agricultural population to a primarily urban dwelling population with several profitable industries, textile production and shoe manufacture being the top two (Tager, 2004). These two industries collapsed throughout New England during the Great Depression and in the years after World War II, Massachusetts moved from an industry based economy to one that relied primarily on service and high-technology companies. Although a predominantly urban state, agriculture, particularly cranberry production, still exists in the Massachusetts economy. Major industries in New Hampshire, which has consistently had a fairly diverse economy, include lumber, pulp, and paper industries, as well as new industries such as tourism and crafts (Starbuck, 2006).

### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 1, including a 1.6-km radius study area around the proposed location. This search consisted of a review of the online Massachusetts Cultural Resource Information System (MACRIS), which contains information about historic buildings, burial grounds, and other objects or structures, the Massachusetts Historical Commission (MHC), which contains data from previous surveys, historical and archaeological sites, soil survey data, and other historical information, and the New Hampshire Division of Historical Resources (DHR). The DHR maintains town research files and archaeological site files for the entire state of New Hampshire. Additionally, the following historic maps were reviewed: John Payne's *The State of Massachusetts from the Best Authorities*, Henry Tanner's 1833 *Massachusetts and Rhode Island*, S.F. Baker's 1857 *Massachusetts,* the 1892 *Railroad Map of New Hampshire,* the 1892 *Bartlett, Carroll County Map,* Rand McNally's 1895 *Massachusetts*, the 1894 *Winchendon, Massachusetts* 30' USGS topographic quadrangle map, the 1908 *Ware, Massachusetts* 30' USGS topographic quadrangle map, the 1935 *Winchendon, Massachusetts* 15' USGS topographic quadrangle map, and the 1946 *Crawford Notch, New Hampshire* 15' USGS topographic quadrangle map. The National Register Information System (NRIS), which contains information related to properties listed on the NRHP, was also consulted for Worcester and Middlesex Counties, Massachusetts, and Carroll County, New Hampshire.

None of the proposed NEON locations in Domain 1 have been previously surveyed for cultural resources. A total of five previous studies have been conducted within the

1.6-km study areas of the NEON facilities in Burlington and one previous study has been conducted within the 1.6-km study areas of the Harvard Forest.

Resources previously documented within the vicinity of the proposed NEON locations include historic residences, farms, cemeteries, churches, schools, and one historic district (Table 3.5.1.3-3). These built historic resources include buildings formally recorded in MACRIS as well as buildings and features that are visible on the various historic maps reviewed. No previously recorded prehistoric or historic archaeological resources are known to exist within the area of disturbance of any NEON facilities in Domain 1.

**TABLE 3.5.1.3-3**
Literature Search Results—Domain 1, Northeastern United States
*National Ecological Observatory Network (NEON) EA*

| | | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | | |
|---|---|---|---|---|---|---|---|
| NEON Facility Number | Previously Surveyed | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Number Evaluated | Number Eligible |
| C-01 | No | 0 | 0 | 0 | 17 | 0 | n/a |
| C-02 | No | 0 | 0 | 0 | 21 | 0 | n/a |
| C-03 | No | 0 | 0 | 0 | 25 | 0 | n/a |
| R-01 | No | 0 | 0 | 0 | 172 | 0 | n/a |
| R-02 | No | 0 | 0 | 0 | 23 | 2 | 2 |
| A-01 | No | 0 | 0 | 0 | 22 | 0 | n/a |
| A-02 | No | 0 | 0 | 0 | 3 | 0 | n/a |

Source: Massachusetts Historical Commission (MHC), Massachusetts Cultural Resource Information System (MACRIS), New Hampshire Division of Historical Resources (DHR), National Register Information System (NRIS), the 1894 *Winchendon, Massachusetts* 30' USGS topographic quadrangle map, the 1908 *Ware, Massachusetts* 30' USGS topographic quadrangle map, the 1935 *Winchendon, Massachusetts* 15' USGS topographic quadrangle map, the 1946 *Crawford Notch, New Hampshire* 15' USGS topographic quadrangle map; n/a = not applicable

The study areas for the NEON locations within the Harvard Experimental Forest significantly overlap due to the proximity of the proposed facilities of the Core Site. A total of 32 resources are located within the combined study area of Core Tower C-01, Core Tower C-02, Core Tower C-03, and Aquatic Array A-01. These resources are a combination of structures formally recorded in MACRIS and buildings or features which are visible on the 1894 *Winchendon, Massachusetts* 30' USGS topographic quadrangle map, the 1908 *Ware, Massachusetts* 30' USGS topographic quadrangle map, and the 1935 *Winchendon, Massachusetts* 15' USGS topographic quadrangle map. Specifically, a total of 17 resources are located within the study area of C-01, a total of 21 resources are located within the study area of C-02, a total of 25 resources are located within the study area of C-03, and a total of 22 resources are located within the study area of A-01. Although most of these resources have been recorded, none have been evaluated as eligible for listing on the NRHP.

The study areas for the NEON locations in Burlington, Massachusetts partially overlap due to the proximity of the proposed locations and a total of 23 historic structures are recorded within the overall study areas of the two locations. These resources consist of those formally listed in MACRIS. Specifically, three structures are recorded within the study area for A-02, while 23 structures are recorded within the study area for Relocatable Site R-02. Of the total 23 structures recorded within the overall study areas in Burlington, two are listed on the NRHP. Both structures are well outside of the area of disturbance for either proposed NEON facility. A total of 157 historic structures are recorded within the 1.6-km study area for Relocatable Site R-01 on the 1946 *Crawford, Massachusetts*, 15’ USGS topographic map. In addition to the structures, 2 reservoirs, 12 historic roads, and the Maine Central Railroad, formerly the Portland and Ogdensburg Railroad, are depicted. None of these resources have been formally recorded or evaluated for the NRHP.

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 1 did not identify any significant known historic properties within or adjacent to areas where NEON infrastructure would be placed.

Of the many historic structures and other historic features that have been previously documented or appear on historic maps within the 1.6-km study area surrounding the NEON locations, two are listed on the NRHP. These two historic structures are within the study area for R-02 but well outside of the area of disturbance and not visible from proposed NEON infrastructure locations. The other resources within the study area have not been evaluated for significance.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 1, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF’s Section 106 compliance can be carried out.

## Utilities

### *Affected Environment*

Each proposed tower location at Harvard Forest (C-01, C-02, C-03) is within 1,000 m of electric transmission lines. The proposed Aquatic Array at Bigelow Brook is close enough to Basic Tower C-03 to share utility services.

The proposed Bartlett Experimental Forest Relocatable Site (R-01) is located about 1,500 m south of the village of Bartlett. Existing electric and communication services would be available at Bear Notch Road, approximately 1,285 m east of the AP.

The proposed Relocatable Site in Burlington (R-02) is adjacent to the power grid on Mill Street, and the proposed Aquatic Array on Sawmill Brook is approximately 150 m from the power grid.

### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the existing access road where access for maintenance activities would be available. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for environmental impacts from land disturbed by trenching.

### Transportation

#### *Affected Environment*

Access to Harvard Forest is from State Route 32, approximately 4.5 km south of Highway 202. The proposed NEON tower locations (C-01, C-02, C-03) within Harvard Forest are within 2 km of a paved road. Harvard Forest also has more than 50 km of gravel roads, placing almost any point within Harvard Forest within 0.5 km of an internal gravel road (Foster, 2007).

The proposed Burlington sites (R-02, A-02) would be in an urban area with multiple paved roads through the residential neighborhoods. The closest access to the proposed NEON sites would be from Skilton Lane off of Cambridge Street or from Mill Street off of Winn Street. All of these roads are two-lanes. The location of the proposed Relocatable Tower (R-02) at Burlington is adjacent to a community park and would be accessed through the parking area for the park. The proposed Aquatic Array would be accessed from Sawmill Road, a dead-end street off of Mill Street. A small parking area is located at the end of Sawmill Road, to provide local residents with access to the park area (Town of Burlington, 2009).

The proposed Relocatable Site at Bartlett Experimental Forest (R-01) is located approximately 80 m from an unpaved forest road and approximately 0.60 km from Bear Notch Road, the nearest paved road. U.S Route 302 is approximately 1.3 km north of the intersection of the forest road with Bear Notch Road. The road to Bartlett Experimental Forest closes at Thanksgiving and access through the winter is only by foot or snowmobile (Brissette, 2008, personal communication).

#### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and transported by hand from that point to the construction site. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur.

Improved trails would be created to move from the road to a proposed NEON location. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access. Trails created at the two proposed Burlington sites (R-02, A-02) would be expected to receive substantial human use in the area.

A boardwalk would be constructed to the proposed sampling location in Black Gum Swamp (C-02). Small footbridges would be constructed across streams if necessary to provide safe and low-impact access.

Bartlett Experimental Forest is open to the public, but the entry road is closed beginning at Thanksgiving. Only pedestrian and snowmobile access is available through the winter (Brissette, 2008, personal communication). The trail leading to the proposed Relocatable Tower (R-01) would be posted. The entrance would be gated and signed to deter snowmobile use.

### Human Health and Safety

#### *Affected Environment*

Harvard Forest is private property with access limited to staff and researchers. Both proposed Burlington sites (R-02 and A-02) are in areas open to public access and in proximity to an area with a high level of public activity, the Sawmill Brook Conservation Area (Town of Burlington, 2009). The proposed Bartlett Experimental Forest site has public access, but the proposed location is not typically used by the public.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. Similar risks would be present at the time of site closure. Appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

Harvard Forest is private and public access is not allowed. The proposed NEON location at Bartlett Experimental Forest (R-01) is not regularly used by the public. Therefore, the potential for human health and safety issues is minimal except at the proposed Burlington sites.

The proposed tower and aquatic locations in Burlington (R-02, A-02) would be in areas used regularly by the public. However, the tower, guy wires, and IH would be located within a locked fence. The aquatic instruments would not be fenced in, but would not impact human health or safety. These instruments would be secured. In addition, towers would be fenced and locked, reducing the risk of unauthorized access to the tower.

At Harvard Forest and Bartlett Experimental Forest, there would be the potential for staff or researchers riding all-terrain vehicles (ATVs) to contact the guy wires during routine work or during NEON maintenance and data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential of an injury.

### Recreation

#### *Affected Environment*

This section addresses the proposed NEON locations at Bartlett Experimental Forest (R-01) and Burlington (R-02, A-02). Harvard Forest is restricted and no public recreation occurs there. NEON would not affect recreational resources in or near Harvard Forest.

Burlington is a suburban community in the Boston area. Relocatable Site R-02 would be adjacent to Rahanis Park, which has two multi-purpose fields, two softball fields, six tennis courts, a basketball court, a sand volleyball court, a playground, a picnic area, and restrooms (Town of Burlington, 2009b). The tennis courts are used by the Burlington High School boys and girls tennis teams and heaviest use of the park is between May and October (Burlington Public Schools, 2009). The proposed Aquatic Array at Burlington (A-02) would be adjacent to the Sawmill Brook Conservation Area, which contains trails regularly used by the public for walks and hikes.

Bartlett Experimental Forest is used by the public for recreational activities such as hiking, biking, and snowmobile use. The road to Bartlett Experimental Forest closes at Thanksgiving and access through the winter is only by foot or snowmobile (Brissette, 2008, personal communication).

There are no NSTs or NHTs within 10 km of the proposed NEON locations in Domain 1.

#### *Environmental Consequences*

Minor short-term impacts to recreation may occur at some proposed NEON locations during construction. Long-term impacts on recreation would be negligible. Because the NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would be likely.

Construction activities and noise would have temporary, minor effects on the public using Rahanis Park and the Sawmill Brook Conservation Area. The greatest potential for disturbance would be noise during trenching for utility lines for R-02 and A-02. However, this disturbance would not prevent recreational activities at the park. Any impacts would likely be negligible. Access to the park could be temporarily interrupted when materials for construction are delivered, as the parking area for the park would be used for the deliveries. Any such interruptions would be intermittent, temporary, and minor.

Bartlett Experimental Forest is designated for research rather than for recreational activities (USFS Bartlett Experimental Forest, 2008). However, there is public use and recreation in Bartlett Experimental Forest. The area proposed for Relocatable Tower R-01 is not commonly used by the public. However, elevated noise levels during construction at Bartlett Experimental Forest would be noticeable by persons hiking on nearby trails. This noise would be a nuisance, but the elevated noise would cease following construction. Any impacts would be negligible.

**Protection of Children**

***Affected Environment***

Neither Harvard Forest nor Bartlett Experimental Forest are routinely visited by children and proposed NEON actions in these areas would not create environmental health or safety risks to children. Therefore, Harvard Forest and Bartlett Experimental Forest are not further discussed for this resource area.

The proposed NEON locations at Burlington (R-02, A-02) are adjacent to developed recreational areas that are frequented by children and in proximity to residential areas where children live and congregate. Both the proposed Relocatable Tower adjacent to Rahanis Park and the proposed Aquatic Array along Sawmill Brook would be expected to routinely have children present.

***Environmental Consequences***

No impacts to the environmental health and safety of children would be expected. Because NEON locations would be spatially separated, no cumulative impacts on the health and safety of children would be likely.

There could be potential safety issues for children from the temptation to try to climb the tower at Rahanis Park. Access to the tower would be restricted with secure fencing. As a result, no pathway would exist for direct exposure to an environmental health or safety risk. No impacts to the environmental health and safety of children would be expected.

### 3.5.1.4 References for Domain 1

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**Figure 3.D01-1** Domain 1 Proposed Site Locations

**Figure 3.D01-2** Domain 1 Proposed Site Locations

**Figure 3.D01-3** Domain 1 Proposed Site Locations

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### 3.5.2 Domain 2 Mid-Atlantic States

#### 3.5.2.1 Introduction

Domain 2 is east of the Appalachian Mountains and extends from west-central Georgia through the lower half of New Jersey (Figure 2-1). This domain includes the Coastal Plain, Piedmont, and Valley and Ridge Region. The Core Site Advanced Tower (C-04, Figure 3.D02-1), Basic Towers (C-05 and C-06, Figure 2-D02-1), and an Aquatic Array (A-03, Figure 3.D02-1) would be at the Smithsonian Conservation Research Center (SCRC) in Warren County, Virginia. A Relocatable Site (R-3, Figure 2-D02-3) would be placed at the Smithsonian Environmental Research Center (SERC) along the western shore of Chesapeake Bay in Anne Arundel County, Maryland. A Relocatable Site (R-4, Figure 3.D02-2) also would be placed at the Blandy Experimental Farm (BEF), which is operated by the University of Virginia, approximately 18 km north-northeast of the SCRC in Clarke County, Virginia. A STREON Site (S-04, Figure 3.D02-4) would be located at Oregon Ridge Park (ORP) in Baltimore County, Maryland.

#### 3.5.2.2 Resource Areas Considered But Not Addressed for Domain 2

Preliminary analysis indicated that there would be no potential to significantly impact five resource areas based on site locations. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Wetlands: There are no wetlands within or near the proposed NEON sites in Domain 2. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to wetlands.
- Sensitive Species: No natural populations of state or federally protected species are known to occur at or adjacent to the proposed NEON sites in Virginia and Maryland (Virginia Department of Conservation and Recreation [VDCR], 2008, Maryland Department of Natural Resources [Maryland DNR], 2009a). NEON infrastructure and operation would be separated from the part of the SCRC where protected species research and breeding are done.
- Environmental Justice: The proposed NEON sites would be located on private land with limited public access or on public lands. All potential impacts would be confined to the immediate areas and there would be no potential to disproportionately impact minority or low-income populations.
- Protection of Children: The proposed NEON sites would be placed in areas that are not routinely visited by children and placement of the NEON infrastructure would not attract children to these sites. All potential impacts would be confined to the immediate areas and no environmental health and safety risks to children would be created.

#### 3.5.2.3 Resource Areas Considered in Detail for Domain 2

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 2 where site-specific conditions would influence the anticipated environmental consequences.

## Geology/Seismicity

### *Affected Environment*

Domain 2 encompasses many of the physiographic regions that lie within the Mid-Atlantic States, including Valley and Ridge, Blue Ridge, Piedmont, and Coastal Plain (USGS, 2009a). The Piedmont and Blue Ridge Regions are underlain by metamorphic and igneous rocks that form complex bedrock that is overlain by an unconsolidated material known as regolith, which is mostly earthy, decomposed bedrock (USGS, 2009b). The Valley and Ridge Region consists of permeable rocks that have folded to form a series of parallel valleys (USGS, 2009c). The Coastal Plain, which stretches from North Carolina to Delaware, is underlain by young sedimentary rocks overlaying older harder rocks from the Piedmont. The layer of sedimentary rock is thinnest at the fall line where the Coastal Plain meets the Piedmont and becomes increasingly thicker toward the sea (New Georgia Encyclopedia, 2009).

Within the vicinity of proposed NEON sites, the maximum % pga acceleration with a 2 percent probability of occurrence in 50 years ranges from 8 % pga to 12 % pga for short wave motion and is 4 % pga for long wave motion (USGS, 2008a, 2008b).

### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites would not be placed in areas with geological features that influence surface activity and NEON activities would not impact the underlying geology. The seismic hazard is low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

## Soils

### *Affected Environment*

Soils within the general area of the proposed locations in the SCRC consist of Myersville and Montalto soils and Lew loam. Myersville and Montalto soils are very stony and have slopes ranging from 15 to 25 percent. These soils are considered to be mildly susceptible to rill and sheet erosion. The soil at the proposed location at the SCRC (C-04, C-05, and C-06) consists of Lew loam. Lew loam is well drained, with slopes ranging from 25 to 65 percent. The typical soil profile for this type of soil is channery loam to 31 cm and very channery loam to 153 cm. This soil is not considered to be highly susceptible to rill and sheet erosion. The soil at the Posey Creek Aquatic Array A-03 proposed for this site is also Lew loam (NRCS, 2009a; NRCS, 2009b).

Soils in the vicinity of the SERC and the proposed Relocatable Site R-03 mostly consist of variations of Collington-Wist soil. The soil type prevalent on the proposed site for Relocatable Site R-03 is Collington-Wist complex. This soil is well drained, with slopes ranging from 5 to 10 percent. The typical soil profile for this type of soil is fine sandy loam to 25 cm, sandy clay loam to 87 cm, and fine sandy loam extending to 183 cm. This soil type is not considered highly susceptible to rill or sheet erosion (NRCS, 2009c; NRCS, 2009d).

The soil in the vicinity of the proposed location of Relocatable Site R-04 at the BEF consists of variations of Poplimento silt loam. The soil type at the proposed location of Relocatable Site R-04 is Poplimento silt loam, which is rocky and has a slope ranging from 3 to 8 percent. This soil is not considered to be highly susceptible to rill or sheet erosion (NRCS, 2009e; NRCS, 2009f).

Soils in the vicinity of the Baisman Run STREON Site (S-04) are in the Manor-Glenelg Association. These soils are gently rolling to very steep, deep, well-drained soils that are somewhat excessively well drained. Glenelg soils typically are located upslope of Manor soils and the somewhat poorly drained soils from the Gleenville series occur in the bottoms of ravines within this series. The Manor-Glenelg Association tends to be very stony. Manor soils are highly susceptible to rill or sheet erosion, while Glenelg soils are susceptible to rill or sheet erosion (NRCS, 1976).

#### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

At each of the proposed NEON locations in Domain 2, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would be approximately 0.3 ha at C-04, C-05, C-06, and A-03 at the SCRC, less than 0.04 ha at R-03, and less than 0.08 ha at R-04. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are highly prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby waterbodies.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and 30 years at the Core Site.

### Climate

#### *Affected Environment*

The mean annual precipitation on the SCRC is 106 cm, with peak rainfall occurring from May through August. The mean annual high and low air temperatures are 19˚C and 4˚C, respectively (weather.com, 2009a). The SERC and BEF are located approximately 135 km east-northeast of the SCRC. The mean high and low annual temperatures and annual rainfall average at the BEF are slightly higher than at the SCRC: at 18˚C and 7˚C and 114 cm per year, respectively (weather.com, 2009b). The ORP is located 140 km northeast of the SCRC. The mean annual high and low temperatures are 19˚C and 8˚C, respectively, and the average annual rainfall is approximately 130 cm (weather.com, 2009c).

During summer, weather fronts come predominantly from the south-southeast and the prevailing wind direction in spring and summer is south-southeast. In winter, storms tend to move from west to east and then shift toward the northeast paralleling the Gulf Stream as they near the coast. Under these conditions, moisture moving westward from the ocean can result in heavy snow events in and near the mountains (University of Virginia Climatology Office, 2009). Tropical weather from June to November occasionally makes landfall, and has the potential to create high wind speeds and heavy downpours.

#### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. Due to the potential for extreme wind conditions from hurricanes and major storms, towers would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind.

### Air Quality

#### *Affected Environment*

The SCRC, SERC, BEF, and ORP are all located in rural areas. In Maryland, Anne Arundel County, proposed location for Relocatable Tower R-03 and Baltimore County, proposed location for STREON Site S-04, are designated as nonattainment areas for ozone and $PM_{2.5}$ (USEPA, 2009a). The remaining areas proposed for NEON infrastructure are in counties that are considered in attainment for all criteria pollutants (USEPA, 2009a).

The SCRC abuts the northeast border of the Shenandoah National Park, a designated Class I Wilderness Area. Additionally, the Dolly Sods and Otter Creek Wilderness Areas in West Virginia are approximately 105 km west of the SCRC and are designated as Class I Wilderness Areas (USEPA, 2009b).

#### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because the proposed NEON locations in Domain 2 are separated spatially and emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts on air quality. The amount of ground disturbance would be less than 0.01 ha at any proposed location and no large earthmoving equipment would be used. Appropriate

BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

No ground disturbance would occur at the STREON Site (S-04), so there would be no potential for air quality impacts from construction. The BEF proposed Relocatable Site (R-04) is near hiking trails and fugitive dust from trenching or clearing could be a nuisance to hikers during construction. Any impacts would end following construction.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze and would not impact visibility at the Shenandoah National Park or the Dolly Sods and Otter Creek Wilderness Areas.

### Airspace

#### *Affected Environment*

This discussion is limited to the proposed SERC Relocatable Site (R-03) and the proposed STREON Site (S-04) because there is no restricted airspace around the proposed Core Site or the BEF (R-04). There are three areas with restricted airspace near the SERC (FAA, 2009). An area of Washington D.C. has restricted airspace that is approximately 40 km west of the SERC Relocatable Site. There is restricted airspace associated with the City of Baltimore, which is approximately 42 km north-northeast of the SERC. Finally, there is restricted airspace over a segment of the Potomac River, approximately 70 km southwest of the SERC. Restricted airspace associated with the City of Baltimore is approximately 28 km southeast of the ORP.

#### *Environmental Consequences*

The AOP flights should be able to avoid restricted airspaces. Flight schedules and flight plans would be provided to the FAA prior to any AOP flights. Should it be necessary to cross restricted airspace, NEON, Inc., would coordinate with FAA to obtain authorization for flights. No impacts are anticipated with regard to restricted airspace.

### Noise

#### *Affected Environment*

The noise environments at the SCRC, SERC, and BEF would be similar. All are located in rural areas with low populations in surrounding areas. There are no residential areas near the proposed sites. Existing noise levels at all three locations would likely be approximately 40 dBA (USEPA, 1974). The noise environment at ORP would likely be somewhat higher because of its suburban setting.

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would have no impacts on residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. No new roads would be constructed. During construction, noise levels would be elevated periodically during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to relocate from the construction area, but be expected to resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at Core Site tower locations and up to 5 years at Relocatable Sites).

There are residences near the proposed NEON locations. Therefore, noise from AOP overflights would have no potential to impact residents. Potential impacts of AOP overflights on wildlife are discussed below.

### Water Quality

#### *Affected Environment*

A few small ponds and lakes are located within or near the SCRC boundaries (Table 3.5.2.3-1). Multiple small creeks and streams are present, but there are no major rivers in this area. Streams on the southwestern part of the property drain to Sloan Creek. Sloan Creek has good water quality and currently meets its designated uses (VDEQ, 2008a). On the other side of the property, streams drain to Manassas Run, a Category 5 listed water due to elevated levels of fecal coliform bacteria (VDEQ, 2008a, 2008b). Although Manassas Run is not within any proposed NEON project areas on the SCRC, it would receive runoff from proposed NEON sites.

**TABLE 3.5.2.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 2, Mid-Atlantic States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-04 | 14 | 0 | 13 | 0 | 9 | 0 |
| C-05 | 14 | 0 | 14 | 0 | 11 | 0 |
| C-06 | 14 | 0 | 11 | 0 | 8 | 0 |
| R-03 | 16 | 0 | 38 | 0 | 54 | 0 |
| R-04 | 11 | 0 | 23 | 0 | 19 | 0 |
| A-03 | 16 | 1 | 14 | 0 | 12 | 0 |
| S-04 | 10 | 1 | 14 | 1 | 18 | 0 |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009d.

Streams on BEF drain to Spout Run, a Category 5 Listed Water due to elevated levels of fecal coliform bacteria and low values from benthic macroinvertebrate bioassessments. Spout Run is on the Virginia 303(d) List of Impaired Waters (VDEQ, 2008a, 2008b).

North Fork Muddy Creek is near the proposed Relocatable Tower R-03 on SERC. North Fork Muddy Creek and Muddy Creek, which it flows into downstream, have good water quality and currently meet designated uses. Neither is on the Maryland 303(d) List of Impaired Waters (MDOE, 2006, 2008).

The proposed STEON Site (S-04) would be on Baisman Run, a perennial stream that flows into Beaverdam Run. Baisman Run and Beaverdam Run have good water quality and currently meet designated uses and neither is on the Maryland 303(d) List of Impaired Waters (MDOE, 2008).

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality from stormwater runoff could occur during construction. Moderate long-term impacts to Baisman Run would occur at ORP from STREON experiments. After Baisman Run flows into Beaverdam Run, any downstream water quality impacts would be negligible. Because any impacts would be localized, there would be no potential for cumulative impacts.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be used to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

Elevation of $NH_4NO_3$ or $H_3PO_4$ concentrations in Baisman Run to 5 times ambient concentrations for a 10-year period could result in long-term impairment of water quality in this stream and lead to eutrophication within the experimental reach. Because the stream reach is in a hardwood forest area, nutrient additions in winter and early spring, prior to canopy leaf-out, would likely result in increased growth of algae and periphyton due to the direct exposure to sunlight and greater nutrient availability. Once the canopy closes and shades the stream, lack of sunlight would be expected to slow growth of algae and periphyton, which could lead to greater downstream transport of $NH_4NO_3$ or $H_3PO_4$, which could impact downstream waters, particularly lakes and impoundments. There also could be a die-off of algal and periphyton biomass, which could lead to oxygen depletion in the stream from aerobic decomposition. Oxygen depletion could in turn result in changes to vertebrate and invertebrate communities in the immediate area (Hauer and Lamberti, 2006). Impacts would likely be long-term and moderate. No impacts would be expected from the recirculation tracer experiments.

There would be potential for transport of $NH_4NO_3$ or $H_3PO_4$ to incrementally interact with other human and natural events and produce cumulative impacts to downstream water quality, including accelerated eutrophication of ponds and lakes. However, downstream of the study reach, Baisman Run flows into a larger stream, Beaverdam Run. There are no additional major sources of $NH_4NO_3$ or $H_3PO_4$ along this portion of Beaverdam Run. The greater assimilative capacity of the larger stream would likely result in any downstream impacts being negligible.

## Floodplains

### *Affected Environment*

There are no floodplains within the SCRC Sites or the BEF Relocatable Site. Floodplains occur on much of the SERC. The Relocatable Site (R-03) would be approximately 130 m outside of the floodplain of North Fork Muddy Creek (FEMA, 1983). The proposed ORP STREON Site is within the narrow floodplain of Baisman Run (FEMA, 2008).

### *Environmental Consequences*

At ORP, only the STREON Sampling devices would be placed within the floodplain. All of the supporting infrastructure would be located outside of the floodplain. No increase in flood elevations would result and the change in flood storage capacity would be negligible. There would be no cumulative impacts to floodplains in Domain 2.

There would be the potential for equipment to be damaged during flood events. NEON, Inc., would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts on existing water quality if they were to be lost in streams. There are no environmentally harmful components associated with this monitoring equipment. NEON, Inc., would temporarily remove equipment from flood prone areas when flooding is forecast for the area.

## Common Vegetation and Plant Communities

### *Affected Environment*

At the SCRC, predominant land uses are forest, old field, pasture, and hayfields (Aulenbach, 2008a). Within the SCRC, all three towers and the Aquatic Array would be placed within a forested area. The overstory consists of tulip poplar, white ash, black walnut, northern (American) hackberry, red maple, white oak, and pignut hickory. The mid-canopy is dominated by eastern red bud and dogwoods. The ground cover consists of garlic mustard, yellow violet, and comfrey (Aulenbach, 2008a, 2008b, 2008c).

The surrounding landscape at the SERC is a matrix of land uses, predominantly forest, cropland, and pasture (Bourg and Lerdau, 2008). The Relocatable Site would be placed in a hardwood forest. Typical hardwood forests along the Chesapeake Bay consist of white oak, loblolly pine, red maple, American beech, swamp white oak, southern red oak, willow oak, sweetgum, tulip poplar, black gum, American holly, and sweetbay (NPS, 2009). Common understory shrubs in this region are inkberry and blueberries (NPS, 2009).

The BEF is home to the State Arboretum of Virginia. The BEF consists of actively farmed agricultural fields, early successional habitats ranging in age from 3 to 19 years since last disturbance, and 100-year old second-growth forest (Bourg and Lerdau, 2008). The proposed location for the Relocatable Site would be within a plant succession research field, a young shrubby field that abuts an agricultural field. Vegetation within the BEF consists of black gum, flowering dogwood, fringe tree, pond cypress, red bud, sweetgum, sycamore, white oak, and many species of ginkgo (BEF,2009b).

ORP is located in a hardwood forest in central Maryland. Typical forested vegetation in this area consists of multiple oaks; most dominant are the white oak, red maple, American holly, yellow birch, hornbeam, American elderberry, flowering dogwood, mountain laurel, red bud, pignut hickory, and black walnut (Maryland DNR, 2009b).

### *Environmental Consequences*

Tree removal along utility lines would be a minor long-term impact to vegetation and plant communities. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation (less than 0.01 ha) would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Advanced and Basic Towers. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate. Where overhead utility lines are extended, there could be limited removal of trees along the route. Because of the need to keep the utility lines clear of woody vegetation, these would be kept free of trees by hand removal of saplings, as necessary, until the end of the NEON project.

## Common Fauna

### *Affected Environment*

The SCRC, in Warren County is approximately 20 km south-southeast of BEF, in Clarke County. Common wildlife species are similar at both locations. Common types of birds at the SCRC and BEF include the brown-headed cowbird, American crow, mourning dove, Canada goose, and several species of owls and woodpeckers (VDGIF, 2009a, 2009b). Common mammals at both the SCRC and BEF include the bobcat, common gray fox, red fox, common muskrat, raccoon, least shrew, white-tailed deer, northern gray squirrel, eastern cottontail rabbit, and several species of bats (VDGIF, 2009a, 2009b). An example of common reptiles and amphibians at the SCRC and BEF include the eastern fence lizard, little brown skink, northern copperhead, northern brownsnake, gray tree frog, Fowler's toad, and marbled salamander (VDGIF, 2009a, 2009b).

The SERC is located in the Chesapeake Bay area in Anne Arundel County, Maryland. Typical birds occurring in the SERC include osprey, bald eagle, and other raptors. Some reside year-round and others only visit in the winter months (Chesapeake Bay Program [CBP], 2009a). The great blue heron and black-crowned night heron are the only wading birds that live in this area year-round (CBP, 2009a). Robins and cardinals are also common to this area (CBP, 2009a). Mammals that reside in the SERC include deer, squirrel, and raccoon. There are also beaver, muskrat, and river otter (CBP, 2009b). Common reptiles and amphibians in the SERC include copperhead, diamondback terrapin, eastern box turtle, green frog, and southern leopard frog (CBP, 2009c).

The ORP is in the Piedmont Region of Maryland in Baltimore County. Common birds in this region of Maryland include the whip-poor-will, blue jay, American crow, and American robin (Maryland DNR, 2009c). Mammals that typically occur in this region include Virginia opossum, eastern cottontail, woodchuck, muskrat, and white-tailed deer (Maryland DNR, 2009d). The most common reptiles and amphibians observed in the ORP include the eastern box turtle, eastern fence lizard, northern coal skink, eastern garter snake, northern slimy salamander, upland chorus frog, and mountain chorus frog (Maryland DNR, 2009e).

### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. Areas surrounding the proposed locations have adequate habitat, which could provide refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding would be expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Towers and guy wires would pose a minimal risk to common birds and flying mammals. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Maryland Department of Natural Resources and Virginia Department of Game and Inland Fisheries prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

There would be a long-term loss of habitat at towers and IHs, but the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall, impacts to wildlife would be negligible.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because flights would be conducted after canopy leaf-out, visual stimuli would be minimal and the closed canopy could reduce airplane noise. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight.

Exclusion of top-level predators from experimental baskets in Baisman Run as part of the STREON experiments would have a negligible impact on common fauna. Suitable habitat to support local populations would be available in areas within the stream where baskets would not be placed.

STREON nutrient addition experiments could result in a long-term shift in community composition among common fauna in Baisman Run (Hauer and Lamberti, 2006). Increases in the amount of organic matter can lead to changes in the composition of the stream macroinvertebrate community. Decreased dissolved oxygen levels in the upper part of the sediments can cause reductions in aerobic stream meiofauna (small invertebrates that reside in the spaces between sediment particles), as well as shifts in the composition of fish and macroinvertebrate communities (Hauer and Lamberti, 2006).

Because impacts would be separated in space and time, no potential for interaction among proposed NEON projects or between NEON projects and other projects would be expected.

### Sensitive Ecological Communities

#### *Affected Environment*

There are no known sensitive ecological communities within the SCRC, BEF, and ORP (VDCR, 2008, Maryland DNR, 2009a). Within the SERC, Maryland DNR (2009a) has identified Forest Interior Dwelling Bird Habitat (FIDBH), which is considered sensitive in the Chesapeake Bay Critical Area (Maryland DNR, 2000).

#### *Environmental Consequences*

Proposed Relocatable Tower R-03 would be installed near an existing Forestry Tower and would not be within FIDBH. Tree removal would be limited to the footprint of the site and vegetation would be allowed to return to its pre-construction condition following site closure. No additional roads would be required. No direct impacts to FIDBH would occur. Negligible long-term indirect impacts to FIDBH could occur. NEON, Inc., would follow procedures in *A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area* (Maryland DNR, 2000) to minimize the potential for indirect impacts. Maryland DNR suggests that forest habitat not be removed or disturbed from April through August, the breeding period for forest interior dwelling bird species (FIDS). The seasonal restriction may be expanded to February through August if certain early nesting FIDS are present (Maryland DNR, 2009a). No cumulative impacts to FIDBH would result.

### Cultural Resources

#### *Affected Environment*

The Core Site for Domain 2 would be within the CRC at Fort Royal, Virginia in the Blue Ridge Mountains. The 1,295-ha area is owned by the Smithsonian National Zoological

Park and is operated as a research facility which houses 30 to 40 endangered species. Facilities include labs, a veterinary clinic, field stations, and biodiversity monitoring plots. The NEON Core Site would contain three towers (C-04, C-05, and C-06) and Aquatic Array A-03.

Relocatable Site R-03 would be in the SERC along a sub-estuary of Chesapeake Bay in Maryland. The main SERC campus includes 1,130 ha of forest, agricultural land, freshwater wetlands, tidal marshes, estuaries, and pasture land. Relocatable Site R-04 would be in the BEF in the northern Shenandoah Valley, near Winchester, Virginia. The Farm encompasses approximately 113 ha of mostly undeveloped land, including pasture land, successional fields, woodlots, and ponds. A STREON Site (S-04) would be placed in the Oregon Ridge Park, a mostly undeveloped park encompassing approximately 170 ha near Cockeysville, Maryland.

### Prehistoric Context

More sites in North and South America are beginning to be accepted as dating to earlier than the Terminal Pleistocene approximately 12,000 years before the present. In the mid-Atlantic domain, the Cactus Hill site is currently under investigation as a Pre-Clovis site. Pre-Clovis dates and tools have been uncovered intact under Clovis and Archaic components at the site on top of a hill which looks over the Nottoway River. One of the earliest dates found at Cactus Hill extends to 17,000 years ago. Clovis sites, which are found across the continent and date to beginning approximately 12,000 years ago, are found in especially large numbers in Virginia (Funk, 1978). Other stone tools found at Clovis sites include scrapers, gravers, perforators, wedges, and knives. Evidence uncovered so far in Virginia suggests that such tools were used to spear game, cut up meat, scrape and cut hides, and split and carve bone of deer, bison, and rabbit. Caribou, elk, moose, and possibly mastodon also may have been hunted (Funk, 1978).

The Archaic period dates from approximately 10,000 years ago to approximately 3,000 years ago and includes new adaptations by the early people related to the change from the cold, moist climate of the Pleistocene Age to a warmer, drier one as warm winds melted the glaciers to the north and warmed the ocean water. Researchers generally agree that Archaic cultures evolved from Late Paleoindian groups in the Southeast and Midwest. The Archaic period is characterized by increasing temperatures, changing flora and fauna, and rising sea levels. People lived in larger mobile egalitarian bands, hunting smaller game and gathering a wider variety of supplies. By end of the Archaic, people had become more sedentary, had begun raising varieties of squash, and trade routes were established between people in the mountains of Virginia and the mid-Atlantic coast. Groups of settled people began to form small settlements run by elders with simple tribal identities.

The Woodland period dates from approximately 1200 B.C to approximately A.D. 1600 and refers to the sedentary cultures of the extensive eastern United States woodlands. Pottery was introduced into Virginia from peoples along the coasts of present day South Carolina and Georgia during the early Woodland. The first evidence for houses dates to the Early Woodland. Other technological advances that first appeared during the Middle Woodland include the bow and arrow, the ungrooved axe, and artistic curved or effigy tobacco pipes. During the latter Woodland period, villages typically contained rows of houses around a plaza with a council house or temple elevated on a mound possibly with a palisade surrounding the entire village. Corn, beans, and squash were cultivated, as was tobacco. Hunting and gathering was still practiced and class separation is evidenced by elaborate accoutrements for higher classes, including beads, pendants, ceremonial objects of stone, copper, and shell, and a wide array of elaborate burial customs. The people who occupied the area of the proposed NEON sites during the Late Woodland were the Virginia and Carolina Algonquians, who intensively utilized natural estuary resources and practiced well developed farming. Villages tended to be smaller than elsewhere in the mid-Atlantic domain and were likely occupied year round. Other groups in the area included a number of Algonquian speaking groups (Snow, 1978; Feest, 1978).

During the subsequent Protohistoric period, native populations shifted due to the presence of the Europeans. The Europeans introduced a range of diseases to the local native populations. Epidemics of smallpox in 1617, 1622, and 1631 killed thousands of Native Americans along the East coast. The epidemics among the native populations occurred after Europeans had visited the villages (Brasser, 1978). Native populations also joined the European fur trade, which further disrupted their previous lifeways and resulted in a greater awareness of territorial boundaries among native groups. At the start of the 17th century, Native American groups in the mid-Atlantic domain show a well developed social stratification where land ownership and political leadership were restricted to a small upper class (Brasser, 1978). Throughout the 17th century, however, these populations continued to decline rapidly due to disease and conflict with Europeans.

### Historic Context

The first successful European settlement along the east coast of the present day United States was Jamestown, which was established in 1607 at the confluence of the James and York Rivers in Virginia. The European population of Virginia grew throughout the 1600s. Land was taken from the Native Americans by treaty and by force. African workers were imported into Virginia in 1619. Williamsburg became the colonial capital in 1699. e colonial capital was moved in 1699 to Williamsburg, where the College of William and Mary had been founded in 1693. Throughout the 1700s colonial dissatisfaction with British rule increased, particularly related to several taxation acts, including the Sugar Act and the Stamp Act. On May 15, 1776, Virginia declared independence from Britain. Maryland followed later that year. The capitol of Virginia was moved to Richmond during the Revolutionary War, as Governor Thomas Jefferson, felt Williamsburg was too vulnerable to British attack (Rubin, 1977).

At the end of the Revolutionary War, the newly liberated states were united under the Articles of Confederation. Representatives from Virginia and Maryland and other states met at the Annapolis Convention in 1786 to discuss strengthening the union. The new plan called for a stronger national government. Virginia delegates, pushing for the addition of a Bill of Rights to the United States Constitution, finally agreed to the terms and became the tenth state. Maryland was the seventh state to ratify the Constitution and join the new union. In 1790, Virginia and Maryland ceded land to create the District of Columbia. Throughout the early 1800s, Virginia developed two distinct cultures, the wealthy land owners and plantations of the east and the small rural farms of the west. Slaves worked the large plantation farms in the east and families worked the small subsistence farms in the west. Many planters in Maryland freed their slaves during the years following the Revolution, and by the start of the Civil War the free African American population in Maryland constituted half of the African American population in the state.

Virginia seceded from the Union in 1861, one of the last of the southern states to secede. The differences between western and eastern Virginia at this point were so vast, that the state split. West Virginia and Maryland remained with the Union, the latter in part, due to the suspending of civil liberties of all state citizens and the jailing of several pro-South politicians by President Lincoln. The capitol of the Confederacy was moved from Alabama to Richmond, Virginia. More battles were fought in Virginia than in any other state during the Civil War, including the first and last significant battles, the Battle of Manassas, or Bull Run, and the Battle of Appomattox Courthouse (Rubin, 1977).

By the end of the war, the roads, rail lines, and overall infrastructure of the state were largely destroyed. Maryland, however, remained relatively unscathed. Virginia rejoined the Union in 1870 and Reconstruction followed. The years between Reconstruction and World War II were years of rebuilding for Virginia. Virginia developed a diversified economy, balancing agriculture and industry. After the bombing of Pearl Harbor, Hawaiʻi, the primary location for the U.S. Navy fleet was moved to Norfolk, Virginia. Virginia is characterized by a very diverse economy, which includes tourism, coal, tobacco, software manufacture, communication technology, military installations, cattle, peanut, tomato, and soybean farming, and wineries. Maryland is characterized by transportation, ports, automobile import, commercial fishing, agriculture, educational and medical research, and its proximity to the center of the U.S. government.

### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations within a defined study area that extended 1.6 km around each proposed location.

A literature search was requested of the Virginia Department of Historic Resources (VDHR). The VDHR serves as the official state repository on historic resources, including architectural and archaeological resources. The VDHR also provides information regarding eligibility for inclusion on the Virginia Landmarks Register (VLR) and the NRHP. The Maryland Historical Trust was contacted to request a literature review of proposed NEON sites in Maryland. The Trust reviewed the Maryland Inventory of Historic Properties, which serves as a repository for information on districts, sites, buildings, structures, and objects of known or potential value to the prehistory, history, upland and underwater archaeology, architecture, engineering, or culture of the State of Maryland.

Only Relocatable Site R-04, which would be on the BEF property, has been previously surveyed for cultural resources. Resources previously documented within the vicinity of the proposed location for R-4 include historic buildings, including mills, residences, farm buildings, a dairy, historic trash deposits, and the site of a Civil War battle

(Table 3.5.2.3-3). The area of disturbance of R-04 is within one historic resource, the BEF, currently listed on the NRHP and the VLR. A total of 18 recorded sites, mostly historic structures, lie within 1.6 km of the proposed location of R-04. Of these, eight have been evaluated for inclusion on the VLR and the NRHP. Seven are eligible for or listed on the NRHP and six are eligible for inclusion on the VLR. The remaining sites have not been evaluated or recommended as eligible for the NRHP or any other state or local register.

**TABLE 3.5.2.3-3**
Literature Search Results– Domain 2, Mid-Atlantic States
*National Ecological Observatory Network (NEON) EA*

| | | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | | |
|---|---|---|---|---|---|---|---|
| **NEON Site Number** | **Previously Surveyed** | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | **Number Evaluated** | **Number Eligible** |
| C-04 | No | 0 | 1 | 0 | 1 | 0 | n/a |
| C-05 | No | 0 | 1 | 0 | 1 | 0 | n/a |
| C-06 | No | 0 | 1 | 0 | 1 | 0 | n/a |
| R-03 | No | 0 | 0 | 0 | 1 | 1 | 1* |
| R-04 | Yes | 0 | 3 | 1 | 15 | 8 | 7* |
| A-03 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| S-04 | No | 0 | 0 | 0 | 0 | 0 | n/a |

Source: Virginia Department of Historical Resources; Maryland Inventory of Historic Properties
*Listed on NRHP or VLR

A single unevaluated site is within 1.6 km of the proposed locations of C-04, C-05, and C-06. No resources are located within the study area of A-03. The historic Battle of Wapping Heights occurred near the Core Site but no formal documentation has been prepared. One architectural resource is located within 1.6 km of R-03. This resource is currently listed on the NRHP and is a National Historic Landmark in the State of Maryland, but is located well outside the area of disturbance.

### *Environmental Consequences*

The literature search revealed that R-04 would be on the BEF, a historic site listed on both the NRHP and the VLR. However, the contributing structures of the farm would not be directly or indirectly impacted by proposed NEON infrastructure at R-04, given the distance from the facility. It is recommended that appropriate measures be taken during final design and construction to avoid impact to this historic resource.

Of the cultural resources that have been previously documented or appear on historic maps within 1.6 km of proposed NEON locations, all of these resources are located outside of the areas of disturbance and not visible from proposed NEON infrastructure locations.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 2, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

### Utilities

#### *Affected Environment*

SCRC receives power via overhead power lines, with availability of electrical hook-ups at the research facilities in the central area of the SCRC on Rivinus Road (SNZP, 2009). From the farthest Basic Tower, the research facilities are approximately 2.3 km west-southwest. At the research facilities, potable water and solid waste disposal are available.

The SERC receives power via overhead power line, with availability of electrical hook-ups at the Reed Education Center (SERC, 2009a). An existing Forestry Tower is located near the proposed Relocatable Site. Electrical and communication service would be brought to the proposed Site from Old Muddy Creek Road, approximately 262 m west of the proposed tower site.

The BEF has a fully functional Nature Center less than 800 m from the proposed site. Power would likely be received from the existing grid on U.S. Highway 17. Potable water and solid waste disposal are provided within the housing area, also approximately 800 m from the proposed site. There is an existing telephone line at the BEF (BEF, 2009a).

The ORP site would receive power via overhead power lines. Electric and communication service is available on Ivy Hill Road, approximately 174 m from the proposed STREON hut. The proposed STREON Site is approximately 1.5 km south of the main park buildings. Potable water, solid waste disposal, and telephone lines are available in the main buildings (BCDRP, 2009).

#### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the existing access road where access for maintenance activities would be available. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for impacts. Extended overhead lines would be kept clear of trees by hand clearing saplings, as necessary, for the duration of the NEON project at a location.

### Transportation

#### *Affected Environment*

SCRC is approximately 8 km south of Interstate 66 along U.S. Highway 522. There is a network of roads within SCRC, most of which are gravel or dirt.

BEF is approximately 3.4 km from U.S. Highway 322 along US-17. There are multiple USFS roads and footpaths within BEF (BEF, 2009a).

SERC contains a network of paved and unpaved roads. Access to SERC is by paved roads, including Maryland State Highways and county roads. Access to the Proposed Relocatable Tower would be from paved roads, except for the last approximately 400 m.

ORP is located adjacent to Ivey Hill Road. The proposed STREON Site would be approximately 170 m north of Ivey Hill Road. An unimproved service road extends from Ivey Hill Road to the proposed STREON Site (ORNC, 2009).

#### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and transported by hand from that point to the construction site. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur.

Materials would be transported by hand from the road to the proposed NEON location. Improved trails would be created to move from the road to a proposed NEON location. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

## Human Health and Safety

### *Affected Environment*

The SCRC is within private property where access is restricted from the public. Access is limited to employees and researchers. NEON construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

The proposed SERC Relocatable Tower (R-03) would be accessible from a trail to the SERC Forestry Tower, although this area is typically not used by the public. The proposed Relocatable Tower at BEF would be accessible by users of the bridle trail in the arboretum, but riders would not be expected to leave their horses to venture through the woods to the tower location. The proposed STREON Site at the ORP would be accessible from hiking trails within ORP.

### *Environmental Consequences*

There would be minor potential for injuries to workers during construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

Proposed site locations would have restricted public access. This would limit health and safety issues to the public. In addition, towers would be secured with fencing and locked gates to deter unauthorized access.

There would be a potential for pedestrians in the SERC, BEF, and ORP to strike guy wires while on foot. Additionally, there would be potential for employees or researchers riding ATVs to strike the guy wires during routine work or during NEON maintenance or data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

## Aesthetics and Visual Resources

### *Affected Environment*

SCRC is near Shenandoah National Park and a portion of the Appalachian NST (AT). BEF is within 10.5 km of the AT, but is not visible from the trail. BEF is near U.S. Highway 17 and the elevated utility infrastructure along that road. SERC is located amid suburban development and there are elevated utility lines in the area. There are no nearby areas that are routinely viewed for aesthetic quality. ORP is in an urban area, with other elevated towers and utility poles in proximity to the proposed NEON location. The aesthetic quality at and around ORP is already impaired.

#### *Environmental Consequences*

Hikers would not see the proposed NEON infrastructure on SCRC from the AT. The AT passes by SCRC on the opposite side of a ridge. There would be no change to views from the AT.

The proposed NEON towers on SCRC would be visible from Shenandoah National Park. However, between the proposed NEON locations and the national park, there is a ridgeline with multiple existing telecommunications towers. This ridgeline is visible from any location in Shenandoah National Park where visitors would be able to see the proposed NEON towers. Because of the presence of multiple towers in this viewshed prior to construction of the proposed NEON towers, any impacts to the viewshed and aesthetics of Shenandoah National Park would be negligible.

The proposed NEON infrastructure at BEF would not impact the viewshed of the AT and any impacts to other aesthetic values would be minor due to the nearby presence of existing elevated utility lines. Any aesthetic or visual impacts at SERC and ORP would be minor due to the presence of nearby elevated utility lines.

### Recreation

SCRC does not offer public recreation and is not included in this discussion. There would be no recreation impacts at SCRC.

#### *Affected Environment*

The BEF contains the State Arboretum of Virginia, which is open to the public year-round. There also are a bridle trail, amphitheater, walking trails, equestrian trails, and picnic pavilions on BEF (BEF, 2009a). The proposed Relocatable Tower (R-04) would be placed in an area designated as a research field for plant succession. The field is located away from the main attractions (amphitheater and picnic areas) but is near the bridle trail.

The SERC offers public programs and canoeing along Muddy Creek and has two self-guided walking trails (SERC, 2009a). The proposed Relocatable Tower (R-03) would not be near the walking trails but would be near North Fork Muddy Creek (SERC, 2009b).

The ORP offers recreation, including swimming, picnicking, hiking, and numerous special events and concerts (BCDRP, 2009). The proposed STREON Site would be in the area of the park farthest away from the main attractions, but would be near the Ivy Hill Yellow Trail and Ivy Hill Pond on Baisman Run (ORNC, 2009).

As noted mentioned above, the AT is more than 10 km from any proposed NEON sites. Both the John Smith NHT and the Star-Spangled Banner NHT are within 10 km of SERC. No key locations and resources along the Star-Spangled Banner NHT are within 10 km of SERC. SERC is within 5 km of places where John Smith put ashore on his first and second voyages.

### *Environmental Consequences*

Minor short-term impacts on recreation could occur at some proposed NEON locations during construction. Long-term impacts on recreation would be negligible. Because the NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would be likely.

Users of the bridle trail on BEF would likely experience minor impacts from the construction and operation of the proposed Relocatable Tower. The segment of the trail near the proposed tower location would likely be closed during tower installation. Because persons on horses would remain on the trail, no impacts to equestrian use would be expected from the presence of the tower and guy wires. The tower would be secured with fencing and locked gates to deter unauthorized access.

AOP overflights could startle horses on the equestrian trails at BEF. AOP overflights planned for 150 m would have the greatest potential to affect horses and riders. BEF would be notified in advance of AOP overflights to allow BEF to notify recreational riders of the occurrence of the overflight.

Aesthetics could be impacted for trail users. It is likely that any aesthetic impacts would be negligible due to the presence of intervening vegetation.

There would be no impacts to hikers at SERC because the walking trails are more than 600 m from the proposed Relocatable Tower site. Persons in canoes or kayaks on North Fork Muddy Creek could experience negligible aesthetic impacts if the Relocatable Tower is within their viewshed. The site would be secured with fencing and locked gates to deter unauthorized access.

Installation of the STREON Site would not require use of construction equipment and would be no more than a nuisance to hikers in ORP. It is not anticipated that any restrictions on trail use would be imposed during STREON installation. The STREON infrastructure would not be visible from the trail and no operational impacts to recreation would be likely from its presence.

There would be no potential to impact the AT. Because no key locations or key resources along the Star-Spangled Banner NHT are within 10 km of SERC, no impacts to this trail would be expected. The shore of Chesapeake Bay is stabilized with rip-rap and man-made rock breakwaters in this area and there is extensive urban/suburban development along the shore. There are numerous overhead electrical transmission lines and other towers already visible from the NHT in the general area of SERC. Because of the development in the area and the fact that the proposed R-03 tower would be more than 6 km inland from the Chesapeake Bay, no impacts to the John Smith NHT would be expected.

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**Figure 3.D02-1** Domain 2 Proposed Site Locations

**Figure 3.D02-2** Domain 2 Proposed Site Locations

**Figure 3.D02-3** Domain 2 Proposed Site Locations

**Figure 3.D02-4** Domain 2 Proposed Site Locations

### 3.5.3 Domain 3 Southeastern Coastal Plain

#### 3.5.3.1 Introduction

Domain 3 extends from the Gulf of Mexico Coastal Plain in eastern Texas through the South Atlantic Coastal Plain and the Great Dismal Swamp in southeastern Virginia (Figure 2-1). Lower peninsular Florida is not included within Domain 3. Domain 3 is characterized by low level to gently rolling topography. Community types include sandhill, rolling pine-dominated uplands, pine flatwoods and savannas, seepage bogs, bottomland hardwood forests, barrier islands, coastal dune systems, rivers, swamps, and estuaries. There is a high percentage of land area in wetlands here compared to other ecoregions in the continental United States. Soils within the region typically are derived from erosion of the Appalachian Mountains (LandScope America 2008a, 2008b). The proposed Core Site for Domain 3 would be located at the Ordway-Swisher Biological Station (OSBS) in Florida. An Advanced Tower (C-07, Figure 3.D03-1), two Relocatable Towers (C-08, C-09; Figure 3.D03-1), and two Aquatic Arrays would be placed on OSBS. The two Aquatic Arrays proposed for OSBS are Suggs Lake (A-05, Figure 3.D03-1), a perched black water lake that is fed by surface water and not connected to groundwater, and Barco Lake (A-06, Figure 3.D03-1), a clear water lake that is fed by groundwater.

Relocatable Sites proposed for Domain 3 would be located at the Disney Wilderness Preserve (DWP) near Orlando, Florida (R-05, Figure 3.D03-2), and at the Joseph W. Jones Ecological Research Center (Jones Center) in southwestern Georgia (R-06, Figure 3.D03-3). The Jones Center also would have an Aquatic Array (A-07, Figure 3.D03-3) on Ichawaynochaway Creek

#### 3.5.3.2 Resource Areas Considered But Not Addressed for Domain 3

Preliminary analysis indicates that there would be no potential to significantly impact five of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Airspace: There is no special use airspace near any of the proposed NEON locations in Domain 3 (FAA, 2009). No potential for airspace constraints would be expected in this domain.
- Recreation: The proposed NEON sites would be located on private land with limited public access. No recreational activities occur on OSBS or DWP. At the Jones Center, private recreational activities include quail and deer hunting and riverbank fishing, but these activities are not available to the general public. The proposed NEON research would not conflict with the private recreational activities at the Jones Center. There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 3. No impacts would extend off-property, so there would be no potential to impact recreation.
- Environmental Justice: The proposed NEON sites would be located on private land with limited public access. All potential impacts would be confined to the private lands and there would be no potential to disproportionately impact minority or low-income populations.

- Protection of Children: The proposed NEON sites would be located on private land with limited public access. All potential impacts would be confined to the private lands and there would be no environmental health and safety risks to children.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 3 are designated research areas that are not routinely viewed by the public for aesthetic quality. The aesthetic quality of these areas is important to the private landowners, but provision is made to accommodate (within reason) research facilities and activities that are consistent with the overall management of the sites. The potential for negative impacts to aesthetics are minimized through a site use request system and planning. Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

#### 3.5.3.3 Resource Areas Considered in Detail for Domain 3

The following sections describe the affected environment and anticipated site-specific environmental consequences for resource areas in Domain 3 where site-specific conditions would influence the anticipated environmental consequences.

**Geology/Seismicity**

***Affected Environment***

Domain 3 is within the Southeastern Coastal Plain. The underlying geology is young sedimentary rocks above older, harder rocks from the Piedmont. The layer of sedimentary rock is thinnest at the fall line where the Coastal Plain meets the Piedmont and becomes increasingly thicker toward the sea (New Georgia Encyclopedia, 2009). The surface topography on the Florida peninsula is controlled by buried karst with a thick sand mantle overlying a confining layer over Tertiary limestone bedrock (Hayes, 2007).

The Southeastern Coastal Plain is relatively stable from the standpoint of seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 2 % pga to 6 % pga for long wave motion and 4 % pga to 12 % pga for short wave motion, with the exception of an area on the central South Carolina coast where seismic activity is higher (USGS, 2009a, 2009b).

***Environmental Consequences***

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact the underlying geology. The seismic hazard is low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

## Soils

### *Affected Environment*

Soils were investigated using the Web Soil Survey (NRCS, 2008). Initial soils data were analyzed within approximately 3.3 km of each proposed NEON location. Further detailed analysis was done within 500 m of each proposed NEON location.

Soils within the general area of the proposed locations on OSBS consist of mostly fine sands in the uplands and muck soils in the wetlands (NRCS, 2008). The soil at the proposed locations for the Core Site Advanced Tower (C-07; Figure 3.D03-1) and Basic Tower (C-08; Figure 3.D03-1) consist of Candler fine sand that is excessively drained. Slopes in these areas range from 0 to 8 percent. The typical soil profile for this soil type consists of fine sand from the surface to a depth of 200 cm. Candler fine sand and other sands at and around OSBS are not considered highly susceptible to sheet or rill erosion by water (NRCS, 2008).

The proposed location of the Core Site Basic Tower (C-09; Figure 3.D03-1) is within a wetland and soils consist of Samsula muck and Okeechobee muck. Samsula muck soils are muck from the surface to a depth of 74 cm, with fine sand extending below the muck to a depth of 200 cm. Okeechobee consists of muck and mucky peat. Both soil types are very poorly drained and frequently ponded (NRCS, 2008). Muck soils are slow to form and are sensitive to trampling and compaction.

Both proposed Aquatic Arrays (A-05; Figure 3.D03-1 and A-06; Figure 3.D03-1) on OSBS would be located in lakes. The lake bottoms would be below the area of potential impact and there would be no potential to impact sediments at the proposed aquatic locations.

On DWP, soils in the vicinity of the proposed Relocatable Site (R-05; Figure 3.D03-2) typically consist of fine sands in the uplands and muck in the wetlands, neither of which are prone to sheet or rill erosion (NRCS, 2008). Soils at the proposed Relocatable Tower location on DWP consist of Cassia fine sand and/or Smyrna fine sand. Neither of these soils is prone to erosion and both are poorly drained or somewhat poorly drained (NRCS, 2008).

Soils in the general vicinity of the proposed tower (R-06; Figure 3.D03-3) and the proposed Aquatic Array (A-07; Figure 3.D03-3) at the Jones Center consist mostly of sand and loamy sand, neither of which are highly prone to sheet or rill erosion (NRCS, 2008). The soils at the proposed Relocatable Tower (R-06) location at the Jones Center consist chiefly of Lucy loamy sand and Troup sand. Slopes at this proposed tower location range from 0 to 5 percent. Both of these soils are well drained to somewhat excessively drained, with sand in the upper layer and sandy clay loam beneath. These soils typically are not highly erodible (NRCS, 2008).

Soils along Ichawaynochaway Creek at the proposed location for an Aquatic Array (A-07) at the Jones Center consist of Troup sand with slopes ranging from 0 to 5 percent and Hornsville fine sandy loam with slopes ranging from 0 to 2 percent. Hornsville fine sandy loam is mainly located along the Ichawaynochaway Creek corridor. Hornsville fine sandy loam consists of fine sandy loam at the surface and sandy clay loam at a depth of 157 cm. These soils are typically not highly erodible (NRCS, 2008).

*Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

During construction of the project, soils would be disturbed as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals, towers, and instrument arrays. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby waterbodies. Less than 0.03 ha of soils would be disturbed during construction of C-07, C-08, and R-05. Less than 0.02 ha would be disturbed at R-06 and less than 0.01 ha would be disturbed at A-07. Approximately 0.07 ha would be disturbed at C-09, and 0.13 ha would be disturbed at A-05. No soil disturbance would occur at A-06.

The muck soils in Ashley Prairie would be impacted by trampling and compaction from personnel accessing the site for data collection and maintenance. To prevent this impact, a pedestrian boardwalk would be constructed to the tower site (C-09). Also, to minimize the potential for disturbance and compaction of these sensitive muck soils, the electric power extension through Ashley Prairie would be placed in an above-ground conduit across the wet prairie to the IH.

A similar potential for impacts to soils would occur during site closure. Soils in areas covered by buildings and tower pads would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

#### 3.5.3.4 Climate

*Affected Environment*

The climate is consistent at OSBS, DWP, and the Jones Center. The mean annual precipitation is approximately 130 cm with peak rainfall occurring from April through July. The mean annual air temperature is 20˚C. Weather fronts come predominantly from the south-southeast. The prevailing wind direction in spring and summer is south-southeast and northeast during fall and winter. Hurricanes and lightning are major weather features in this area (Loescher, 2008). Hurricanes often create damaging winds. Lightning has the potential to create an unplanned natural fire.

*Environmental Consequences*

Implementation of NEON would not impact the regional climate. Due to the potential for extreme wind conditions from hurricanes and tornadoes, towers would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind. Site design also would incorporate deep grounding (ground to 6-m depth) and power filtering to protect instrumentation from damage from electrical surges due to intense lightning prevalent in the region.

## Air Quality

### *Affected Environment*

The OSBS, DWP, and the Jones Center are all located in rural areas. All of the proposed NEON locations are within areas designated as in attainment (Florida Department of Environmental Protection [FDEP], 2006; USEPA, 2008). DWP is located in Osceola County and is the closest of the three locations to a non-attainment area, metropolitan Orlando in Orange County, which is approximately 35 km east of the proposed site.

The Okefenokee Swamp NWR, the Chassahowitzka NWR, St. Marks NWR, and Bradwell Bay Wilderness Area are all Federal Class I Wilderness Areas within 161 km of proposed NEON locations in Domain 3.

### *Environmental Consequences*

Short-term negligible direct and indirect impacts will occur to air quality during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because the proposed NEON locations in Domain 3 are separated in space and emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts to air quality. The construction area at any location would be less than 0.01 ha and no large earthmoving equipment would be used. BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions. Proposed instrumentation sites are located on private property with no surrounding development. Human health and human nuisance values would not be impacted from fugitive dust created during construction. Site closure would result in a similar potential for air quality impacts as described for construction. Appropriate BMPs would be implemented at site closure to minimize the potential air quality impacts from fugitive dust.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze and would not impact visibility at any of the Class I areas.

## Noise

### *Affected Environment*

The noise environments at OSBS, DWP, and the Jones Center would be similar. All are located in rural areas with low populations in surrounding areas. There are no residential areas near the proposed sites except at DWP, where a residential neighborhood is approximately 0.8 km to the east. Existing noise levels at all three locations would likely be approximately 40 dBA (USEPA, 1974).

### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would have no impacts to residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. Equipment and materials would be brought in by hand with as little impact as possible. No new roads would be constructed. During construction, noise levels would be elevated periodically only during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations, depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar noise impacts would result from site closure activities.

The residential area near DWP could be impacted by noise from construction of NEON infrastructure (R-05). Absent intervening vegetation, the sound would be reduced to 64 dBA as a result of natural attenuation from traveling the 0.8 km to the residential area (Federal Highway Administration [FHWA], 2007). The vegetation present at DWP would be expected to further reduce the sound level by 8 dBA (Ward, 1984) and persons inside of houses would experience a further reduction of 15 to 25 dBA (USEPA, 1974). Because of the distance and the presence of screening vegetation, construction-related noise would be barely perceptible to persons outdoors in the residential area near DWP and not perceptible to persons indoors. The elevated outdoor noise would be below nuisance levels and would not impact residents during outdoor activities.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to temporarily relocate from the construction area, but would likely resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

The pumps for atmospheric sampling equipment on an FIU would operate continuously. Typically, these pumps produce noise of approximately 65 dBA. NEON, Inc. would place the pumps within noise shielding to reduce the sound to less than 60 dBA at 12 m. This would likely result in long-term minor impacts to residents in the neighborhood near the DWP site.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at the Core Site and up to 5 years at Relocatable Sites).

Noise from the AOP would have potential to impact residents near DWP. No potential sensitive receptors live near the Core Site (C-07, C-08, C-09) and the Jones Center Relocatable Site (R-06). AOP flights at 1,000 m above the canopy would be expected to have no impact on residents. AOP flights at 150 m above the canopy would be a short-term nuisance, but any impacts to residents would be negligible. The potential for AOP flights to disturb wildlife is discussed below.

### Water Quality

#### *Affected Environment*

OSBS is dotted with a variety of lakes, ponds, and wetlands (Table 3.5.3.3-1). There is no major river or stream flowing through the area. Many of the waterbodies are isolated, but some are connected by small stream channels. The existing water quality of these waterbodies is near pristine, as the site has a history of low human impact at OSBS for the past 75 years (Hayes, 2007) and a majority of the waterbodies are isolated and do not receive runoff from offsite.

Sandhill upland lakes and clastic upland lakes occur in the proposed project area. Sandhill upland lakes with gradually sloping shorelines have broad bands of emergent vegetation. Submerged aquatic plants occasionally dominate much of the water column and floating plants sometimes cover the water surface (Florida Natural Areas Inventory [FNAI], 1990). Clastic upland lakes are shallow to relatively deep, irregular-shaped depressions or basins occurring in uplands on clay substrates. They have surface inflows but commonly lack significant outflows. Water is generally dissipated through evaporation and transpiration, but it may move through sinks that connect with the aquifer (FNAI, 1990).

**TABLE 3.5.3.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 3, Southeastern Coastal Plain
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-07 | 2 | 0 | 33 | 0 | 499 | 1 |
| C-08 | 4 | 0 | 66 | 0 | 737 | 1 |
| C-09 | 5 | 0 | 59 | 1 | 694 | 1 |
| R-05 | 1 | 0 | 80 | 0 | 78 | 0 |
| R-06 | 3 | 0 | 1 | 0 | 0 | 0 |
| A-05 | 3 | 0 | 38 | 1 | 667 | 1 |
| A-06 | 1 | 0 | 41 | 1 | 482 | 1 |
| A-07 | 2 | 1 | 0 | 0 | 0 | 0 |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009c.

Suggs Lake, the proposed location of an Aquatic Array (A-05) on OSBS, is a 12-ha dark water system fed by surface waters only and is not connected to groundwater. This type of lake is a clastic upland lake. The depth of the lake is 4 m, with groundwater located a few meters below the lake bottom. Flow to and from the lake is ephemeral and channels flow only during rain events (Loescher, 2008).

Barco Lake, also the proposed location for an Aquatic Array (A-06) on OSBS, is a 4-ha clear water system fed by groundwater only, and is also classified as a sandhill upland lake. This lake is not connected through ephemeral streams or ditches to other ponds, but is connected to groundwater (Loescher, 2008). This type of lake is susceptible to eutrophication through chemicals and nutrients that may be brought in via groundwater.

DWP is located in the headwaters of the Everglades and is bounded by Reedy Creek to the east and Lake Hatchineha to the south. This area is also known as the Chain of Lakes in the upper Kissimmee River basin. The Kissimmee River basin was channelized in the 1960s with the loss of more than 16,000 ha of floodplain marsh. The middle third of the Kissimmee River (approximately 70 km) is being restored through the removal of two dams (U.S. Army Corps of Engineers [USACE], 2009).The area around DWP provides 27 percent of the total citrus production in Florida (FDEP, 2008). The proposed location for a Relocatable Tower (R-05) on DWP is not near any stream and the nearest wetland is 0.24 km to the southeast (Table 3.5.3.3-1).

The proposed location for the Relocatable Tower (R-06) at the Jones Center is in an upland area approximately 50 m from the proposed Aquatic Array (A-07) location on Ichawaynochaway Creek, which flows into the Flint River. Both of these waters are considered high priority streams by the Georgia Department of Natural Resources (GADNR) and contain state listed rare and endangered mussel species (GADNR, 2008 a, b). Ichawaynochaway Creek is unique in the Southeastern Coastal Plain due to the limestone geology that creates stream channels that are rocky with many shoals (Jones Center, 2008a). Both of these streams are located in agricultural areas with potential for receiving runoff containing concentrations of nutrients and pesticides from surrounding agricultural practices (USGS, 1998).

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality from stormwater runoff could occur during construction. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be used to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

## Wetlands

### *Affected Environment*

OSBS contains a large hardwood swamp, 3 wet prairies, and approximately 55 permanent and ephemeral lakes and ponds (Table 3.5.3.3-1). There are two types of permanent lakes on the property: sandhill upland lakes and clastic upland lakes. Ephemeral ponds and wetlands are scattered throughout the property (University of Florida OSBS, 2008 a, b). The Ashley Prairie, proposed as a Basic Tower (C-09) location, and Harry Prairie are examples of wet prairies on OSBS property. These prairies form riparian zones around the lakes on OSBS and frequently flood from the lakes.

DWP is located in the headwaters of the Everglades and was developed as a wetland mitigation area. DWP contains 1,030 ha of wetlands, including both natural and restored wetlands, with upland areas interspersed among the wetlands (Table 3.5.3.3-1) (The Nature Conservancy, 2008; Disney, 2008). The proposed location for a Basic Tower (R-05) on DWP is within an upland restoration area that is within the wetland/upland mosaic on the property.

The Jones Center has over 90 documented depressional wetlands (Table 3.5.3.3-1). Many of these wetlands are relatively undisturbed and are located within the fire-maintained longleaf pine uplands, some of which require active restoration and management. These isolated wetlands contain much of the biodiversity within the longleaf pine ecosystem (Jones Center, 2008b). Neither of the two proposed sites (R-06, A-07) at the Jones Center (R-06 and A-07)) is located within a depressional wetland.

### *Environmental Consequences*

There would be minor long-term direct impacts to wetlands from installation of Basic Tower C-09, fencing, and construction of boardwalks to access C-09. No other direct wetland impacts would occur. No indirect wetland impacts would be likely from implementation of NEON in Domain 3. No cumulative impacts to wetlands would be expected from this project in Domain 3.

Wetlands occur near proposed NEON locations on all three sites (OSBS, DWP, and Jones Center). With the exception of the proposed Ashley Prairie Basic Tower (C-09) at OSBS, no towers or supporting infrastructure would be placed in wetlands. NEON, Inc. would implement and maintain appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for direct and indirect impacts to wetland areas.

A boardwalk would be constructed to access Basic Tower C-09 for data collection and maintenance. The boardwalk would eliminate the potential for impacts to Ashley Prairie from trampling and soil compaction as a result of persons accessing the site. Any impacts would be long-term and minor. The boardwalk would be removed at site closure.

Ashley Prairie on OSBS would be impacted by placement of the tower, fencing, and guy wire anchors. The amount of disturbance would be the minimum necessary to secure the tower and all material placed in the wetlands would be removed at the close of the project. To eliminate other potential disturbance to Ashley Prairie, utility lines would be brought to the tower (C-09) through an above-ground conduit.

Impacts to wetlands at Ashley Prairie would be long-term and minor. Temporary minor impacts to wetlands at Ashley Prairie would also be expected at the time of site closure. However, site closure would result in removal of the NEON tower and boardwalk from the wetland, which would then be a long-term benefit to the wetland as the area would be returned to its pre-construction condition.

No other wetland impacts would occur as a result of implementing NEON in Domain 3.

### Floodplains

#### *Affected Environment*

Floodplains occur on much of OSBS. The Basic Tower proposed for Ashley Prairie (C-09) would be located in a designated floodplain, but the other two towers would be outside of floodplains. The two proposed Aquatic Arrays (A-05, A-06) would be located on lakes within floodplains (FEMA, 1994).

DWP has extensive floodplains across the property. However, the proposed location of the Basic Tower (R-05) on DWP is not in a floodplain (FEMA, 2001).

Floodplains on the Jones Center are associated with Ichawaynochaway Creek and the Flint River. The floodplains along Ichawaynochaway Creek are fairly wide, whereas the floodplain along the Flint River is narrow near and on the Jones Center. The proposed Relocatable Tower (R-06) would be out of the floodplain, but would connect to the proposed Aquatic Array (A-07), which would be located in the floodplain of Ichawaynochaway Creek (FEMA, 1997).

#### *Environmental Consequences*

There would be negligible direct impacts to flood prone areas as a result of implementation of NEON. One Basic Tower and one Aquatic Arrays would be placed in areas prone to flooding. The minimal displacement of the proposed equipment would result in a negligible impact on flood storage, flood elevations, and flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected.

Structures built in floodplains have the potential to increase flood elevations and reduce flood storage capacity by displacing water in proportion to the size of the structure. Additionally, structures in floodplains may impede flood conveyance by increasing resistance to water movement or acting as traps for debris in floodwaters, which can create barriers to water movement.

At OSBS, only a Basic Tower (C-09) would be placed within the floodplain. All of the supporting infrastructure would be located outside of Ashley Prairie and outside the floodplain. Ashley Prairie provides low-velocity water storage during floods. No increase in flood elevations would result and the change in flood storage capacity would be negligible.

At the Jones Center, only the Aquatic Array (A-07) would be placed in a floodplain. No increase in flood elevations would result and the change in flood storage capacity and flood conveyance would be negligible.

There would be the potential for equipment to be damaged during flood events. NEON, Inc. would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage.

### Common Vegetation and Plant Communities

#### *Affected Environment*

OSBS contains 9 major plant communities with 516 species of plants documented on the station. Major vegetation communities include sandhill, xeric hammock, upland mixed forest, baygalls, basin swamp, basin marsh, marsh lake, clastic upland lake, and sandhill upland lake (University of Florida OSBS, 2008c).

The Advanced Tower (C-07) would be located in sandhill habitat, which consists of widely spaced longleaf pine with a moderately dense sub-canopy and midstory of turkey oak and a moderately dense ground cover consisting of grasses and forbs (FNAI, 2008). Sandhills are a fire-dependent, fire climax community with a natural fire recurrence interval of 2 to 5 years (FNAI, 1990). Portions of the sandhill community on the property are under prescribed burn management (Loescher, 2008).

Basic Tower C-08 on OSBS would be located in an upland mesic oak hardwood hammock community, which consists of well-developed, closed-canopy forests of upland hardwoods on rolling hills (FNAI, 1990). The proposed tower location is dominated by oaks (live oak, water oak, and gamble oak) with scattered sand pine and longleaf pine. This community has a distinct multi-layered canopy (Loescher, 2008).

Basic Tower C-09 on OSBS would be located in Ashley Prairie, a wetland ecosystem dominated by clumped species of grasses and forbs of various heights. This type of prairie accumulates large amounts of detrital mass. This system floods periodically with water at or above plant level (Loescher, 2008). Nearly all plants that inhabit this community are adapted to fires, with a fire recurrence interval of 2 to 4 years (FNAI, 1990). Wax myrtle rapidly invades wet prairies if the fire interval is longer.

The two Aquatic Arrays proposed for OSBS (A-05 and A-06) would be placed in lakes. Aquatic Array A-06 would be located in Barco Lake, a sandhill upland lake, and Aquatic Array A-05 would be located in Suggs Lake, a clastic upland lake. At sandhill upland lakes, vegetation is mostly restricted to a narrow band along the shoreline, which consists of hydrophytic grasses and herbs or a dense shrub thicket. Sandhill upland lakes with gradually sloping shorelines have much broader bands of emergent vegetation and submerged aquatic plants occasionally dominate the water column. Floating plants sometimes cover the water surface (FNAI, 1990).

Vegetation along the shore of clastic upland lakes may be dominated by hydrophytic shrubs, sedges, grasses, rushes, and trees or by a combination of these plants. Shallower areas of clastic upland lakes are densely vegetated with bands of emergent species, floating-leaved plants, and submersed aquatic vegetation (FNAI, 1990).

DWP contains multiple habitat types, with pine flatwoods and oak scrub dominating upland areas. The Relocatable Tower (R-05) would be located in an upland area that has been planted with native vegetation to restore the native longleaf pine flatwoods community. Before restoration, the area was a pasture (Gordon, 2008, personal communication). Longleaf pine flatwoods typically consist of an open canopy forest of widely spaced pine trees with little or no understory and a dense ground cover consisting of grasses, herbs, and shrubs (FNAI, 1990).

The Jones Center is a research area surrounded by lands in agricultural production. The Jones Center contains extensive longleaf pine forest, slash pine forest, oldfield loblolly pine stands, mixed pine-hardwood forest, riparian hardwood forest, live oak depressions, isolated depressional wetlands, creek swamps, agricultural fields, shrub-scrub uplands, and rivers and creeks (Jones Center, 2008a). The location proposed for the NEON Relocatable Tower (R-06) at the Jones Center is within a mixed hardwood and longleaf pine stand that will be restored to a longleaf-wiregrass community through hardwood removal, planting of pine seedlings, and continued prescribed burning. More than 1,100 species of vascular plants have been identified on the Jones Center. Common species are similar to those in upland longleaf pine communities on OSBS. The ground cover under longleaf pine stands on the Jones Center is very diverse, with up to 50 species occurring within approximately 1 $m^2$ (Jones Center, 2008a). The Aquatic Array (A-07) on the Jones Center would be located in the riparian zone of Ichawaynochaway Creek, an area dominated by shrubs and hardwood tree species.

### *Environmental Consequences*

Tree removal along utility lines would be a minor long-term impact to vegetation and plant communities. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation (less than 0.01 ha) would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project activities, up to approximately 5 years at Relocatable Sites and 30 years at the Core Site. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate. Where overhead utility lines are extended, there could be limited removal of trees along the route. Because of the need to keep the utility lines clear of woody vegetation, these would be kept free of trees by hand removal of saplings, as necessary, until the end of the NEON project.

### Common Fauna

#### *Affected Environment*

OSBS has compiled an inventory of 282 species of vertebrates, including 26 fish species, 27 amphibian species, 45 reptile species, 149 bird species, and 35 mammal species (University of Florida OSBS, 2008c). There have been 713 species of invertebrates identified at OSBS. A few species of note at OSBS include the Sherman fox squirrel, eastern indigo snake, gopher tortoise, striped newt, rosemary wolf spider, bald eagle, gopher frog, and the black bear (University of Florida OSBS, 2008c).

The proposed location of the Advanced Tower on OSBS (C-07) is in a sandhill community. Common wildlife in the sandhill community are tiger salamander, barking treefrog, spadefoot toad, gopher frog, gopher tortoise, worm lizard, fence lizard, mole skink, indigo snake, coachwhip snake, pine snake, short-tailed snake, crowned snake, eastern diamondback rattlesnake, bobwhite, ground dove, red-headed woodpecker, rufous-sided towhee, fox squirrel, and pocket gopher (FNAI, 1990).

The proposed location for Basic Tower C-08 on OSBS is an upland mesic oak hardwood community. Common wildlife species in this community include slimy salamander, Cope's gray treefrog, bronze frog, box turtle, eastern glass lizard, green anole, broadhead skink, ground skink, red-bellied snake, gray rat snake, rough green snake, coral snake, woodcock, barred owl, pileated woodpecker, shrews, eastern mole, gray squirrel, wood rat, cotton mouse, gray fox, and white-tailed deer (FNAI, 1990).

Ashley Prairie, which is the proposed location for Basic Tower C-09, is a wet prairie. Typical wildlife species in wet prairie include the cricket frog, chorus frog, little grass frog, black racer, yellow rat snake, cottonmouth, pygmy rattlesnake, northern harrier, caracara, southeastern kestrel, killdeer, long-billed marsh wren, red-winged blackbird, marsh rabbit, cotton rat, and cotton mouse (FNAI, 1990).

Aquatic Array A-06 would be located in Barco Lake, which is a groundwater fed clear water sandhill upland lake (Loescher, 2008). Sandhill upland lakes provide breeding areas for terrestrial amphibians, which includes the state-threatened gopher frog, as well as a variety of insects. Mammals use the lakes as a water source and wading birds and ducks use the lakes as feeding areas (FNAI, 1990).

Aquatic Array A-05 would be located in Suggs Lake, which is a surface water fed black water clastic upland lake (Loescher, 2008). Clastic upland lakes are important breeding areas for many terrestrial and semi-aquatic amphibians. These types of lakes also provide feeding and nesting areas for many wading birds, ducks, reptiles, and fish (FNAI, 1990).

The proposed tower at DWP (R-05) would be located in an upland area on DWP that has been planted with native vegetation to restore the native longleaf pine flatwoods community. Before restoration, the area was an upland pasture area (Gordon, 2008, personal communication) consisting of exotic pasture grasses. Habitat of pine flatwoods typically consists of an open canopy forest of widely spaced pine trees with little or no understory but with a dense ground cover consisting of herbs and shrubs. Typical animals may include the oak toad, little grass frog, narrowmouth toad, black racer, red rat snake, southeastern kestrel, brown-headed nuthatch, pine warbler, Bachman's sparrow, cotton rat, cotton mouse, black bear, raccoon, gray fox, bobcat, and white-tailed deer (FNAI, 1990).

The location proposed for the NEON Relocatable Tower (R-06) and instrumentation at the Jones Center is within a mixed hardwood and longleaf pine stand that will be restored to longleaf-wiregrass with hardwood removal, planting of pine seedlings, and continuation of prescribed burning. The site would be near a creek but outside the riparian zone (Boring, 2008, personal communication). Longleaf pine forests at the Jones Center provide habitat and are managed for the northern bobwhite quail and white-tailed deer. Over 280 species of vertebrates have been documented on the property. Notable non-game species include gopher tortoise, fox squirrel, red-cockaded woodpecker (RCW), Florida pine snake, gopher frog, and alligator snapping turtle (Jones Center, 2008c).

The Aquatic Array (A-07) would be placed on Ichawaynochaway Creek approximately 50 m from the Relocatable Tower. Ichawaynochaway Creek is considered a stream of importance by the GADNR and is noted as prime habitat for a variety species of plants and animals (Jones Center, 2008a).

#### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide wildlife refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding is expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Towers and guy wires would pose a minimal risk to common birds and flying mammals. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Georgia Department of Natural Resources Wildlife Resources Division and the Florida Fish and Wildlife Conservation Commission prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

There would be a long-term loss of habitat at towers and IHs, but the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall, impacts to wildlife would likely be negligible.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because flights would be conducted after canopy leaf-out, visual stimuli would be minimal and the closed canopy could reduce airplane noise. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight. Domain 3 is within a part of the country where energy transmission companies make low-altitude (less than 150 m above tree canopy) fixed-wing aircraft flights along pipeline ROWs to inspect for signs of damage or leaks. Typically, these flights occur every 1 or 2 weeks along each such ROW. Any impacts from additional overflights at either 1,000 m or 150 m for the AOP would likely be negligible.

### Sensitive Ecological Communities

#### *Affected Environment*

There are three documented rare habitat occurrences within a 5-km radius of the three proposed tower sites on OSBS (C-07, C-08, C-09): sandhill, depression marshes, and sandhill upland lakes (FNAI, 2008). The sandhill upland lake community was described in Section 3.3.3.6 and the sandhill community was described in Section 3.3.3.9. Because these two communities have been previously described, only the depression marsh community is described here.

Depression marshes typically are surrounded by the sandhill community. A depression marsh is a wetland community with an open water center bordered by a dense, grassy cover. Typical grasses include bluestems and panic grasses. The bottom of a depression marsh is a loamy muck sand (FNAI, 1990; FNAI, 2008).

FNAI documented five rare habitats known to occur within a 5-km radius of the Basic Tower at DWP (R-05), most of which are within the DWP property. These habitats include floodplain swamp, dry prairie, wet prairie, seepage slopes, and a colonial bird rookery.

Floodplain swamps occur on flooded soils along stream channels and in low spots along stream channels and oxbows within river floodplains. Dominant trees are typically buttressed hydrophytic trees such as cypress and tupelo and the understory and ground cover are generally very sparse (FNAI, 1990). Floodplain swamps on the DWP property are considered pristine and contain huge flat-topped cypress (FNAI, 2008).

A wood stork and anhinga rookery occurs on DWP. The bird rookery is located on an island in a creek, surrounded by cypress and prairie pasture (FNAI, 2008).

Dry prairies are characterized as a nearly treeless plain with a dense ground cover consisting of wiregrass, saw palmetto, and other grasses, herbs, and low shrubs. The natural fire recurrence interval in these habitats is 1 to 4 years. Dry prairies are endemic to Florida and provide important habitat for rare species such as the caracara and the burrowing owl (FNAI, 1990).

Wet prairies are described as treeless plains with a sparse to dense ground cover consisting of grasses and herbs, including wiregrass, toothache grass, maidencane, spikerush, and beakrush. These habitats are inundated or saturated 50 to 100 days each year and burn every 2 to 4 years. This community provides habitat for rare species such as the caracara and the southeastern kestrel (FNAI, 1990).

Seepage slopes are wetlands characterized as shrub thickets or boggy meadows on or at the base of a slope where moisture is maintained by downslope seepage such that the ground is usually saturated but rarely inundated. This is caused by an impermeable layer, usually clay or rock, below the ground surface that blocks the water as it percolates through the sand. This type of community typically burns every 5 years (FNAI, 1990).

There is no recorded high priority habitat within the project area at the Jones Center (GADNR, 2008). However, the fire-maintained longleaf pine ecosystem is a rare and sensitive habitat that is home to rare species such as gopher tortoise, fox squirrels, RCW, Florida pine snake, gopher frog, and alligator snapping turtles (Jones Center, 2008a). No areas at or near proposed tower or aquatic locations in Domain 3 have been designated as critical habitat for species listed under the ESA.

#### *Environmental Consequences*

Minor direct impacts to sensitive communities could occur from construction and operation of NEON infrastructure. No indirect or cumulative impacts sensitive communities would be expected from this project.

Sensitive sandhill habitat would be disturbed at OSBS. Construction, including creation of access trails and installation of fencing around towers, would occur within the sandhill community. The majority of OSBS consists of sandhill habitat and no substantial loss of this habitat would occur. The Aquatic Array proposed for Barco Lake (A-06), a sandhill upland lake, would be accessed by boat using an existing boat ramp with minimal disturbance to the lake. Impacts to these sensitive habitats at OSBS would be negligible.

The proposed tower locations at DWP (R-05) and the Jones Center (R-06) are not in sensitive habitat. No impacts to sensitive habitats would occur at DWP. The Aquatic Array at the Jones Center (A-07) would be located next to a high priority stream, Ichawaynochaway Creek. Erosion control BMPs would be used to limit runoff into the creek. These BMPs are further discussed in Section 2.2.2. Impacts to sensitive habitat on the Jones Center would be negligible.

## Sensitive Species

### *Affected Environment*

In Florida and Georgia, sensitive species include those with federal endangered or threatened status; species proposed for listing as federal endangered or threatened; and rare, state endangered, threatened, and species of special concern status. Sensitive species also include those species protected under the MBTA.

All sensitive species identified as having potential to occur at or adjacent to OSBS, DWP, or the Jones Center are identified in Table Domain 3, Appendix B, along with their legal status and preferred habitat types. This table also provides the scientific names for the species discussed in the following sections. Relocatable Site R-06 is the only proposed NEON location where a sensitive species is known to occur at or adjacent to the site (Table 3.5.3.3-2). All of the proposed locations are within suitable habitat for sensitive species. The following discussion is limited to those species that may occur in or near the proposed project locations.

**TABLE 3.5.3.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 3, Southeastern Coastal Plain
*National Ecological Observatory Network (NEON) EA*

| | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-07 | 3-ESA | 0 | 1-ESA | 12 | 0 | 6 |
| C-08 | 3-ESA | 0 | 1-ESA | 12 | 0 | 6 |
| C-09 | 3-ESA | 0 | 1-ESA | 12 | 0 | 7 |
| R-05 | 6-ESA | 0 | 3-ESA | 12 | 0 | 9 |
| R-06 | 7-ESA | 0 | 6-ESA | 9 | 1 | 3 |
| A-05 | 3-ESA | 0 | 2-ESA | 12 | 0 | 7 |
| A-06 | 3-ESA | 0 | 2-ESA | 12 | 0 | 7 |
| A-07 | 7-ESA | 0 | 6-ESA | 9 | 0 | 8 |

Source: Appendix B Domain 3

## Federally Protected Species

FNAI has documented three federally protected species of animals on or near OSBS, including the indigo snake, wood stork, and the American alligator. All three of these species may occur at or adjacent to proposed NEON sites on OSBS (Table 3.5.3.3-2).

The federally threatened eastern indigo snake has a broad range of habitats, from scrub and sandhill to wet prairies and mangrove swamps. The eastern indigo snake usually winters in gopher tortoise burrows in sandy uplands in the northern part of its range and forages in hydric habitats. This species is active year-round and lays eggs in May and June (FNAI, 2001a; FNAI, 2008). This species could occur at any of the proposed tower locations on OSBS (C-07, C-08, C-09).

The federally threatened wood stork nests in colonies in a variety of inundated forested wetlands, which include cypress strands and domes, mixed hardwood swamps, sloughs, and mangroves. Wood storks typically forage in shallow water in freshwater marshes, swamps, lagoons, ponds, tidal creeks, flooded pastures, and ditches. Colonies may form in late November to early March in south Florida and February to March in central and north Florida (FNAI, 2001b). This species is also protected under the MBTA. Wood stork may occur at the two proposed Aquatic Arrays (A-05, A-06) and near the proposed Ashley Prairie Basic Tower location (C-09).

The American alligator is not rare, but is afforded protection under the ESA due to its similarity of appearance to the federally endangered American crocodile. The American alligator inhabits most permanent bodies of freshwater in the lower Southeastern Coastal Plain, including marshes, swamps, lakes, and rivers. The American alligator is most active from spring through fall and nests in late spring and is more inactive in cold weather. Alligator eggs hatch in the summer (FNAI, 2001c). Alligators at OSBS occur in ponds and typically migrate to new ponds during breeding season (Loescher, 2008). This species could occur in Barco Lake and Suggs Lake.

There are six documented occurrences of federally protected species within a 5-km radius of the proposed location of the Basic Tower at DWP (R-05), which is in a pine flatwoods community. Of the species known to occur in the area, the crested caracara, Florida scrub-jay, and sand skink may occur at or adjacent to the proposed tower location.

The crested caracara is a large raptor typically associated with vultures because of its scavenging habits. This bird inhabits open country, which includes dry prairie and pasture lands. The crested caracara is non-migratory and is generally monogamous. Adult pairs typically stay year-round in their territory, which may be maintained for years. This species prefers to nest in cabbage palms, followed by live oak hammocks (FNAI, 2001d). Reproduction occurs from late December to early April, concentrated near the middle of this period in Florida. Clutch size is typically two to three and incubation lasts about 30 days. Crested caracara typically do not have a second brood in a year. Young fledge at about 8 weeks, with the family group remaining together approximately 3 months after fledging (NatureServe, 2008). Even though the species is non-migratory, it is protected under the MBTA. This species may also occur near the proposed Relocatable Tower on DWP.

FNAI data indicate that there are multiple Florida scrub-jay populations near the proposed location of the Basic Tower at DWP. The Florida scrub-jay prefers fire-dominated, low-growing, oak scrub habitat on well drained soils, but it may occur in areas with sparser oaks or scrub areas that are overgrown. This species is faithful to its territory (FNAI, 2001e), and is protected under the MBTA even though non-migratory.

The sand skink is a nearly legless lizard that resembles a snake. The sand skink prefers rosemary scrub habitat, but also occurs in sand pine and oak scrubs, scrubby flatwoods, turkey oak ridges with scrub, and along edges of citrus groves occupying former scrub. This species requires loose sand for burrowing with large patches of sparse to no groundcover or canopy. The sand skink frequently occurs in areas with scattered shrubs and lichens. The sand skink is present year-round but is most active from March to June (FNAI, 2001f).

DWP has recently reintroduced RCW to the property. The population dynamics of this species are closely monitored on the site.

There have been seven documented federally protected species occurrences within a 5-km radius of the proposed sites at the Jones Center (R-06, A-07). These include four mussel species that may occur in Ichawaynochaway Creek, the RCW, chaffseed, and pond spicebush. These species, with the exception of chaffseed, may occur at or adjacent to the proposed NEON locations on the Jones Center.

The shinyrayed pocketbook, purple bankclimber, Gulf moccasinshell, and oval pigtoe are mussel species that occur in Ichawaynochaway Creek, the Flint River, and other suitable smaller streams in the area (GADNR, 2008a). The shinyrayed pocketbook and Gulf moccasinshell both prefer medium sized creeks and rivers with sandy, rocky bottoms. The oval pigtoe prefers medium sized creeks with sandy bottoms. The purple bankclimber prefers small to large rivers with a moderate current and sand, fine gravel, or muddy sand substrate (GADNR, 2008b).

The Jones Center has a Safe Harbor Agreement for RCW and their habitat and the Jones Center contains a RCW mitigation area within the property (Boring, 2008, personal communication). RCWs prefer open, climax long-leaf pine stands (NatureServe, 2008). Proposed NEON locations at the Jones Center are not in areas where federally protected species occur (Boring, 2008, personal communication).

Pond spicebush is a woody shrub that prefers wetter conditions and typically occurs around the margins of areas that pond water for a portion of the year. This plant occurs in seasonally flooded wetlands including floodplain/bottomland hardwood forests, forested swales, in and around shallow seasonal ponds in old dune fields, along the edges of ponds and depressions in pinelands, around the edges of sinkholes in coastal areas with karst topography, and along the borders of sphagnum bogs. These plants usually inhabit shaded areas but can tolerate full sun (NatureServe, 2008). This species could occur along the floodplain of Ichawaynochaway Creek.

Birds listed in the MBTA also receive federal protection. The list includes all migratory birds, including most wading birds and some non-migratory bird species. Species protected under the MBTA use a variety of habitats and may occur on all three properties at any time of year, either as year-round residents, spring or fall migrants, or summer or winter residents. Species protected under the MBTA may occur at all proposed NEON locations in Domain 3.

### State Sensitive Species

Twelve state-listed species that are not federally protected are known to occur within a 5-km radius of the proposed NEON sites at OSBS, according to the FNAI

(Table 3.5.3.3-2). Six of these, the gopher tortoise, Florida pine snake, gopher frog, Sherman's fox squirrel, Florida mouse, and the Florida toothache grass, are typically associated with the sandhill community, which occurs throughout the OSBS (FNAI, 1990).

The gopher tortoise prefers xeric upland communities with sandy soils, which includes all proposed upland sites in Domain 3. Gopher tortoises typically inhabit pine flatwoods with sandy soils for burrowing. These burrows typically consist of a half-moon-shaped opening; outside the opening a large sand pile is left from the burrowing. Other species use gopher tortoise burrows (FNAI, 2001g).

The Florida pine snake may occur at or adjacent to the proposed Advanced Tower (C-07) and the proposed upland Basic Tower at OSBS (C-08). This species prefers relatively open canopies, especially in sandhill habitat, and dry sandy soils, for burrowing. This species spends most of its time below ground. Eggs are typically laid from June to August and hatch in September and October. This species often shares burrows and coexists with pocket gopher and gopher tortoise (FNAI, 2001h).

The gopher frog occasionally occurs in pine flatwoods, but prefers dry, sandy uplands, chiefly sandhill and scrub, that include an isolated wetland or large pond within 1.6 km. This species normally spends daytime in stumpholes, tunnels, or burrows, especially those of a gopher tortoise. The gopher frog migrates to ponds for breeding from October through April, but may also breed during summer in central and south Florida (FNAI, 2001i). This species may occur near the proposed NEON sites on OSBS.

Sherman's fox squirrel dwells in high pine sandhills, pine flatwoods, and pastures and other open, ruderal habitats with scattered pines and oaks. This species could occur at or adjacent to the proposed Advanced Tower (C-07) and the proposed upland Basic Tower at OSBS (C-08). This species depends on a variety of oaks for seasonal food and nest material and is active year-round. Nests are usually located in oak trees and are constructed of oak leaves and Spanish moss. Longleaf pine cones and seeds are an important food source (FNAI, 2001j).

The Florida mouse typically inhabits xeric upland communities with sandy soils, including scrub and sandhill communities. This species is an omnivore and is active year-round, except on especially cold nights, feeding mostly on seeds, nuts, insects, and other invertebrates. The Florida mouse is typically associated with the gopher tortoise, cohabitating with it and utilizing its burrows (FNAI, 2001k).

Florida toothache grass has potential to occur at all proposed upland locations at OSBS. This grass prefers sandhills and other dry pinelands. This species is a perennial, with flowering stalks 0.3 to 1.5 m in height and is endemic to northeast Florida and southeast Georgia (FNAI, 2001l).

The Spoon-leaved Sundew occurs in sedge prairies (FNAI, 2008). This species could occur at Ashley Prairie, the proposed location for C-09.

There are 12 documented occurrences of state-protected species within a 5-km radius of the proposed location of the Basic Tower in DWP (R-05), including the 6 federally protected species already discussed. Cutthroat grass, gopher tortoise, gopher frog, giant orchid, many flowered grasspink, and Ashe's savory all may inhabit pine flatwoods, which is the target restoration community at the proposed DWP site.

The habitat requirements of the gopher tortoise and gopher frog were discussed previously. While neither species is known from the proposed tower site at this time, as the habitat develops through the restoration effort, these species could emigrate to the area.

Cutthroat grass may occur in pine flatwoods at DWP but prefers sandy seepage slopes. It also may occur around small seasonal ponds in scrubby flatwoods and around depressions, marshes, and ponds in wet flatwoods. This species is fire-dependent (NatureServe, 2008).

The giant orchid is a plant ranging from 0.3 to 1.7 m tall. The giant orchid typically occurs in open areas in sandhill, scrub, pine flatwoods, and pine rocklands. Many-flowered grasspink is also an orchid that occurs in dry to moist flatwoods with longleaf pine, wiregrass, and saw palmetto (FNAI, 2001n). Ashe's savory is an herb that typically occurs in longleaf pine-scrub oak forests associated with scattered rosemary, woody goldenrod, and red mint shrub (Patrick et al., 1995). These three species could occur at the proposed DWP tower location (R-05) or be in the persistent seedbank and re-establish during the 30-year NEON project.

The Jones Center has nine state-listed species that are known to occur on the site in addition to the six federally listed species previously discussed. The bluestripe shiner, delicate spike, highscale shiner, and alligator snapping turtle are aquatic animals that may occur at or adjacent to the proposed Aquatic Array (A-07), as they are known to occur in Ichawaynochaway Creek and the Flint River.

Barbour's map turtle spends the majority of its life in and around rivers and the wetlands associated with the rivers. Barbour's map turtle also occurs in upland areas consisting of sand and/or dunes. Barbour's map turtle typically occurs in riparian zones, with their nests located in sand at the water's edge. Sometimes this species may nest 100 m from water (NatureServe, 2008). This species has the potential to occur near the proposed Jones Center Aquatic Array.

Swamp buckthorn is a large shrub or small tree that also may inhabit the riparian zone as is typically present in oak flatwoods where the soils usually remain saturated for long periods (NatureServe, 2008). This species has the potential to occur near the proposed Jones Center Aquatic Array.

Velvet sedge occurs on the Jones Center in sandy woods with acid soils with habitat consisting of shady woods, floodplains, or bluffs (NatureServe, 2008). This species could occur at or adjacent to both proposed locations at the Jones Center.

The Jones Center has gopher tortoise on the property and an active gopher tortoise burrow is located approximately 100 m from the proposed tower location (R-06) (Boring, 2008, personal communication).

The southeastern pocket gopher is known to inhabit areas of long-leaf pine forests with loose soils, fairly similar to the proposed location of the Relocatable Tower (R-06). This species prefers deep sandy soils of open areas within long-leaf pine forests (NatureServe, 2008). The southeastern pocket gopher may occur near the proposed tower location on the Jones Center.

### *Environmental Consequences*

Minor short-term and long-term impacts to sensitive species could result from installation of NEON infrastructure. No cumulative impacts to sensitive species would be expected.

NEON, Inc. would work with property owners and site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid any such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat.

There could be the potential to disturb sensitive wildlife in the area during construction activities. All of the proposed construction sites are surrounded by larger amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

At DWP, proposed NEON infrastructure and access routes to R-05 would not be placed in or adjacent to RCW nesting or foraging habitat. No impacts to the reintroduced RCW population on DWP would be expected.

The gopher tortoise is known to occur on or near all of the proposed NEON upland locations in Domain 3. Burrows within 10 m of the proposed NEON site locations would be investigated for the presence of gopher tortoise prior to construction. If a burrow is determined to be inactive, construction would proceed. If a burrow is active and it is not possible to shift the construction site to avoid the active burrow, NEON, Inc. would coordinate with the USFWS to relocate the gopher tortoise to nearby suitable habitat away from the construction site. Where there are one or more active burrows near but not within a construction area, exclusion fencing would be placed around the construction area to prevent accidental entry of gopher tortoise into the work area.

Three small mammal species of concern, Sherman's fox squirrel, Florida mouse, and Southeastern pocket gopher, could be inadvertently captured in small mammal traps deployed as part of an FSU. Juvenile gopher tortoise also could be inadvertently captured at upland locations. These species could be encountered at all three proposed Domain 3 Core and Relocatable Sites. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. An animal handling permit would be obtained as described in Section 5.3 and all specified conditions would be followed to ensure proper treatment and handling of captured animals. If inadvertently captured, these sensitive species would be released.

Any impacts would be short-term and minor. No population level impacts would be expected.

MBTA listed birds may be disturbed during construction and operation. Should nesting bird species protected by the MBTA occur in or adjacent to an area that would be cleared or be subject to a high level of human activity during construction, work would be delayed until after the young have fledged if the site could not be relocated.

### Cultural Resources

#### *Affected Environment*

The proposed NEON locations for Domain 3 are within three areas: the Ordway-Swisher Biological Station (OSBS) in north-central Florida near Gainesville, the Disney Wilderness Reserve (DWR) in central Florida, and the Joseph W. Jones Ecological Research Center (Jones Center) in southwestern Georgia. The Ashley Prairie of the OSBS is in an area established for the long-term study and conservation of unique ecosystems in Putnam County, Florida. The location of the Core Site, including three of the tower locations and two of the Aquatic Arrays, is within the OSBS. The station encompasses approximately 3,640 ha, the majority of which is not developed. The DWR is located just south of Orlando. One proposed Relocatable Site is within the DWR. The 4,856-ha preserve is undeveloped and protects the headwaters of the Everglades ecosystem. The location of the proposed Relocatable Site is adjacent to Lake Russell, one of the last undeveloped lakes in central Florida. The Jones Center at Ichauway is a forested island in a rural area of southwestern Georgia. One Relocatable Site and one Aquatic Array are within the Jones Center near Ichawaynochaway Creek. Research at the 11,735-ha outdoor laboratory focuses on the ecology and management of longleaf pine woodlands, associated wildlife, adjacent wetlands, and the aquatic resources.

### Prehistoric Context

During the past several years, more evidence is being gathered that human occupation of North and South America began earlier than the Terminal Pleistocene ca. 12,000 BP. In the Southeast domain, the Page-Ladson site, located along the Aucilla River in Florida, is currently under investigation as a Pre-Clovis site. The Paleoindian Period in Florida and Georgia, which began approximately 14,000 years ago and lasted until approximately 10,000 years ago, is represented by a general hunter and gatherer strategy employed by small, highly mobile groups. The Archaic Period, which began approximately 8,000 years ago and lasted until approximately 2,000 years ago in Florida and approximately 3,000 years ago in Georgia, is represented by small populations which continued to remain small and mobile, adapting to changing climatic conditions and gradually becoming more sedentary by the Late Archaic. The first pottery known in North America appeared in southwestern Georgia 4,500 years ago during the Late Archaic (O'Steen et al., 2002). By approximately 3,000 years ago during the Post-Archaic, or Woodland Tradition, cultural diversity becomes evident in the archaeological record throughout Florida and Georgia.

**North Central and Central Florida.** Overall, the post Archaic in these regions of Florida is marked by a greater sedentism and increasingly complex economic, social, and political organization (Milanich and Payne, 2003). North-central Florida is identified by the following cultural chronology: Deptford (2,500 years ago to 1,800 years ago), Cades

Pond (A.D. 200-700), which is a Weeden Island related culture specific to Alachua County and parts of Putnam County, and the Alachua Tradition, which includes the Hickory Pond, Alachua, and Potano I and II periods (A.D. 700-1702) (Milanich and Fairbanks, 1980, Milanich and Payne, 1993). At least seven different culture regions are found within east and central Florida, collectively referred to as the St. Johns cultures. The best chronology of the St. Johns groups, who exhibit a number of southeastern and Hopewellian ceremonial traits, is as follows: the Transitional Period (3,200 to 2,500 years ago) to the St. Johns I Period (2,500 to 1,200 years ago) to the St. Johns II Period (A.D. 800 to 1565) (Milanich and Payne, 1993). The cultivation of corn appears among the St. Johns and Weeden Island cultures around 750 A.D. (Milanich and Fairbanks, 1980, Milanich, 1998).

When the first Europeans arrived in northern Florida, the Timucua, a group of 15 different tribes with a common language, occupied the region. During the latter half of the 18th Century, Native American groups from southern Georgia began to move into the region. These migrating groups would later be referred to as the Seminoles (Fairbanks, 1978).

**Southwestern Georgia.** The Woodland Period in Georgia began approximately 3,000 years ago and lasted until approximately A.D. 900. This period is characterized by small, widely dispersed villages whose inhabitants practiced a gathering and hunting lifestyle that was supplemented by horticulture (Pluckhahn, 2003). By A.D. 900, the Mississippian Period had emerged in Georgia. During the Mississippian Period, the first chiefdoms appeared and eventually evolved into large permanent fortified towns with public architecture and a lifestyle characterized by intensive agriculture supplemented by gathering and hunting. By end of the period, the large chiefdoms of the Middle Mississippian had broken apart into much smaller chiefdoms (King, 2002). The period came to an end in the latter half of the 16th Century when the first European explorers reached Georgia. During the early 1700s in Georgia, several groups, including the Lower Creek, Oconee, Yuchi, Alabama, Choctaw, and Shawnee, moved into southern Georgia. By the latter half of the 18th Century, the Upper Creeks moved into the area and all of the clans in the area were labeled Seminole (Nelson, 2003).

### Historic Context

The Historic Period generally begins in the Southeastern Domain in 1513 with the arrival of Ponce de Leon on Palm Sunday (Pascua Florida). The interior of Florida was first explored in the early 1500s by Spanish explorers such as Alvaro Nunez Cabeca de Vaca and Hernando de Soto (Shipp 1881; Smith and Gottlob, 1973), and the First Spanish Period in Florida began with the establishment of the first permanent settlement at St. Augustine (San Augustín) in 1565. Spanish missions, both Jesuit and Franciscan, were established in northern Florida and in present day Georgia by 1633 (Smith and Gottlob, 1973). By the late 1600s, the fluid colonial boundaries of the present day southeastern United States had shifted and although the Spanish remained firmly established in present day Florida, English settlers had moved into present day Georgia and French explorers had moved into the Mississippi River valley and along the Gulf Coast. In 1776, Georgia became the last of the 13 colonies to declare independence from the British crown (Cashin, 2005). Florida, however, remained loyal to the British crown (Coleman, 1991). Georgia became the fourth state of the new United States of America when the state legislature ratified the United States Constitution in 1788 (Cashin, 2005). At the close of the First Seminole War in 1821, Spain formally ceded Florida to the United States (Gannon, 1993). Florida achieved statehood in 1845 shortly after the end of the Second Seminole War (Gannon, 1993).

In 1861, Georgia and Florida joined the other southern states to form the Confederate States of America. Reconstruction followed. By the start of the 20th Century, Georgia was characterized by strict segregation, agriculture, and a predominantly rural society, while Florida was characterized by large-scale commercial agriculture, including citrus production, cattle-raising, and busy port towns. World War II created much economic development in Florida and Georgia as these states became major training grounds for troops serving in the war (Gannon, 1993). Industry in Florida has since expanded beyond tourism, cattle, and citrus and includes electronics, plastics, construction, real estate, international banking, and the U.S. space program (Gannon, 1993). Georgia industries include the production of paper, textile products, chicken, peanuts, peaches, transportation equipment, and marble.

### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 3, including a 1.6-km radius study area around the proposed location. This search consisted of a review of the Florida State Master File (FSMF) and the Florida Department of Environmental Protection (FDEP) land survey document search. A literature search of the Georgia Archaeological Site File (GASF) was performed. The files at the Natural, Archaeological, and Historical Resources GIS (NAHRGIS) contain information on archaeological resources, historical resources, including buildings, structures, historic sites, landscapes, and districts included in the Georgia Historic Preservation Division's Historic Resources Survey or listed on the NRHP. Additionally, the following historic maps were reviewed: Finley's 1826 *Map of Florida According to the Latest Authorities*, John Wescott's 1857 *Map of the State of Florida*, the 1892 *Arredondo, Florida* 30′ USGS topographic quadrangle map, Callendar's 1797 *A Correct Map of the Georgia and Western Territory*, T.G. Bradford's 1835 *Georgia*, J.H. Colten's 1864 *Georgia*, the 1866 *Map of Baker County,* Amanda Barnett's 1867 *Accurate Map of Baker County,* Hammond's 1926 *Complete Map of Georgia, the Southern Part*, the 1938 *State of Georgia, System of State Roads*, and Smith J. Harmon's *State of Georgia Showing the Major Campaign Areas and Engagement Sites of the War Between the States, 1861-1865* (1961). The National Register Information System (NRIS), which contains information related to properties listed on the NRHP, was also consulted for Osceola and Putnam Counties, Florida, and Baker County, Georgia.

Of the proposed NEON locations in Domain 3, only Relocatable SiteR-05 and A-07 have been previously surveyed for cultural resources. R-05 was surveyed in 2006 and the previous survey for A-07 was conducted in 1993; much of the area previously surveyed is now under water. The majority of the archaeological resources found within the 1.6-km study area of the proposed NEON sites at the Jones Center, R-06 and A-07, are along Ichawaynochaway Creek. These areas directly along the creeks appear to be of moderate to high sensitivity for cultural resources.

Resources previously documented within the vicinity include historic home sites, the remains of prehistoric canoes, chert quarries, lithic and ceramic scatters, and lithic scatters (Table 3.5.3.3-3). A review of the Florida State Master File (FMSF) GIS database revealed one known prehistoric archaeological resource that appears to be located within the area of disturbance of Core Tower C-09. This site has not been evaluated for the NRHP or any other state or local register. The review of the GASF revealed that there is one known prehistoric archaeological resource that appears to be located within the area of disturbance of A-07. This site has not yet been evaluated for the NRHP and is presently partially submerged in Ichawaynochaway Creek. Two historic roads are visible on the 1866 *Map of Baker County* and Amanda Barnett's 1867 *Accurate Map of Baker County* within the 1.6-km study area around R-06 and A-07. Neither road has been formally recorded as a historic resource and both roads remain visible on the Hopeful USGS quad.

**TABLE 3.5.3.3-3**
Literature Search Results—Domain 3, Southeastern Coastal Plain
*National Ecological Observatory Network (NEON) EA*

| | | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | | |
|---|---|---|---|---|---|---|---|
| **NEON Site Number** | **Previously Surveyed** | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | **Number Evaluated** | **Number Eligible** |
| C-07 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-08 | No | 0 | 5 | 0 | 0 | 0 | n/a |
| C-09 | No | 1 | 8 | 0 | 0 | 0 | n/a |
| R-05 | Yes | 0 | 2 | 0 | 0 | 0 | n/a |
| R-06 | No | 0 | 15 | 0 | 2 | 3 | 3 |
| A-05 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| A-06 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| A-07 | Yes | 1 | 14 | 0 | 2 | 3 | 3 |

Source: Florida State Master File (FMSF), Georgia Archaeological Site File (GASF), Florida Department of Environmental Protection (FDEP), National Register Information System (NRIS), Natural, Archaeological, and Historical Resources GIS (NAHRGIS), 1866 *Map of Baker County,* Amanda Barnett's 1867 *Accurate Map of Baker County*, and *Hopeful, Georgia* USGS topographic quadrangle map; n/a = not applicable

The study areas for the NEON locations within the Jones Center significantly overlap due to the proximity of R-06 and A-07. A total of 17 resources are located within the combined study area of R-06 and A-07. Specifically, a total of 16 resources are located within the study area of R-06 and a total of 17 resources are located within the study area of A-07. Of these 17 resources, only 3 have been evaluated and all were recommended eligible for the NRHP. Similarly, the study areas for C-08 and C-09 partially overlap due to the relatively proximity of these two proposed locations. A total of nine resources are situated in the overall study area for these two locations. Specifically, a total of five resources are located within the study area for C-8, while a total of nine resources are located within the study area for C-09. None of these sites have been evaluated for inclusion in the NRHP or any other register and no other sites found during this literature search are listed or have been recommended eligible for the NRHP or any other state or local register.

### *Environmental Consequences*

The literature search revealed the potential presence of prehistoric resources within or near the area of disturbance of the C-09 and A-07 facilities. Mapping data gathered from the available literature are not precise enough to determine whether these two archaeological sites are within the area of disturbance and neither has been previously formally evaluated for significance.

The archaeological site near A-07 is submerged in Ichawaynochaway Creek and would not be impacted by the temporary placement of the NEON aquatic instrumentation in the creek.

The site in the vicinity of C-09 would need to be revisited prior to construction so that its exact location can be mapped for avoidance. It is NEON, Inc.'s intention to avoid impacts to sensitive resources through final selection of locations for NEON facilities. During the final site selection process, a site would be selected such that the proposed facility would not cause adverse effects on cultural resources. The final site selection of C-09 would completely avoid the previously documented archaeological site.

A total of 15 cultural resources have been documented outside the areas of disturbance, but within the 1.6-km study areas of R-06 and A-07. While three of these sites have been previously recommended eligible for the NRHP, all fall outside of the area of disturbance from the NEON facilities and the known historic properties would be screened by vegetation from the proposed NEON infrastructure.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 3, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

## Utilities

### *Affected Environment*

OSBS receives power from overhead power lines with availability of electrical hook-ups at the centrally located field office. A land line phone is available at the field office and cellular coverage is available across most of OSBS (Hayes, 2007).

DWP has a fully functional Learning Center approximately 0.9 km from the proposed tower location (R-05). The Learning Center receives electricity through the local power grid and has potable water and sewer service.

The Jones Center has onsite facilities including connection to the electric power grid via overhead lines, water, and sanitary waste treatment service.

### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed along existing roads to the point nearest the proposed tower locations. A portal would be placed at the point nearest the existing access road where access for maintenance activities would be available. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Ashley Prairie would be crossed by placing utility lines in a conduit that would be placed on the surface. Erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for environmental impacts.

**Transportation**

***Affected Environment***

OSBS is bounded by Florida SR 21, SR 26, and SR 100, which provide access to nearly major cities. OSBS has an internal network of roads totaling approximately 120 km. These roads are primarily a mix of clay and sand substrate that are accessible in dry conditions by two-wheel drive vehicles. Four-wheel drive vehicles may be required during wetter conditions. Primary roads may be improved with asphalt or other materials. Construction of new roads is prohibited on OSBS by its covenant (Hayes, 2007).

Access is limited and not open to the public at DWP. Access to DWP is through Scrub Jay Trail off of Pleasant Hill Road. Pleasant Hill Road becomes a 4-lane divided road that connects to U.S. Highway 92 to the west and north. The Nature Conservancy's Learning Center is located at the end of Scrub Jay Trail. There are unimproved field roads within DWP.

Access to the Jones Center is via State Route 91, a two-lane road extending northward to Albany, Georgia. State Route 300 from Albany extends northward to I-75. Access to the Jones Center is limited and the facility is closed to the public. Field roads are located throughout the site and are used for scientific research.

***Environmental Consequences***

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

Existing roads and field roads on OSBS, DWP, and the Jones Center would be used to bring in materials for construction. Improved trails may also be required to bring in the equipment and materials, which would be brought in by hand. Improved trails made for access would be restricted from public use. Signs and/or gates would be used to keep the public off the trails.

OSBS has an extensive network of roads and the proposed locations are within a short distance of a field road. Existing field roads may be improved to facilitate year-round access, but no new roads would be constructed. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur. Trails would be made from the road to proposed NEON sampling locations to provide access. A boardwalk would be constructed across Ashley Prairie. Access to Aquatic Arrays on Barco Lake (A-06) and Suggs Lake (A-05) would be by boat and each of these lakes has an existing boat ramp with access from field roads (Loescher, 2008).

The proposed Basic Tower at DWP (R-05) is located approximately 240 m from Scrub Jay Trail near the Learning Center. A trail would be constructed to access the proposed site.

The proposed Basic Tower at the Jones Center (R-06) would be located approximately 80 m from a road. A small trail would be required to provide access. The proposed Aquatic Array at the Jones Center (A-07) would be located approximately 100 m below the Basic Tower. The access trail would be extended to the Aquatic Array.

### Human Health and Safety

#### *Affected Environment*

All of the proposed locations are within private property with restricted public access. Access is limited to staff and researchers. Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

Proposed site locations are all within private property, with restricted access to the public. This would limit public health and safety issues. In addition, towers would be secured with fencing and locked gates, reducing the risk of unauthorized access to the tower.

Because there is no public access, the general public would have no risk of striking guy wires on towers. However, there would be the potential for staff or researchers riding ATVs to contact the guy wires during routine OSBS work or during NEON maintenance or data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential of an injury.

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**Figure 3.D03-1** Domain 3 Proposed Site Locations

**Figure 3.D03-2** Domain 3 Proposed Site Locations

**Figure 3.D03-3** Domain 3 Proposed Site Locations

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## 3.5.4 Domain 4 Southern Neotropics

### 3.5.4.1 Introduction

Domain 4 includes the entire Commonwealth of Puerto Rico and the southern tip of the State of Florida (Figure 2-1). The northern boundary of Domain 4 begins along the east coast of Florida, approximately 20 km south of Port St. Lucie, arches northwest for approximately 50 km, and then extends southwest to the Gulf of Mexico, approximately 38 km south of Cape Coral, Florida. Domain 4 includes Lake Okeechobee and the Florida Everglades. All proposed Domain 4 sites would be in Puerto Rico.

Puerto Rico has coastal flatlands and a mountainous central region. The island is 161 km by 50 km, with an area of 8,972 $km^2$. Domain 4 sites would be located in the south-southwestern coastal region of the island. The proposed Core Site, consisting of one Advanced Tower (C-10; Figure 3.D04-1) and two Basic Towers (C-11 and C-12; Figure 3.D04-1), would be located within the Guánica Dry Forest Reserve (GDFR), which has been designated as a Biosphere Reserve by the United Nations Education, Scientific, and Cultural Organization (UNESCO) due to its high level of biodiversity (Engman, 2008). The proposed Relocatable Site 1 and an Aquatic Array (R-07 and A-09; Figure 3.D04-2) would be located within the Lajas Agricultural Experiment Station (LAES), which hosts agricultural experiments involving extreme drought conditions. The LAES is located adjacent to the Laguna Cartagena National Wildlife Refuge to the northeast. The proposed Relocatable Tower R-08 (Figure 3.D04-3) would be placed in the urban area of Ponce Metro, within a wooded lot on the campus of Pontificia Universidad Católica de Puerto Rico (the Catholic University). The proposed STREON Site (S-10; Figure 3.D04-4) would be located along the Rio Cupeyes, a low-order stream in the foothills of the Central Mountain Range and adjacent to the Bosque Estatal de Maricao (Maricao State Forest [MSF]).

### 3.5.4.2 Resource Areas Considered But Not Addressed for Domain 4

Preliminary analysis indicated that there would be no potential to significantly impact certain resource areas based on site locations. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Airspace: There is no restricted airspace near the proposed NEON locations in Puerto Rico (FAA, 2009). No potential for airspace constraints would be expected in this domain.
- Protection of Children: The proposed NEON sites would be located on commonwealth-owned land that is used by the public for recreational purposes; however, the sites would have restricted access by means of fences or gates. All potential impacts would be confined to the restricted areas and there would be no environmental health and safety risks to children.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 4 are designated research areas that are not routinely viewed for aesthetic quality or urban lands where aesthetic quality is impaired. Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

#### Resource Areas Considered but Not Addressed for LAES Sites R-07 and A-09

- Sensitive Ecological Communities: The proposed NEON sites would be on a commonwealth-owned research facility that is used for agricultural research and raising livestock. There are no ecologically sensitive areas within LAES and NEON activities would not cause impacts offsite, including to the Laguna Cartagena National Wildlife Refuge.
- Sensitive Species: Sites R-07 and A-09 would occur on private land that is used for agricultural research and raising livestock. There are no known occurrences of protected or sensitive species at or adjacent to these proposed locations.
- Recreation: The proposed NEON sites would be located on private land with limited public access. No recreational activities occur on LAES. No impacts would extend off-property, so there would be no potential to impact recreation.
- Environmental Justice: The proposed NEON sites would be located on private land with limited public access. All potential impacts would be confined to LAES and would not create a potential to disproportionately impact minority or low-income populations.

#### Resource Areas Considered but Not Addressed for Catholic University (R-08)

- Sensitive Ecological Communities: The proposed NEON site would be located in a woodlot within an urban area which is highly developed. There are no ecologically sensitive communities within the vicinity of this site.
- Sensitive Species: The proposed NEON site would be placed within an urban Catholic University campus, which is highly developed. There are no known occurrences of protected or sensitive species at or adjacent to the proposed location.

### 3.5.4.3 Resource Areas Considered for Domain 4

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 4 where site-specific conditions would influence the anticipated environmental consequences.

### Geology/Seismicity
### *Affected Environment*

A karst landscape forms in Puerto Rico when the limestone bedrock dissolves underneath the surface. Karst is present across approximately 27 percent of Puerto Rico (Miller, 2004) and the Core Site is likely underlain with karst topography (USFWS, date unknown). Karst landscapes host the largest aquifers on Puerto Rico (Miller, 2004). The Rio Cupeyes watershed is not underlain by karst. Ponce Metro and LAES are in alluvial systems.

Domain 4 is within the Puerto Rican physiographic region known as the Coastal Flatlands. The entire island is relatively unstable from the standpoint of seismicity. Throughout Domain 4, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 120% pga to 150% pga for short wave motion and from 10% pga to 45% pga for long wave motion (USGS, 2009).

### *Environmental Consequences*

Specialized tower design and additional guy wire support and anchoring would be used in areas of moderate to high probability for seismic activity. These approaches would not require additional land disturbance in comparison to those installed in relatively stable environments. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

## Soils

### *Affected Environment*

Soils in the area of proposed towers C-10 and C-11 mainly consist of La Covana-Limestone outcrop-Seboruco complex on 12 to 40 percent slopes and the Pitahaya-Limestone outcrop-Seboruco complex on 60 to 90 percent slopes. None of the soils in the area of proposed towers C-10 and C-11 are highly prone to erosion. C-10 and C-11 would be located on the La Covana-Limestone outcrop-Seboruco complex on 12 to 40 percent slopes. These well drained soils typically occur on hillslopes and ridges consisting of gravelly clay at the surface with a cemented layer just above the bottom layer of silt loam. The Pitahaya-Limestone outcrop-Seboruco complex is similar to the La Covana complex, but with bedrock typically near the surface (NRCS, 2009a; NRCS, 2009b).

Soils in the area and at the location of proposed tower C-12 consist of Tuque stony clay loam on 12 to 60 percent slopes. This soil type occurs on hillslopes and ridges and is derived from weathered material. The soils are typically a stony clay loam at the surface with weathered bedrock sometimes 61 cm below the surface. These soils are not highly prone to erosion (NRCS, 2009c).

Soils in the area of the proposed LAES Tower R-07 and Aquatic Array A-09 chiefly consist of Fraternidad clay on 0 to 2 percent slopes, Cartagena clay on 0 to 2 percent slopes, occasionally ponded Aguirre clay, and urban land, none of which are highly prone to erosion. Fraternidad clay and Cartagena clay soils typically occur on fan skirts and are alluvium derived from igneous, metamorphic, and sedimentary rock. These soils are clay throughout and typically are not flooded. Fraternidad clay soils are moderately well drained and Cartagena clay soils are somewhat poorly drained. Proposed Tower R-07 would be located on Cartagena clay on 0 to 2 percent slopes. Aguirre clays are occasionally ponded hydric soils on basin floors and depressions (NRCS, 2009d). Areas with Aguirre clays at LAES are typically used for agriculture.

San Anton clay loams on 0 to 2 percent slopes occur along Quebrada Plantina, the proposed location for A-09. San Anton clay loams are hydric soils that typically occur on floodplains, as these soils are occasionally flooded. The parent material of San Anton clay loams is alluvium derived from igneous, metamorphic, and sedimentary rock. These soils are generally clay loam in the upper profile and sandy clay loam at the bottom. These soils are not highly prone to erosion (NRCS, 2009d).

Soils in the area of proposed Tower R-08 consist mainly of Constancia silty clay and Cortada silty clay loam. The proposed tower would be located on Constancia silty clay. This soil typically occurs on floodplains and is frequently flooded. Cortada silty clay loams are also present on floodplains but are only occasionally flooded. Both soils are considered hydric and are not considered highly prone to erosion (NRCS, 2009e).

Soils in the area of S-10 consist mainly of El Cacique-La Taina complex on 20 to 60 percent slopes and Murcara loam on 20 to 40 percent slopes. These soils typically occur on hillslopes, mountain slopes, and ridges. Murcara loam is typically a shallow soil consisting of loam at the surface and gravelly sandy loam at the bottom. Murcara loams parent material is residuum weathered from basalt and basic volcanic breccia. S-10 would be located on Murcara loams. El Cacique-La Taina complex soils are gravelly clay loam at the surface with weathered bedrock less than 36 cm from the surface. The parent material of these soils is colluvium derived from serpentinite and/or residuum weathered from serpentinite. These soils are not considered highly prone to erosion (NRCS, 2009f).

#### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

During construction, soils would be disturbed as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals, towers, and instrument arrays. Less than 0.01 ha of disturbance would occur for the construction of C-10, C-11, C-12, A-09, and S-10. Less than 0.02 ha of disturbance would occur for R-07 and R-08. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. Towers would be placed on areas of near-level slope to minimize the potential for erosive forces to develop. None of the soils that would be disturbed are prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby waterbodies.

A similar potential for impacts to soils would occur during site closure. Soils in areas covered by buildings and tower pads would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

### Climate

#### *Affected Environment*

The Advanced Tower (C-10) and Basic Towers (C-11, C-12) would be within the driest zone on the island, the dry coastal climate region of the GDFR. The mean annual air temperature in this region of Puerto Rico is 23°C in the forest, but temperature can increase drastically in areas lacking a canopy (Engman, 2008). The average annual precipitation in the GDFR is 840 mm, with peak rainfall occurring from June through November (Loescher, 2008a). Hurricanes are the major weather events in this area and have the potential to create storm surges and damaging winds.

LAES, the proposed location for Relocatable Tower R-07 and an Aquatic Array (A-09), has a mean temperature of 26°C and mean annual rainfall of 1,140 mm (weather.com, 2009a). The LAES is approximately 6 km north of the coast and is subject to heavy winds and rains associated with hurricanes.

The proposed STREON Site on Rio Cupeyes (S-10) is prone to severe flooding during major rain events in the mountains to the north. Located 15 km inland, the proposed STREON Site would likely receive heavy winds and rains associated with hurricanes but storm surges would not occur. The mean annual temperature and rainfall near Rio Cupeyes are comparable to those at LAES, approximately 26°C and 1,140 mm, respectively (weather.com, 2009b).

At the proposed Ponce Metro Relocatable Site (R-08) the mean annual temperature is approximately 27°C and the average annual rainfall is 900 mm (weather.com, 2009c). The city of Ponce is on the coast and is susceptible to hurricanes, tropical storms, and the associated winds, coastal flooding, and storm surge.

#### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. There would be no potential for interaction with other projects and no cumulative impacts to climate would result.

Due to the potential for extreme wind conditions from hurricanes and tropical storms, towers would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind and storm surge. Site design would incorporate appropriate grounding and power filtering to protect instrumentation from damage from electrical surges due to lightning.

### Air Quality

#### *Affected Environment*

The proposed GDFR, LAES, and STREON Sites are in rural areas. The Ponce Metro Relocatable Site is within an urban area, which is highly developed and already receives elevated levels of pollutants compared to the rural sites. There are no nonattainment areas within or near the proposed NEON sites in Domain 4 (USEPA, 2009). There are no mandatory Class I Federal Wilderness Areas within 160 km of the proposed Domain 4 sites (USEPA, 2009b).

#### *Environmental Consequences*

Short-term negligible direct and indirect impacts will occur to air quality during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles and the standby generator during the operation of NEON infrastructure. Because the proposed NEON locations in Domain 4 are separated in space and emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

At all four locations, minor fugitive dust generation during construction and emissions from standby generator use would be expected. Construction would have short-term, negligible impacts on air quality. The construction area would be less than 0.01 ha and no large earthmoving equipment would be used. BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

Comparable potential for air quality impacts would result at the end of the NEON project. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The standby generator would operate on an as-needed basis for up to 72 hours at a time. NOx emissions are the largest emission by volume when generators are operated in standby mode (Peak Power Tools, 2009). Should a standby generator operate for 5 percent of the time (440 hours per year), total emissions from the generator would be less than 454 kg of any criteria pollutant at any location. This would be a long-term negligible impact on regional air quality.

### Noise

#### *Affected Environment*

The noise environments at GDFR, LAES, and Rio Cupeyes would be similar. All are located in rural areas with low populations in surrounding areas and would be expected to have ambient sound levels of approximately 40 dBA or less (USEPA, 1974). The proposed Ponce Metro site (R-08) is surrounded by urban development and is adjacent to a busy highway. Existing baseline noise levels produced by highway traffic are an average of 75 dB (FHA, 2009).

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of the standby generator and vehicle use during operation of NEON infrastructure. AOP overflights would have no impacts to residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. Equipment and materials would be brought in by hand with as little impact as possible. No new roads would be constructed. During construction, noise levels would be elevated periodically only during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure.

The proposed Ponce Metro Site (R-08) is approximately 200 m south of Highway 52, a four-lane controlled access expressway. Noise produced by vehicle traffic from Highway 52 can reach levels of 75 dB during peak traffic hours (FHA, 2009). Because of the proximity to the highway, construction-related noise would be barely perceptible to persons outdoors at the Catholic University and would likely be imperceptible to persons indoors. The elevated outdoor noise would be below nuisance levels and would not impact students during outdoor activities.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to temporarily relocate from the construction area, but to resume normal activity patterns following construction. Any construction-related noise impacts would be temporary and minor.

NEON, Inc. would place a 35-kW propane-powered standby generator at the proposed Core Tower location. The generator would be placed inside of building to reduce environmental noise. This generator would be used only intermittently. Generators of this type produce noise of less than or equal to 71 dBA at 7 m (Peak Power Tools, 2009). Additional noise shielding from the building would reduce this noise to less than 60 dBA at 7 m (USEPA, 1974), though this would still be above ambient noise levels at the rural locations.

At the proposed Core Site, standby generator start-up would likely startle any wildlife nearby. Once operational, the generator noise would be above ambient levels, but would be consistent and at a level at which animal species would be expected to resume normal activity. Any impacts would be minor and temporary. These intermittent disturbances would continue for the duration of the NEON project.

The pumps for atmospheric sampling equipment on an FIU would operate continuously. Typically, these pumps produce noise of approximately 65 dBA. NEON, Inc. would place the pumps within noise shielding to reduce the sound to less than 60 dBA at 12 m. The pump noise would not be expected to impact students at the Catholic University near the proposed Ponce Metro Site (R-08).

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at the proposed Guanica Forest sites.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at the Core Site and up to 5 years at Relocatable Sites). Fuel for the standby generator would be brought to the Core Site during routine visits for maintenance or data collection and no additional trips would be made for this purpose. Refueling the standby generator would not result in increased noise.

Comparable potential for construction noise impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Noise from the AOP would have potential to impact residents, workers, and students at the Catholic University, LAES, and their surrounding areas. No potential sensitive receptors live near the GDFR and Rio Cupeyes sites. AOP flights at 1,000 m above the canopy would be expected to have no impact on residents. AOP flights at 150 m above the canopy would be a short-term nuisance, but any impacts to residents would be negligible. The potential for AOP flights to disturb wildlife is discussed below.

### Water Quality

#### *Affected Environment*

All proposed Domain 4 sites are located within the Southern Puerto Rico watershed (USEPA, 2009c). There are no streams in the immediate vicinity of the proposed Core Site tower locations within the GDFR (C-10, C-11, C-12). However, the GDFR contains multiple perennial and intermittent streams that convey waters from the northern hills and mountains to the coast (Table 3.5.4.3-1).

The proposed LAES Relocatable Site (R-07) would be approximately 50 m south of a series of man-made ponds that are used for agricultural purposes in conjunction with operation of LAES (Table 3.5.4.3-1). Additionally, R-07 would be 150 m east of an unnamed tributary of Quebrada El Chorro.

The proposed Aquatic Array (A-09) would be located on Quebrada Plantina between Calle Piedras Blancas (upstream) and Highway 303 (downstream). This segment of Quebrada Plantina is located within LAES in an agricultural field. The stream flows through cropland and eventually to the Caribbean Sea.

At the proposed Ponce Metro site, there are no surface waters within the immediate vicinity of the proposed tower location (R-08) (Table 3.5.4.3-1). A tributary of Rio Portugues is 0.25 km to the southwest of the proposed site within urban development. Rio Portugues is slightly more than 2.5 km east of the proposed site. Both waterbodies flow directly through the city of Ponce Metro.

Rio Cupeyes originates in the foothills of the Central Mountain Range and flows into Rio Guanajibo, approximately 5.7 km downstream from the proposed STREON Site (S-10).

**TABLE 3.5.4.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 4, Southeast United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-10 | 16 | 0 | 1 | 0 | 13 | 0 |
| C-11 | 19 | 0 | 0 | 0 | 13 | 0 |
| C-12 | 9 | 0 | 1 | 0 | 6 | 0 |
| R-07 | 26 | 0 | 10 | 0 | 22 | 0 |
| R-08 | 14 | 0 | 8 | 0 | 84 | 0 |
| A-09 | 24 | 1 | 12 | 0 | 21 | 4 |
| S-10 | 11 | 1 | 4 | 0 | 0 | 0 |

Sources: USDA, 2008; USFWS, 2008-2009; USGS, 2008-2009.

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. Minor long-term impacts would occur at Rio Cupeyes from STREON experiments. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be used to minimize the potential for impacts to water quality as a result of erosion and sedimentation. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

Elevation of $NH_4NO_3$ or $H_3PO_4$ concentrations in Rio Cupeyes to 5 times ambient concentrations for a 10-year period could result in long-term impairment of water quality in this stream and lead to eutrophication within the experimental reach. Because the stream is in a tropical forest area, low ambient light levels would likely prevent substantial increases in growth of algae and periphyton. This could lead to greater downstream transport of soluble nitrogen and phosphorus, which could impact downstream waters. There also could be periodic die-offs of algal and periphyton biomass, which could lead to oxygen depletion in the stream from aerobic decomposition. Oxygen depletion could in turn result in changes to vertebrate and invertebrate communities in the immediate area (Hauer and Lamberti, 2006). Impacts would likely be long-term and minor. No impacts would be expected from the recirculation tracer experiments.

There would be potential for transport of soluble nitrogen and phosphorus to incrementally interact with other human and natural events and produce cumulative impacts to downstream water quality. However, Rio Cupeyes joins with Rio Guanajibo approximately 5.7 km downstream from the proposed S-10 location. The additional assimilative capacity provided by joining with Rio Guanajibo would likely prevent downstream cumulative impacts.

There would be potential for in-stream monitoring equipment to be washed downstream during periods of heavy rain and strong currents. It is unlikely that this equipment would be recovered if washed away. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts on existing water quality if they were to be lost in the existing stream systems. There are no environmentally harmful components associated with this monitoring equipment. When there is advance warning of potential flood events, NEON, Inc. would temporarily remove equipment from flood prone areas and return the equipment to the sampling location after the flood had receded.

### Wetlands

#### *Affected Environment*

Based on review of remote data, there are no known wetlands within or near the three proposed Core Site tower locations (C-10, C-11, C-12) or the Ponce Metro Relocatable Tower (R-08). However, the proposed location of R-08 is within an area converted from mangrove forest and likely includes areas of coastal wetlands. There also are no known wetlands within or near the proposed STREON Site on Rio Cupeyes (S-10) (Table 3.5.4.3-1), but this area is within moist forest and there could be wetlands at or adjacent to the proposed STREON site.

The LAES contains freshwater emergent wetlands within its boundaries but none are at the proposed locations of the Aquatic Array (A-09) or Relocatable Tower (R-07) (Table 3.5.4.3-1). Any nearby wetlands would be in actively cultivated agricultural fields, pastures, or livestock areas. Any such wetlands would be degraded due to the ongoing agricultural activities.

#### *Environmental Consequences*

Any impacts to wetlands from NEON activities in Domain 4 would be expected to be negligible. No cumulative impacts to wetlands would be expected from this project.

There would be potential to disturb coastal wetlands at R-08 and forested wetlands at S-10. During final site design, NEON, Inc. would avoid wetlands to the extent practicable and, if possible, there would be no impacts to wetlands. Should it be necessary to place infrastructure in wetlands, any infrastructure so placed would be removed at the close of the project. To further minimize the potential for disturbance to wetlands, utility lines would be brought to the tower through an above-ground conduit. A boardwalk would be constructed to minimize the potential for impacts from site access for maintenance and data collection if crossing wetlands would be necessary. Further, NEON, Inc. would implement and maintain appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for direct and indirect impacts to the wetland. If impacts to wetlands could not be avoided, NEON, Inc. would obtain all required local, state, and federal permits regulating activities in wetlands prior to construction at this site and would comply with all permit conditions during construction activities (see Section 5.4 for a discussion of permits and approvals required).

Temporary minor impacts to wetlands also could occur at the time of site closure. However, site closure would result in removal of NEON infrastructure from wetlands, which would then be a long-term benefit to the wetland as the area would be returned to its pre-construction condition.

At all sites, NEON, Inc. would implement BMPs, as discussed in Section 2.2.2, during construction to minimize the potential for indirect impacts to offsite wetlands as a result of erosion and sedimentation from the construction sites. No indirect impacts to offsite wetlands would be expected.

### Floodplains

#### *Affected Environment*

There are no known floodplains within the proposed NEON sites located at GDFR or LAES. The proposed location of R-08 at Ponce Metro is not within a river floodplain, but is in a coastal area and is prone to flooding following heavy rain events, such as those associated with tropical storms. The STREON Site on Rio Cupeyes (S-10) is prone to flooding during heavy rain events, such as tropical storms or hurricanes. Additionally, when heavy rains occur over the Central Mountain Range, floodwaters may surge toward the southern coast by way of Rio Cupeyes.

#### *Environmental Consequences*

The tower and associated infrastructure at R-08 would be within a floodprone area. On Rio Cupeyes, the STREON Site would be placed within the floodplain. All of the supporting infrastructure would be located outside of the floodplain. No increase in flood elevations would result at either R-08 or S-10, and any changes in flood storage capacity would be negligible. There would be no cumulative impacts to floodplains in Domain 4.

There would be the potential for equipment to be damaged during flood events. NEON, Inc. would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts on existing water quality if they were to be lost in streams. There are no environmentally harmful components associated with this monitoring equipment. NEON, Inc. would temporarily remove equipment from flood prone areas when flooding is forecast for the area.

### Common Vegetation and Plant Communities

#### *Affected Environment*

The GDFR is one of the largest remaining tracts of tropical dry coastal forest in the world. It is home to a large variety of vegetation and plant communities. GDFR is known to contain up to 550 plant species, which is twice the number of species in a rain forest (Engman, 2008). Of these species, 16 exist nowhere else in the world (Welcome To Puerto Rico [WTPR], 2009). There are three main groups or communities of vegetation in the GDFR: upland deciduous, semi-evergreen, and scrub (World Wildlife Fund, 2001). Typical vegetation representative of these families includes the pink trumpet tree, gumbo-limbo, turpentine tree, buttonwood tree, black olive, sea grape, rubescens cactus, and several other varieties of cactus (National American Bonsai Federation, 2009).

The Rio Cupeyes STREON Site (S-10) is located adjacent to the MSF, which possesses vegetation similar to the GDFR due to its dry forest habitat. However, the proposed STREON site would be within a moist forest area, where the vegetation would include invasive exotic plants such as mango, bamboo, and rose apple and native species such as American muskwood, royal palm, and pumpwood. The presence of extensive mangrove and bamboo along rivers is an indicator of historical disturbance of these forests.

LAES has very limited natural vegetation because of widespread use of the land for agricultural production. Typical agricultural production consists of rice, annual vegetable crops, orchards of mangoes and citrus, and plantations of mahogany and leguminous forestry species (Keller, 2008).

The proposed Relocatable Site in Ponce Metro (R-08) is on a forested lot within the Catholic University. Vegetation in this area includes mangroves and non-native species encroaching from the surrounding urban development.

#### *Environmental Consequences*

Tree removal along utility lines would be a minor long-term impact to vegetation and plant communities. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation (less than 0.01 ha) would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate. Where overhead utility lines are extended, there could be limited removal of trees along the route. Because of the need to keep the utility lines clear of woody vegetation, these would be kept free of trees by hand removal of saplings, as necessary, until the end of the NEON project.

A windfarm is proposed for the property adjoining GDFR on its southeastern corner. Clearing associated with development of the windfarm may result in encroachment of invasive species into the GDFR, but no interaction with NEON projects with regard to vegetation impacts would be expected due to the distance from the proposed windfarm to the nearest proposed NEON location.

### Common Fauna

#### *Affected Environment*

Comparable wildlife populations are present on the GDFR, which would be the location of the three towers associated with the Core Site (C-10, C-11, C-12), and the forest where the STREON Site (S-10) would be located. The following information relates to these four proposed sites. With the exception of human-introduced species, such as dogs, cats, rhesus monkeys, and livestock, there are only 13 native terrestrial mammals in Puerto Rico and all are bats (Zapata, 2008). Common bat species that occur in Puerto Rico include the greater bulldog bat, Antillean ghost-faced bat, Parnell's mustached bat, sooty mustached bat, Jamaican fruit bat, and the Antillean fruit bat. Common birds of the GDFR are the brown pelican, white-cheeked pintail, little blue heron, great egret, turkey vulture, and American kestrel (Birdtours.com, 2009).

At the LAES, the forest canopy has been removed and native wildlife would be limited to occasional foraging and transient use. LAES is fully developed for agricultural production and provides poor quality habitat for native bats and birds.

#### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding is expected. Similar impacts are anticipated during project closure activities, such as removing the towers and IHs.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible. Because the majority of the land that would be cleared for the proposed windfarm adjacent to the southeastern corner of GDFR would be degraded forest habitat, only minor interaction effects with NEON would be anticipated with regard to wildlife habitat.

Towers and guy wires would pose a minimal risk to common birds and flying mammals. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure. A greater collision hazard would exist if the proposed windfarm is constructed adjacent to the southeastern corner of GDFR. There would be potential for interaction at the population level between collisions at the windfarm and collisions at NEON infrastructure on GDFR. However, because only minimal collisions with the stationary NEON infrastructure are anticipated, any interaction with the windfarm would likely be minor.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Puerto Rico Department of Natural Resources and Environment prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

Operation of the standby generator would likely startle nearby wildlife. Wildlife would likely temporarily relocate during operation of the generator. Potential noise effects are discussed above. There would be a long-term loss of habitat at towers and IHs, but the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall, impacts to wildlife would likely be negligible.

Wildlife react to fixed-wing aircraft overflights in response to visual and auditory stimuli (Ward, 1984). Because flights would be conducted under full canopy conditions, visual stimuli would be minimal and the closed canopy could reduce airplane noise. Birds and bats may startle at the noise of the plane, but no energy-consuming panic response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight.

Because impacts would be separated in space and time, no potential for interaction among proposed NEON project or between NEON projects and other projects would be expected.

#### Sensitive Ecological Communities

##### *Affected Environment*

Within the proposed NEON site locations, only one area, the GDFR, would be considered ecologically sensitive. The GDFR is home to approximately 48 endangered plant species and hosts the greatest number of bird species on the island, including 9 of 16 bird species known to be endemic to Puerto Rico (WTPR, 2009; Zapata, 2008). UNESCO designated GDFR as a biosphere reserve due to its high level of biodiversity (Engman, 2008).

##### *Environmental Consequences*

Minor direct impacts to sensitive ecological communities would occur from construction and operation of NEON infrastructure. There would be no potential for cumulative impacts.

A small amount of sensitive habitat would be disturbed at GDFR. Construction, including access trails and installation of fencing around towers, would occur within the dry forest community. The majority of GDFR consists of tropical dry forest habitat and no substantial loss of this habitat would occur. All three towers associated with the Core Site (C-10, C-11, C-12) would be positioned within the GDFR. Because of the sensitivity of habitats in this forest, the Department of Natural and Environmental Resources of Puerto Rico would not allow tree removal for the placement of overhead utility lines or trenching for placement of buried utility lines within GDFR. Utility service would be extended to the proposed tower locations by placing above-ground conduits parallel to the road. Impacts to this sensitive habitat would be negligible.

### Sensitive Species

#### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the GDFR, LAES, or Ponce Metro Proposed NEON locations (Table 3.5.4.3-2). No data were available on the occurrence of protected species at or near the proposed Rio Cupeyes STREON site. Sensitive species that may occur near proposed NEON locations are identified in Table Domain 4, Appendix B, along with their legal status and preferred habitat types. The following discussion is limited to those species which may occur in or near the proposed project locations in GDFR. The other proposed NEON sites in Puerto Rico do not provide suitable habitat for protected species with potential to occur near the proposed sites.

**TABLE 3.5.4.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 4, Southern Neotropics
*National Ecological Observatory Network (NEON) EA*

| | Number of Federal Protected Species Potentially Occurring | | | Number of Commonwealth Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-10 | 8-ESA | 0 | 8-ESA | 3 | 0 | 3 |
| C-11 | 8-ESA | 0 | 8-ESA | 3 | 0 | 3 |
| C-12 | 8-ESA | 0 | 8-ESA | 3 | 0 | 3 |
| R-07 | 0 | 0 | 0 | 0 | 0 | 0 |
| R-08 | 0 | 0 | 0 | 0 | 0 | 0 |
| A-09 | 0 | 0 | 0 | 0 | 0 | 0 |
| S-10 | NA | NA | NA | NA | NA | NA |

Source: Appendix B Domain 4
NA = No Information Available

### Federally Protected Species

Federally listed species known to occur near the proposed Core Site towers (C-10, C-11, C-12) in GDFR include 3 species of animals and 5 species of plants (Table 3.5.4.3-2).

The Puerto Rican nightjar is a Federally endangered bird species that inhabits heavily wooded areas in dry lowland semideciduous forests, typically lacking grass or brush at the ground level. This species lays eggs directly on leaf litter on the forest floor (NatureServe Infonatura, 2009).

The Puerto Rican crested toad is a Federally threatened amphibian that occurs in semiarid to mesic rocky coastal lowlands. This species spends much of the time underground and has been found under boulders, under bark, and under stones in dry gullies with low grasses and scattered large trees. This amphibian breeds in pools created after heavy rains (NatureServe Infonatura, 2009).

Bariaco is a Federally endangered species endemic to Puerto Rico known to occur in GDFR. This perennial tree/shrub occurs mainly in the Dry Forest Life Zone in woodlands and thickets on the southwestern part of the island, at an altitude of 175 m or less. This species prefers well-drained soils and occurs on the more mesic side of hills (Ventosa-Febles, 2007).

Palo de Rosa is a Federally endangered species known to occur in GDFR. This small evergreen tree may reach up to 15 m in height and prefers serpentine and limestone derived soils of western Puerto Rico. It is known to occur in the more humid canyon bottoms of GDFR and has also been found on drier upper slopes and summits of Quebradillas/Isabela (USFWS, 1994).

Tropical lilythorn is a Federally endangered plant species. The small spiny shrub occurs in Puerto Rico, St. Croix, Barbuda, Antigua, and Guadeloupe within the Subtropical Dry Forest Life Zone. This shrub may reach up to 3.0 m in height and prefers habitat with a nearly continuous single-layered canopy, with little ground cover within dry forests (USFWS, 2005).

#### Commonwealth of Puerto Rico Sensitive Species

The dry forest lizard is a species of special concern in Puerto Rico that occurs mainly in southwestern Puerto Rico, including the GDFR. This species occurs in a limited number of coastal scrub habitats within 1 km of the coast (Genet, 2002). This species and other anoles typically produce one egg per brood. The dry forest lizard is mostly found on the ground, unlike its close relative the crested anole, which typically occurs in higher perches in the trees (Cogger and Zweifel, 1998).

The violet tree is a species of special concern in Puerto Rico that occurs on hillsides of the island (Center for Plant Conservation, 2009). This perennial is adapted to coarse and medium textured soils and grows from 9 to 12 m in height (USDA, 2009).

Tintillo endémico is a species of special concern in Puerto Rico known to occur in the dry forests of southern Puerto Rico, including GDFR. The species is a spiny shrub and prefers limestone substrate in the Subtropical Dry Forest Life Zone (Guzman, 2006).

### *Environmental Consequences*

NEON, Inc. would work with property owners and site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction and infrastructure locations would be adjusted slightly to avoid disturbance of sensitive species while retaining the scientific merit of the location. In situations where a sensitive species or its suitable habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or habitat would be impacted or where there is a lack of available site-specific data on sensitive species, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat.

There would be the potential to disturb sensitive wildlife in the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Towers and guy wires would pose a minimal collision risk to the Puerto Rican nightjar. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the towers. Collisions with the towers or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk would be eliminated at site closure. A greater collision hazard for the nightjar would exist if the proposed windfarm is constructed adjacent to the southeastern corner of GDFR. There would be potential for interaction at the population level between collisions at the windfarm and collisions at NEON infrastructure on GDFR. However, because only minimal collisions by the Puerto Rican nightjar with the stationary NEON infrastructure are anticipated, any interaction with the windfarm would likely be minor.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Puerto Rico Department of Natural Resources and Environment prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

Operation of the standby generator would create noise and have the potential to startle nearby sensitive animal species at start-up. Once operational, the noise from the generator would be above ambient levels, but would be consistent and at a level at which sensitive animal species would be expected to resume normal activity. Any impacts would be minor and temporary. These intermittent disturbances would continue for the duration of the NEON project.

MBTA listed birds may be disturbed during construction and operation. Should nesting bird species protected by the MBTA occur in or adjacent to an area that would be cleared or be subject to a high level of human activity during construction, work would be delayed until after the young have fledged if the site could not be relocated.

### Cultural Resources

#### *Affected Environment*

The proposed NEON locations for Domain 4 are situated within four areas in the south-southwestern coastal region of the Commonwealth of Puerto Rico: The Guánica Dry Forest Reserve (GDFR), the Lajas Agricultural Experiment Station (LAES), Ponce Metro (Pontificia Universidad Católica de Puerto Rico), and along Rio Cupeyes.

## Prehistoric Context

The earliest recorded prehistoric site for the Caribbean cultural area is the El Jobo site in Venezuela, which has been dated as roughly contemporaneous with the Clovis period in North America. This culture is assumed to be an offshoot of the North American Big Game Hunting tradition, concentration on the hunting of Pleistocene megafauna (Willey, 1971).

Although the Lesser and Greater Antilles were home to various types of extinct Pleistocene megafauna, such as the giant ground sloth, no actual cultural artifacts have been identified for this time period 14,000 to 8,900 years ago for the Caribbean Islands. Some authors have treated the occurrence of Pleistocene megafauna and an acknowledged lower sea level of nearly 20 m that could facilitate travel between the northern coast of South American and the Antilles during the Paleoindian period as positive conditions for Paleoindian occupation (Veloz Maggiolo and Ortega, 1976).

The cultures of the Mesoindian period of the Caribbean area were considered roughly equivalent to North American Archaic hunting and gathering cultures. This period is generally believed to have commenced about 7,900 years ago and ended for most of the Lesser and Greater Antilles about two thousand years ago. A people referred to by the early Spanish as Ciboney, utilizing a Mesoindian life style, continued to exist in extreme western Cuba until historic times. This period was characterized as representative of a hunting and gathering people, who increasingly became dependent on the littoral zones of the islands for subsistence (Willey, 1976).

The first noted Mesoindian occupation in the Antilles was the Banwari culture, a small animal-hunting and shellfish-gathering phase from Trinidad around 7,900 years ago which appeared to have possibly moved up the Lesser Antilles to Puerto Rico, Hispaniola, and Cuba over time. Most of the sites excavated from this period are related in some manner to the utilization of shellfish. Twice during the Mesoindian period from 5,420 to 4,500 years ago and 3,800 to 2,800 years ago sea levels lowered, destroying the shellfish environments of the islands and causing a depopulation of coastal areas.

Mesoindian period sites are generally open camp sites of small shell middens found on or near the coast. The faunal material recovered consists of fresh and saltwater shellfish and remains of fish and sea and land mammals. In the islands of Cuba, Hispaniola, and Puerto Rico, where the greatest concentration of Mesoindian sites are found, these period sites tended to be coastal shell middens. The Mesoindian tool assemblage consists of stone tools, such as flake points, awls, and knives. Ground stone celts, manos, and axes are also found. In addition, modified conch shells made into vessels and plates are found. Sites in Puerto Rico tend to produce more ground stone tools.

The most important archeological site in the Caribbean area is the Tibes Indigenous Ceremonial Center near Ponce, Puerto Rico. This site is a ceremonial ballpark of the Taino Indians, who dominated Puerto Rico until the arrival of the Spanish Conquistadores in 1500. It represents the continuous habitation of indigenous people more than 1,000 years before the arrival of Columbus.

### Historic Context

Originally named Borinquen (Island of the Brave Lord) by the Taino Indians, Puerto Rico was discovered in 1493 on Christopher Columbus' second voyage to the New World. He landed on the northwestern part of the island and named it San Juan Bautista. The island derived its present name from the exclamation “Que puerto rico!” (what a rich port) spoken by conquistador Juan Ponce de Leon, upon entering the bay. Puerto Rico was eventually ceded by Spain to the United States in 1898 following the Spanish-American War. In elections held in 1967 and 1993, voters chose to retain Commonwealth status.

Ponce, on the southern coast, is Puerto Rico's second largest city. Its architecture dates from the 1890s to the 1930s when Ponce was the hub of the island's sugar cane, rum, and shipping industries. Nearby, the Tibes Indigenous Ceremonial Center includes the oldest Taino cemetery in the Antilles, an astronomical feature dating to 700 A.D., seven rectangular ball courts, and stones carved with petroglyphs.

### Archival Literature Search

To assess potential impacts to cultural resources contacts were made to local officials at each of the four proposed NEON locations in Puerto Rico. The area of inquiry for each proposed NEON location was defined as a study area that extended 1.6 km from each proposed location. Data were gathered from each official regarding the known presence of cultural resources and cultural resources sensitivity within the defined study areas. Contacts were made to the Guánica Dry Forest Reserve, Lajas Agricultural Experiment Station, Pontificia Universidad Católica de Puerto Rico, and Bosque Estatal de Maricao. This search also included consultation with the Instituto de Cultura Puertorriqueña (ICP), and a review of The National Register Information System (NRIS), which contains information related to properties listed on the NRHP. No sites listed on the NRHP are located within the areas of disturbance of the proposed NEON locations for Domain 4. The Puerto Rico State Historic Preservation Office (PR SHPO) was also contacted as part of the search.

Resources previously documented within the general vicinity of the proposed NEON locations in Domain 4 include prehistoric Taino earthen terraces, concheras (shell middens), prehistoric petroglyphs, coffee plantation sites, Civilian Conservation Corps (CCC) constructions, historic buildings, and historic farmsteads (Table 3.5.4.3-3). The proposed Core Site Advanced Tower (C-10) and Basic Towers (C-11 and C-12) would be within the Guánica Dry Forest Reserve. Resources known to exist in the area include Taino terraces, CCC features, and shell middens; however, none of the previously documented resources are in the vicinity of the proposed NEON towers.

Proposed Relocatable Site R-7 and Aquatic Array A-9 would be located within the Lajas Agricultural Experiment Station. The station is managed by the University of Puerto Rico and is used for agricultural research. The area is heavily disturbed from grazing, dairy operations, rice seed production, feeding operation for animals, and other agricultural uses. No known significant cultural resources are present on this site.

**TABLE 3.5.4.3-3**
Literature Search Results–Domain 4 Southern Neotropics
*National Ecological Observatory Network (NEON) EA*

| Neon Site Number | Previously Surveyed | Number of Archaeological Resources Present: Within Area of Direct Impact of Proposed NEON location | Number of Archaeological Resources Present: Within 1.6-km Study Area | Number of Historic Resources, including Architecture Present: Within Area of Direct Impact of Proposed NEON location | Number of Historic Resources, including Architecture Present: Within 1.6-km Study Area | Number Evaluated | Number Eligible |
|---|---|---|---|---|---|---|---|
| C-10 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-11 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-12 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R7 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R8 | No | 0 | 0 | 0 | 8 | 8 | 8 |
| S-10 | No | 0 | 0 | 0 | 0 | 0 | n/a |

Source: National Register Information System (NRIS).

Proposed Relocatable Site R-8 would be placed in Ponce Metro, within a wooded lot on the campus of Pontificia Universidad Católica de Puerto Rico (the Catholic University). This location would be in a highly developed urban setting with a mix of buildings, parking lots, parks, and sports fields. Historic structures and resources listed on the NRHP are present in Ponce; however, the search revealed that the University is highly developed and no cultural resources constraints exist at the proposed location of R-8.

The proposed STREON Site (S-10) would be located along the Rio Cupeyes, a low order stream located at the foothills of the Central Mountain Range and adjacent to the Bosque Estatal de Maricao. The area is frequently flooded and no significant cultural resources are present.

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 4 did not identify known NRHP eligible historic properties within the proposed areas of disturbance for any of the proposed NEON locations.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 4, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

## Environmental Justice

### *Affected Environment*

Proposed NEON projects would have the potential to interfere with subsistence land crabbing activities in southern Puerto Rico, which could disproportionately impact low-income populations near some proposed NEON sites. Land crabs, locally referred to as *jueyes*, live within holes or burrows near coastal areas, wetlands, and marshes. Hunting land crabs for food is a common practice on the island, and is a subsistence practice. It is likely that the preferred habitat for the land crab exists within the boundaries of the GDFR and perhaps near the proposed Tower locations (C-10, C-11, C-12). However, crab harvesting is prohibited in state forests and reserves in Puerto Rico (Hostetler et al., 2007).

R-08, proposed for Ponce Metro, would be in an area used by residents as a baseball field and for horse grazing and tethering. The proposed tower location would be in a woodlot adjacent to the open land used by residents.

### *Environmental Consequences*

No direct or indirect impacts to environmental justice would be expected. There would be no potential for interaction with other projects and no cumulative impacts to environmental justice would occur.

R-08 would be secured with fencing, but the fencing would be the minimum needed to deter unauthorized access to NEON infrastructure. The presence of the tower and supporting infrastructure would not interfere with use of the adjacent open land for baseball and horse grazing.

Because crab harvesting is prohibited within the GDFR, implementation of NEON within GDFR would not adversely impact subsistence land crabbing in the region. The NEON infrastructure would be placed on controlled lands at all proposed locations and any impacts would be confined to the immediate project areas, so no disproportionate impacts to low-income or minority populations would result.

## Recreation

### *Affected Environment*

The GDFR has 12 hiking trails and is adjacent to a public beach. A Basic Tower (C-11) would be located near the public beach and the tower would likely be visible to hikers and beachgoers. Additionally, tower guy wires may be within walking distance and be visible from the hiking trails.

Although the proposed STREON Site (S-10) is not within the MSF, a number of trails which may be used for recreational purposes are near the site. These trails would connect with hiking trails associated with the MSF.

There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 4.

### *Environmental Consequences*

Minor short-term impacts to recreation could occur at some proposed NEON locations during construction. Long-term impacts on recreation would be negligible. Because NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would be likely.

Minor impacts to recreational hikers would occur in the immediate vicinity of the three towers within GDFR (C-10, C-11, C-12) and the STREON Site adjacent to MSF during construction activities. Hikers would likely be prohibited from entering the segments of the trails that abut active construction zones. Any impacts would be temporary and negligible, as the hikers would be able to use other trails during construction.

During operation, the towers and guy wires would create minor impacts to the aesthetics of the trails and nearby beaches. However, the presence of the towers would not prevent people from using the trails and beaches. Occasional standby generator noise could be a nuisance to recreational users of these areas, but operation of these generators would not prevent recreational use of nearby areas.

At proposed NEON locations where recreational vehicle activity could occur, guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

**Utilities**

***Affected Environment***

The GDFR station receives power from overhead lines; however, power to the proposed Core Site towers (C-10, C-11, C-12) would be placed in conduits paralleling the existing roads, approximately 20 m from the edge of the road.

There is an existing power source at LAES which would be used to power the proposed Relocatable Tower (R-07) and Aquatic Array (A-09).

The proposed Ponce Metro Relocatable Tower (R-08) would be powered through the existing grid system that is available at the Catholic University. A new line would be placed to the tower.

At the proposed Rio Cupeyes STREON Site (S-10), power would be obtained from the grid through a new power line that would parallel the main road (SR 3363) leading to the site.

***Environmental Consequences***

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities at some proposed NEON locations during construction. Because of the spatial separation of projects, no cumulative impacts would be expected.

No impacts would result from extension of utility services at the Catholic University or LAES.

Within GDFR, the installation of aboveground power lines would not be permitted. Power would be extended parallel to an existing road, approximately 20 m off the side of the road, in a conduit that would be placed on the surface. The conduit would be concealed in vegetation.

At Rio Cupeyes, power would be extended from the grid terminus, with surface conduits lines placed along existing roads to the point nearest the proposed location (S-10). A portal would be placed at the point nearest the existing access road where access for maintenance and standby generator refueling would be available. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for environmental impacts.

NEON, Inc. would place a 35-kW propane-powered standby generator at the proposed Core Advanced Tower location. The generator would be placed inside the APs to reduce noise and further reduce the potential for a fuel spill to reach the environment.

### Transportation

#### *Affected Environment*

GDFR is most easily accessible from SR 334 East from Maria Antonia. GDFR has an internal network of roads and hiking trails. These roads are primarily a mix of gravel and sand substrate accessible in dry conditions by two-wheel drive vehicles with good clearance levels. Four-wheel drive vehicles may be required during wet conditions.

LAES is accessed by either SR 101 or SR 303. There are a number of maintained dirt roads that could be used to access the proposed Relocatable Tower (R-07) and Aquatic Array (A-09) within LAES.

The proposed Ponce Metro site (R-08) is in an urban area with multiple roads providing access to the area.

The proposed STREON Site on Rio Cupeyes (S-10) is approximately 3.2 km north of SR 2 on SR 3363. The proposed site is approximately 300 m west of SR 3363, within 20 m of a trail that is accessible by foot or ATV.

#### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and transported by hand from that point to the construction site. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving would occur.

Materials would be transported by hand from the road to the proposed NEON location. Improved trails would be created to move from the road to a proposed NEON location. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

### Human Health and Safety

#### *Affected Environment*

All three proposed towers associated with the Core Site (C-10, C-11, C-12) would be accessible either from GDFR hiking trails or from the public beach that would be adjacent to the Basic Tower (C-12). The proposed STREON Site on Rio Cupeyes (S-10) is also in proximity to hiking trails and public lands.

At LAES, Aquatic Array A-09 and Relocatable Site R-07 would not be accessible by the public. The Aquatic Array would be located away from areas where students from the University of Puerto Rico would be working; however, Relocatable Site R-07 could be located in areas where agricultural research activities are ongoing.

In Ponce Metro, Relocatable Tower R-08 could pose a safety hazard to students attending the Catholic University.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury. A similar potential for worker injury would occur at site closure and any impacts at this time would likely be temporary and minor.

There would be a potential for pedestrians in Ponce Metro to contact guy wires while on foot. Additionally, there would be the potential for station employees or researchers riding ATVs to contact the guy wires during routine work or during NEON maintenance or data collection. Towers and guy wires would abut hiking trails and a public beach at GDFR and be near trails associated with the MSF. Proposed site locations would be secured with fencing and locked gates to deter unauthorized access. Signage would be placed to deter use of trails created to access NEON locations. This would limit potential health and safety issues for the public. Guy wires would be clearly marked and flagged to reduce the potential for accidental contact and injury. These design features would be implemented at all tower locations and on any guy wires where there is a threat to human safety.

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**Figure 3.D04-1** Domain 4 Proposed Site Locations

**Figure 3.D04-2** Domain 4 Proposed Site Locations

**Figure 3.D04-3** Domain 4 Proposed Site Locations

**Figure 3.D04-4** Domain 4 Proposed Site Locations

### 3.5.5 Domain 5 Great Lakes Region

#### 3.5.5.1 Introduction

Domain 5 encompasses the Great Lakes region, extending from the U.S. border with Canada in northern Minnesota, Wisconsin, and Michigan south to northern Indiana and Ohio. The sites selected in Domain 5 are all near the Michigan-Wisconsin border (Figure 2-1). The topography of this region is characterized as undulating till plains, morainal hills, broad lacustrine basins, with areas of extensive sandy outwash plains (Omernik et al., 2000).

The proposed sites for Domain 5 include a Core Site that would have an Advanced Tower (C-13), a Basic Tower (C-14), and an Aquatic Array (A-11) proposed for the University of Notre Dame Environmental Research Center (UNDERC) along the border of Gogebic County, Michigan, and Vilas County, Wisconsin. A second Core Site with a Basic Tower (C-15) would be located in the Ottawa National Forest (ONF), in Gogebic County, near Watersmeet approximately 15 km east of UNDERC. A Relocatable Site (R-09) would be located on Steigerwaldt Land Services (Steigerwaldt). A Relocatable Tower (R-10) and an Aquatic Array (A-12) are proposed for Treehaven. Steigerwaldt and Treehaven are in Lincoln County, Wisconsin.

#### 3.5.5.2 Resource Areas Considered But Not Addressed for Domain 5

Preliminary analysis indicates that there would be no potential to significantly impact five of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Airspace: The proposed NEON sites would be in remote undeveloped areas of Wisconsin and Michigan where FAA has not designated any restricted airspace (FAA, 2009).
- Sensitive Ecological Communities: The proposed NEON project areas in Domain 5 are not within or adjacent to any designated critical habitat area, as defined under the ESA (USFWS, 1992). No sensitive ecological communities are known from the vicinities of the proposed NEON locations on the UNDERC, ONF, Treehaven, or Steigerwaldt (Michigan DNR, 2008; Engelman, 2009). There would be no potential to impact sensitive ecological communities.
- Environmental Justice: The proposed NEON sites would be located on private land with limited public access. All potential impacts would be confined to the private lands and there would be no potential to disproportionately impact minority or low-income populations.
- Protection of Children: The proposed NEON sites would be located on private land with limited public access. All potential impacts would be confined to the private lands and there would be no environmental health and safety risks to children.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 5 are designated research areas that are not routinely viewed for aesthetic. Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

### 3.5.5.3 Resource Areas Considered in Detail for Domain 5

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 5 where site-specific conditions would influence the anticipated environmental consequences.

#### Geology

##### *Affected Environment*

The proposed Domain 5 Core and Relocatable Sites are within the Northern Highlands Lakes Country ecoregion, part of the larger Northern Lakes and Forests physiographic province (Omernik et al., 2000). This region has numerous large, shallow glacial lakes and wetlands. The soils in this region are typically gravelly and sandy and well to excessively drained (Omernik et al., 2000).

The seismicity of the Great Lakes region is stable. Throughout the domain, the maximum percent peak ground acceleration (pga) with a 2 percent probability of occurrence in 50 years ranges from 0 % pga to 6 % pga for both short wave motion and long wave motion. In the immediate area of the proposed NEON sites, the 2% probability of occurrence in 50 years is 2 % pga (USGS, 2009a, 2009b).

##### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact subsurface geological features. The seismic hazard is low in the locations where NEON infrastructure is proposed, and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

#### Soils

##### *Affected Environment*

Soils within the vicinity of the proposed locations on UNDERC consist mostly of sandy loams and silt loams. The soil at the proposed location for C-13 consists of Gogebic, sandy substratum-Pence-Cathro soil, a moderately well drained soil with slopes ranging from 6 to 18 percent. The typical soil profile is slightly decomposed plant material to 3 cm, fine sandy loam to 13 cm, silt loam to 31 cm, fine sandy loam to 50 cm, gravelly fine sandy loam to 84 cm, and fine sandy loam extending to 138 cm. Soil in the proposed area of Core Site C-14 is Lupton-Pleine-Cathro complex and Karlin-Keweenaw-Sarona, dense substratum, complex. Lupton-Pleine-Cathro is a very poorly drained soil with slopes ranging from 0 to 1percent. The typical soil profile for this soil type is muck to 200 cm. Karlin-Keweenaw-Sarona is somewhat excessively drained with slopes ranging from 1 to 6 percent. The typical soil profile for this soil type is highly decomposed plant material to 3 cm, sandy loam to 38cm, and sand to 200 cm (NRCS, 2009a; NRCS, 2009b; NRCS, 2009c; NRCS, 2009d).

The soil in the general area of the proposed Core Site Tower C-15 location consists of variations of Gogebic fine soils, the most common of which is Gogebic fine sandy loam, sandy substrate. This is a moderately well drained soil with slopes ranging from 6 to 18 percent. The typical soil profile for this soil is slightly decomposed plant material to 3 cm, fine sandy loam to 13 cm, silt loam to 31 cm, fine sandy loam to 51 cm, gravelly fine sandy loam to 84cm, and fine sandy loam to 125 cm. The soil at the proposed Core Site Tower C-15 location is Karlin-Keweenaw-Sarona, dense substratum, complex, which was described above (NRCS, 2009e; NRCS, 2009f).

The soils in the general area of Aquatic Array A-11 on UNDERC consist mostly of variations of Karlin-Keweenaw-Sarona and Gogebic sand and silt soils. The soil in the immediate area of proposed Aquatic Array A-11 and along much of Kickapoo Creek is Ausable, frequently flooded-Tawas complex and Karlin-Keweenaw-Sarona, dense substratum, complex. Ausable, frequently flooded-Tawas complex is very poorly drained and has slopes ranging from 0 to 1 percent. The typical soil profile for this soil type is muck to 21 cm, sand to 41 cm, stratified muck to sand to loamy fine sand to 64 cm and very gravelly sand extending to 203 cm. Karlin-Keweenaw-Sarona, dense substratum, complex is generally the same as the previous Karlin-Keweenaw-Sarona with the exception of the slope range, which is 6 to 25 percent in this variation (NRCS, 2009g; NRCS, 2009h; NRCS, 2009i).

The soils on and near Treehaven consist mostly of sandy loams and a few muck soils. The soil at the proposed Aquatic Array A-12 consists of Lupton, Cathro, and Markey mucks. These are very poorly drained soils with slopes ranging from 0 to 1 percent. The typical soil profile for this soil is muck extending to depths of 71 cm to 153 cm, depending on which muck soil variation is present. This soil type is not considered susceptible to rill and sheet erosion (NRCS, 2009j; NRCS, 2009k). The soil at the proposed location of Relocatable Site R-10 is Vilas-Sayner loamy sands. This is an excessively drained soil with slopes ranging from 15 to 35 percent. The typical soil profile for this soil is loamy sand to 38 cm and sand extending to 153 cm. This soil type is not considered susceptible to rill and sheet erosion (NRCS, 2009j; NRCS, 2009k).

The soil in the vicinity of the proposed site for Relocatable R-09 at Steigerwaldt is similar to those at Treehaven. The soil at the proposed location of Relocatable Tower R-09 is Moodig sandy loam, a somewhat poorly drained soil with slopes ranging from 0 to 4 percent. The typical soil profile for this soil is sandy loam to 8 cm, gravelly sandy loam to 56 cm, sandy loam to 135 cm, and gravelly sandy loam extending to 242 cm. This soil is not considered susceptible to rill and sheet erosion (NRCS, 2009l; NRCS, 2009m).

### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

At each of the proposed NEON locations, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would be less than 0.03 ha at C-13 and R-10 and less than 0.02 ha at C-15 and A-11. Approximately 0.034 ha would be disturbed at A-12, 0.20 ha at C-15, and 0.32 ha at C-14. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are highly prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby waterbodies. To minimize the potential for soil compaction and associated erosion as a result of repeated data collection and maintenance visits, boardwalks would be constructed to access the proposed Aquatic Array sites.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

### Climate

#### *Affected Environment*

Annual precipitation rates and temperatures throughout much of Domain 5 are influenced by the Great Lakes. At the proposed UNDERC and ONF locations, the average annual precipitation is 77.1 cm and the mean temperatures range from -1.9˚C to 9.7˚C depending on the season (MRCC, 2009a and 2009b). In the northern portion of Wisconsin near proposed Sites R-09 and R-10, the average annual precipitation is 81.3 cm and the mean temperatures range from -2.4˚C to 10.8˚C (MRCC, 2009c and 2009d). Weather fronts in this region move predominantly from west to east and southwest to northeast, with average seasonal snowfall exceeding 254 cm along the western slope of the Gogebic Range (University of Wisconsin Extension Service [UWEX], 2009).

#### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. Due to the potential for extreme weather conditions from heavy snow and ice storms, towers would be designed and secured to minimize the risk of loss from high winds and ice accumulation. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind and snow accumulation. Site design would incorporate appropriate insulation to protect sites from prolonged periods of extremely cold temperatures.

### Air Quality

#### *Affected Environment*

All proposed NEON locations are in areas with good air quality. The entire Upper Peninsula of Michigan and the Wisconsin counties abutting the Upper Peninsula are classified as in attainment for all criteria pollutants (Michigan Department of

Environmental Quality [DEQ], 2009a, Wisconsin Department of Natural Resources [DNR], 2009a).

Rainbow Lake is the only designated Class I Wilderness area within 161 km of the proposed NEON locations in Domain 5. Isle Royale is approximately 171 km from the nearest proposed NEON location in Domain 5 USEPA, 2009a). Rainbow Lake was excluded from the visual protection aspects of Class I Wilderness Areas in 1980 (USEPA, 2009b.)

#### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts on air quality. The amount of ground disturbance would be less than 0.01 ha at any proposed location and no large earthmoving equipment would be used. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze and would not impact visibility at any designated Class I Wilderness Areas.

### Noise

#### *Affected Environment*

The noise environments at all proposed NEON locations in Domain 5 would be similar. All proposed NEON sites are in rural areas with low surrounding populations. Existing noise levels at all three locations would likely be approximately 40 dBA (USEPA, 1974).

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would have no impact on residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. No new roads would be constructed. During construction, noise levels would be elevated periodically during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure.

Wildlife in the immediate construction area would be exposed to the elevated noise and would likely relocate from the construction area, but would likely resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at the proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at Core Site tower locations and up to 5 years at Relocatable Sites).

There are residences near the proposed NEON locations. Therefore, noise from AOP overflights would have no potential to impact residents. Potential impacts of AOP overflights on wildlife are discussed below.

### Water Quality

#### *Affected Environment*

The Great Lakes region supports a multitude of glacial melt ponds, lakes, and reservoirs (Table 3.5.5.3-1). The Northern Highlands Lakes Country is the origin of most of the major streams in Wisconsin (Omernik et al., 2000 and UWEX, 2009). Aquatic Array A-11 would be located on Kickapoo Creek in UNDERC. Aquatic Array A-12 would be on Pickerel Creek in Treehaven, near its confluence with Big Pine Creek.

**TABLE 3.5.5.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 5, Great Lakes United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-13 | 7 | 0 | 81 | 0 | 54 | 0 |
| C-14 | 9 | 0 | 91 | 1 | 85 | 1 |
| C-15 | 20 | 0 | 82 | 0 | ND | ND |
| R-09 | 5 | 0 | 16 | 0 | ND | ND |
| R-10 | 6 | 0 | 11 | 0 | ND | ND |
| A-11 | 8 | 1 | 97 | 1 | 80 | 1 |
| A-12 | 8 | 1 | 14 | 0 | ND | ND |

ND = No remote data available for this location
Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009c.

There are waters in the vicinity of the proposed Core Site towers at UNDERC (C-13, C-14) and ONF (C-15) that do not meet their designated uses and are listed as impaired due to elevated concentrations of mercury in fish tissue or elevated concentrations of polychlorinated biphenyls (PCBs) in the water column. However, Kickapoo Creek (Aquatic Array A-11) and Kickapoo Lake, from which it flows, meet their designated uses and are not included on the CWA 303(d) list of impaired waters (Michigan DEQ, 2009b).

In Wisconsin, Pickerel Creek and Big Pine Creek on Treehaven meet their designated uses and neither is on the Wisconsin CWA Section 303(d) list of impaired waters. There are two lakes near the proposed NEON Relocatable Sites that are on the list of impaired waters (Wisconsin DNR, 2008). Big Pine Creek flows into Lake Alice, which is listed as impaired due to low sediment oxygen levels and atmospheric deposition of mercury. Clara Lake, which is approximately 1.1 km from the proposed Aquatic Array on Treehaven, also is listed as impaired due to atmospheric deposition of mercury.

#### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur during construction from stormwater runoff. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

### Wetlands

#### *Affected Environment*

The UNDERC Advanced Tower (C-13), the ONF Core Site tower (C-15), and the Steigerwaldt and Treehaven Relocatable Towers (R-09 and R-10) would be in upland areas. The UNDERC Basic Tower (C-14) would be placed in a forested wetland (Table 3.5.5.3-1). The access portal for this corridor would be placed outside of the wetland and a boardwalk would be constructed to access this tower. The Kickapoo Creek Aquatic Array (A-11) would be located near Plum Lake in an area predominantly surrounded by wetlands. The access portal for this location would be placed in upland areas and a boardwalk would be constructed to access the aquatic sensors.

#### *Environmental Consequences*

There would be minor long-term direct impacts to wetlands from installation of Basic Tower C-14, placement of fencing, and construction of boardwalks to access C-14 and A-11. No other direct wetland impacts would occur. No indirect wetland impacts would be likely from implementation of NEON in Domain 5. No cumulative impacts to wetlands would be expected from this project.

Because all work would be confined to uplands, no direct impacts to wetlands would occur at the proposed NEON Core Site on the ONF, Relocatable Sites on Steigerwaldt and Treehaven, or the Core Site Advanced Tower at UNDERC.

NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for indirect impacts to offsite wetlands as a result of erosion and sedimentation from the construction sites. No indirect impacts to offsite wetlands would be expected.

A boardwalk would be constructed to access Aquatic Array A-11 for data collection and maintenance. The boardwalk would eliminate the potential for impacts to the wetland from trampling and soil compaction as a result of persons accessing the site. Any impacts would be long-term and minor.

The amount of disturbance to the wetland at the UNDERC Basic Tower location would be the minimum necessary to secure Basic Tower C-14, fencing, and any facilities placed in the wetland would be removed at the close of the project. To eliminate other potential disturbance to this wetland, utility lines would be brought to the tower through an above-ground conduit. A boardwalk (approximately 100 m) would be constructed to minimize the potential for impacts from site access for maintenance and data collection. Further, NEON, Inc. would implement and maintain appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for direct and indirect impacts to the wetland. NEON, Inc. would obtain all required local, state, and federal permits regulating activities in wetlands prior to construction at this site and would comply with all permit conditions during construction activities (see Section 5.5 for a discussion of permits and approvals required).

Temporary minor impacts to this forested wetland also would be expected at the time of site closure. However, site closure would result in removal of the NEON tower and boardwalk from the wetland, which would then be a long-term benefit to the wetland as the area would be returned to its pre-construction condition.

Impacts to wetlands at the proposed C-14 location and along the approach paths to C-14 and A-11 would be long-term and minor. No other wetland impacts would be expected as a result of NEON implementation in Domain 5.

### Floodplains

#### *Affected Environment*

The four proposed NEON sites in Domain 5 are in remote areas where FEMA has not designated floodplains or flood prone areas. The proposed UNDERC Basic Tower site (C-14) and the two proposed Aquatic Arrays (A-11 and A-12) would be located in and adjacent to streams and wetlands and within flood prone areas. All other proposed NEON infrastructure in Domain 5 would be placed outside of flood prone areas.

#### *Environmental Consequences*

There would be negligible direct impacts to flood prone areas as a result of implementation of NEON. One Basic Tower and two Aquatic Arrays would be placed in areas prone to flooding. The minimal displacement of the proposed equipment would result in a negligible impact on flood storage, flood elevations, and flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected.

At UNDERC, the proposed Basic Tower (C-14) would be placed within a flood prone area. The tower would be placed where floodwaters accumulate, but not in an active flood conveyance area. Only the tower, support pad, and associated fencing would be placed in the flood prone area. The remaining NEON infrastructure would be placed in adjacent uplands that would not flood. The displacement of the tower would be minimal and any change in flood storage capacity would be negligible. There would be no change in flood conveyance and any changes in flood elevations would be negligible.

The proposed Aquatic Arrays (A-11 and A-12) would be placed in and adjacent to streams and subject to high water events in those streams. The displacement of the aquatic monitoring equipment would be minimal and any changes to flood storage or flood elevations would be minimal. The equipment would be positioned to minimize the potential to snag debris and any impacts on flood conveyance would likely be negligible.

There would be the potential for equipment to be damaged during flood events. NEON, Inc. would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts on existing water quality if they were to be lost in streams. There are no environmentally harmful components associated with this monitoring equipment. NEON, Inc. would temporarily remove equipment from flood prone areas when flooding is forecast for the area.

### Common Vegetation and Plant Communities

#### *Affected Environment*

Due to the proximity of the proposed NEON sites at ONF and UNDERC (within 15 km) and the topographic similarity, the common vegetation and ecological communities of the area would be similar. Common habitats in these areas include northern hardwood forest, lake, and wetland. Trees commonly found in northern hardwood forests include quaking aspen, Eastern white pine, red pine, paper birch, red maple, and eastern hemlock. There are more than 100 common shrubs in these forests. There are three main wetland types in this area including bogs, shrub carrs, and marshes. Vegetation common to bogs includes tamarack, black spruce, Northern white-cedar, leatherleaf, sundew, pale laurel, sedges, common pitcher plant, sphagnum moss, and cranberries. Cattails, grasses, sedges, and other soft-stemmed plants commonly occur in marshes. Shrub carrs contain dense thickets of broad-leaved evergreen shrubs and commonly are dominated by gray alder (UNDERC, 2009a; UNDERC, 2009b).

Treehaven is managed for long-rotation timber production, with conifers as the target trees. Steigerwaldt is managed for pulpwood production; most of this property is managed to produce aspen (McReynolds, 2008. personal communication). The landscape at Treehaven and Steigerwaldt is similar to that at UNDERC and ONF outside the areas managed for production.

#### *Environmental Consequences*

Tree removal along utility lines would be a minor long-term impact to vegetation and plant communities. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Advanced and Basic Towers. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate. Where overhead utility lines are extended, there could be limited removal of trees along the route. Because of the need to keep the utility lines clear of woody vegetation, these would be kept free of trees by hand removal of saplings, as necessary, until the end of the NEON project.

### Common Fauna

#### *Affected Environment*

Because of the habitat similarity and proximity (all sites within 80 km), common wildlife species are similar for each of the proposed NEON sites. There are more than 50 mammal species in this area including coyote, raccoon, white-tailed deer, black bear, and eastern gray squirrel (UNDERC, 2009c). There are approximately 350 bird species in the area. Common species include wild turkey, red-tailed hawk, common snipe, mourning dove, wood duck, and great blue heron (UNDERC, 2009d). Approximately 30 types of reptile and amphibian species occur in the area, with common species including common snapping turtle, Eastern garter snake, American toad, green frog, mudpuppy, and western painted turtle (UNDERC, 2009e).

#### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding is expected. Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Towers and guy wires would pose a minimal risk to common birds and flying mammals. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Michigan Department of Natural Resources and Wisconsin Department of Natural Resources prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

There would be a long-term loss of habitat at towers and IHs, but the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall, impacts to wildlife would be negligible.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because flights would be conducted after canopy leaf-out, visual stimuli would be minimal and the closed canopy could reduce airplane noise. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight.

Because impacts to fauna would be separated in space and time, no potential for interaction among proposed NEON project or between NEON projects and other projects would be expected.

### Sensitive Species

#### *Affected Environment*

### Federal Species

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 5 (Table 3.5.5.3-2). However, there are known occurrences of either state or federal protected species within 5 km of all proposed sites. In addition, potentially suitable habitat for protected species is present at or adjacent to all of the proposed NEON locations (Table 3.5.5.3-2). The following sections discuss the species with potential to occur at or adjacent to proposed NEON sites in Domain 5.

**TABLE 3.5.5.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 5, Great Lakes Region
*National Ecological Observatory Network (NEON) EA*

| | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-13 | 1-ESA | 0 | 1-ESA | 3 | 0 | 3 |
| C-14 | 1-ESA | 0 | 1-ESA | 3 | 0 | 3 |
| C-15 | 1-ESA | 0 | 1-ESA | 3 | 0 | 3 |
| R-09 | 3-ESA | 0 | 3-ESA | 8 | 0 | 8 |
| R-10 | 3-ESA | 0 | 3-ESA | 8 | 0 | 8 |
| A-11 | 1-ESA | 0 | 1-ESA | 3 | 0 | 3 |
| A-12 | 3-ESA | 0 | 3-ESA | 8 | 0 | 8 |

Source: Appendix B Domain 5

Deam's rockcress is a tall perennial forb that prefers habitats in moist to dry woods and hills in sandy, rocky soils (University of Wisconsin [UW] Stevens Point, 2009a). This species inhabits mesic alluvial floodplain forests in northern Wisconsin (Engelman, 2009). The rockcress could occur on or adjacent to Treehaven and Steigerwaldt.

The gray wolf population in northern Wisconsin and Upper Peninsula Michigan inhabits areas of 51 to 555 $km^2$ (USFWS, 1992). There are no special habitat requirements for this species other than the presence of native ungulates within its established territory (USFWS, 1992 and Montana Field Guide, 2009). The gray wolf was removed from the ESA in Wisconsin in 2007 after Federal Recovery Plan goals were achieved. The final rule to delist the wolf was published in the FR on February 8 and the rule became effective March 12, 2007 (Wisconsin DNR, 2007). However, as a result of a District Court ruling on September 29, 2008, gray wolves in Wisconsin were placed back on the federal list of endangered species (Wisconsin DNR, 2009b). This species could occur in the vicinity of the Wisconsin NEON sites at Treehaven and Steigerwaldt (R-09 and R-10).

The bald eagle was recently delisted under the ESA, and will be monitored for at least 5 years to determine whether recovery is successful (USFWS, 2007). The bald eagle remains protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act, which are administered by USFWS. The bald eagle prefers habitats near large bodies of water with tall deciduous and coniferous trees or cliffs (NatureServe, 2009). The bald eagle could occur at or adjacent to all proposed Domain 5 NEON sites.

Pondweed is a submerged aquatic plant that occurs in quiet, shallow waters of acidic inland lakes (UW Stevens Point, 2009b and Engelman, 2009). This species could occur in the vicinity of proposed Relocatable Sites on Treehaven (R-09) and Steigerwaldt (R-10) or at the Aquatic Array A-12 if conditions were favorable.

#### State Species

The autumnal water-starwort is a submerged aquatic plant that grows in cold, clean flowing streams and spring ponds with quiet water and muddy, sandy soils (UW Stevens Point, 2009c and Engelman, 2009). This species could occur in the vicinity of the Wisconsin NEON sites at Steigerwaldt (R-09) and Treehaven (R-10) or at Aquatic Array A-12.

Purple clematis is a woody vine that inhabits cool, moderately moist forests with mixed conifer-hardwoods and rocky soil, preferably derived from igneous material (UW Stevens Point, 2009d and Engelman, 2009). This species could occur at the proposed Treehaven NEON site (R-10).

The wood turtle is a semi-terrestrial species that prefers deciduous forests and open meadows along streams and rivers (Conant and Collins, 1998 and Engelman, 2009). This species could occur in the vicinity of the proposed Treehaven and Steigerwaldt sites (R-09, R-10, and A-12).

The common loon prefers habitats with large inland lakes containing islands with minimal shoreline development (Michigan DNR, 2008). This bird winters primarily on large, ice-free inland bodies of water and prefers nesting sites on large lakes (National Geographic, 1987). Given the abundance of nearby lakes and ponds, this species could occur in the vicinity of the proposed towers at UNDERC (C-13, C-14) and ONF (C-15).

The hedge-hyssop is an herbaceous plant that grows in emergent wetlands, swamps, and moist to wet areas (Michigan DNR, 2008; MSUE, 2009). This species is usually found in softer waters to 3.96 m deep in peaty, sandy, and/or acidic soils (Michigan DNR, 2008). This species could occur in UNDERC or ONF.

The Farwell's water-milfoil is a submerged aquatic plant that prefers shallow waters (up to 2 m) of lakes, streams, and ponds in fine sediment soils (UW Stevens Point, 2009e; Engelman, 2009). This species could occur in the vicinity of the Wisconsin NEON sites at Steigerwaldt and Treehaven (R-09 and R-10) or at the Aquatic Array A-12 if conditions were favorable.

The osprey prefers habitats near large areas of surface water, with nearby deciduous or coniferous forests, wetlands, and shrub communities (Engelman, 2009). This species nests in isolated trees near water, where it consumes primarily fish (National Geographic, 1987). The osprey has the potential to occur at the Wisconsin NEON sites at Steigerwaldt and Treehaven (R-09 and R-10).

The hidden-fruited bladderwort is a floating aquatic plant that prefers quiet, shallow lakes and ponds (UW Stevens Point, 2009f and Engelman, 2009). This species could occur in the vicinity of the Wisconsin NEON sites at Steigerwaldt and Treehaven (R-09 and R-10) or at the Aquatic Array A-12 if conditions were favorable.

The purple bladderwort is a floating aquatic plant that prefers softer, quiet, shallow waters of acidic ponds and lakes (UW Stevens Point, 2009g and Engelman, 2009). This species could occur in the vicinity of the Wisconsin NEON sites at Steigerwaldt and Treehaven (R-09 and R-10) or at the Aquatic Array A-12 if conditions were favorable.

The northeastern bladderwort is a floating aquatic plant that prefers wet, sandy shorelines of fluctuating soft-water ponds and lakes in muddy soils (UW Stevens Point, 2009h and Engelman, 2009). This species could occur at the Steigerwaldt NEON site (R-09).

### *Environmental Consequences*

Proposed NEON construction activities would not be expected to impact sensitive aquatic species. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2 to minimize the potential for indirect impacts to sensitive aquatic species from sedimentation as a result of stormwater runoff. Data collection at Aquatic Arrays also would not impact sensitive aquatic species.

NEON, Inc. would work with property site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid any such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat.

There is the potential to disturb sensitive terrestrial wildlife of the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat nearby. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Towers and guy wires would pose a minimal risk to bald eagle and common loon at UNDERC and ONF. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be removed at site closure.

Bald eagles may occur at or adjacent to proposed NEON locations C-13, C-14, C-15, and A-11. If an active bald eagle nest is identified within 400 m of a proposed NEON construction area, land altering activities would be avoided during the critical nesting/rearing period from January 10 to June 10, and a forested (preferred) or natural buffer as wide as possible would be retained around the nest tree (Michigan DNR, 2008).

If a bald eagle nest is identified or near proposed Aquatic Array A-12, construction would be avoided from March 15 to August 15. Any habitat alteration would be done outside of this period and only beyond 100.6 m from the nest. Data collection activities would be kept to a minimum from March 15 through July 15. (Wisconsin DNR, 2009c)

If island or mats of vegetation suitable for common loon nesting are identified near the proposed location of Aquatic Array A-11 project construction would be done outside of the nesting/rearing season, which is from April 15 to August 15 (Michigan DNR, 2008).

If an osprey nest is identified near proposed Aquatic Array A-12, construction would be done outside the nesting period from April 1 to August 15. No activity should occur within 91.44 m of the nest during this time. During operation, if an osprey vocalizes, flies around a person, or obviously focuses on a person, then the scientist or technician is too close and should retreat to a point where the vocalizations and interest cease (Wisconsin DNR, 2009c).

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Michigan Department of Natural Resources and Wisconsin Department of Natural Resources prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

## Cultural Resources

### *Affected Environment*

The proposed NEON locations for Domain 5 would be along the Wisconsin and Michigan border near the Ottawa National Forest. The proposed Core Site would consist of an Advanced Tower (C-13) and a Basic Tower (C-14) on the UNDERC and a Basic Tower (C-15) in the Ottawa national Forest. The UNDERC is an approximately 3,035 ha area in the Upper Peninsula of Michigan and within the Land O'Lakes property in Wisconsin, with the proposed tower locations in the Michigan portion of the property. The UNDERC also would have an Aquatic Array (A-11) on Pickerel Creek just north of the Wisconsin border The area is undeveloped and surrounded by public conservation lands. Relocatable Sites would be located on Steigerwaldt (R-9) and on Treehaven (R-10). Treehaven also would have an Aquatic Array (A-12).

### Prehistoric Context

The Paleoindian Period in the Great Lakes domain dates from approximately 11,000 years ago to 9,500 years ago when people first entered the area following megafauna, such as woolly mammoth, mastodon, and bison, who in turn, were following the retreat of the glaciers northward (WHS, 1996). Evidence uncovered thus far suggests that such tools were used to spear game, cut up meat, scrape and cut hides, and split and carve bone (Funk, 1978). The Archaic period dates from approximately 9,500 years ago to approximately 3,000 years ago and includes new adaptations by the early people related to the change from the cold, moist climate of the Pleistocene Age to a warmer, drier one as warm winds melted the glaciers to the north and warmed the ocean water. The Archaic period is characterized by increasing temperatures, changing flora and fauna, and rising sea levels. People lived in small family groups around water sources and in caves or rockshelters, hunting small game and gathering wild plants, nuts and acorns.

The Woodland period dates from approximately 3,000 years ago to approximately A.D. 1650 and refers to the sedentary cultures of the extensive eastern United States woodlands. Pottery was introduced during the late Woodland into the Great Lakes area. The first evidence for gardening dates to the Early Woodland. Other technological advances that first appeared during the Woodland period include the bow and arrow. During the latter Woodland period, more permanent settlements such as villages were created and elaborate burial customs, including the building of earthen mounds were practiced. Between A.D. 600 and 900, people in the area buried their dead in shaped effigy mounds which resembled birds, mammals, and people. Agriculture was practiced and corn, beans, and squash were cultivated. Tribal boundaries were defined based on kinship (WHS 1996; Funk, 1978). Approximately 1000 years ago, the Effigy Mound culture was influenced by the Mississippian culture to the south, which built fortified towns and created extensive trade networks. The effects of the Mississippian culture were not as strongly felt in the northern areas of the Great Lakes region and approximately 200 years later, the Mississippian culture was replaced by the Oneota. By the time the first Europeans entered the region, the Ho Chunk (Winnebago), the Potawatomi, the Menominee, and the Chippewa inhabited Wisconsin, as did other groups which had migrated south from Ontario, New York, Ohio, and Michigan due to warfare during the mid 1600s (WHS 1996).

## Historic Context

The first explorer known to have traveled through Michigan and Wisconsin is French born Jean Nicolet, who crossed the area in search of the Northwest Passage in 1634. French missionaries established a mission in Michigan at Keweenaw Way in 1660. The French lost possession of much of the area around the Great Lakes as a result of the French and Indian War. The British occupied the area until after the Revolutionary War. Michigan and Wisconsin reverted to American control officially, but the British continued to occupy the region and the fur trade remained the foundation of the local economy. During the early part of the 1800's lead was discovered and American settlers flocked to Wisconsin in search of lead mines. Attempts to remove the Native Americans and subsequent federal policies and conflict between the Native Americans and the white settlers characterized much of the next decades.

In 1805, the Territory of Michigan was organized and in 1836, the Wisconsin Territory was organized. The completion of the Erie Canal in 1825 provided better access into the region. Settlers flowed into the territories seeking good farmland. Michigan was admitted into the Union as the 26th state in 1837 and Wisconsin followed in 1848. The years following the Civil War saw increased industrialization of both states, particularly in southeast Michigan due to canals which made transportation to iron and steel factories easier and increased lumbering of the northern forests. Michigan eventually became the center of the new automobile industry and plants were built in Detroit, Lansing, and Flint. During World War II, the automobile industry produced tanks, jeeps, airplanes, and other war materials. Michigan remains heavily invested in the auto industry today while the Wisconsin economy is linked to tourism, service industries, agriculture, food processing, and dairy remain important to the economy today (Schubach 1998; WHS 1996).

## Archival Literature Search

In order to assess potential impacts to cultural resources a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 5 within a defined study area that extended 1.6 km from each proposed location. This search consisted of a review of the archaeological files at the Michigan Department of History, Arts, and Libraries. Architectural resources were searched via an online database. The Wisconsin Historic Preservation Database (WHPD) containing the following was also searched: the Archaeological Sites Inventory (ASI), the Architectural History Inventory (AHI), and the Bibliography of Archaeological Reports (BAR). These searches include resources considered eligible for or listed on the NRHP.

None of the proposed NEON locations in Domain 5 have been previously surveyed for cultural resources, although two previous studies have been conducted within 1.6 km of some of the proposed NEON locations. There are no known cultural resources within any of the proposed NEON locations. A single unevaluated resource, a prehistoric lithic scatter, is within the 1.6 km of proposed Aquatic Array A-11. No other known cultural resources located within 1.6 km of any of the proposed locations (Table 3.5.5.3-3).

**TABLE 3.5.5.3-3**
Literature Search Results–Domain 5, Great Lakes Region
*National Ecological Observatory Network (NEON) EA*

| | | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | | |
|---|---|---|---|---|---|---|---|
| **Neon Site Number** | **Previously Surveyed** | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | **Number Evaluated** | **Number Eligible** |
| C-13 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-14 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-15 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R9 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R-10 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| A-11 | No | 0 | 1 | 0 | 0 | 0 | n/a |
| A-12 | No | 0 | 0 | 0 | 0 | 0 | n/a |

Source: State Archaeological Files at the Michigan Department of History, Arts, and Libraries, Wisconsin Historic Preservation Database (WHPD)

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 5 did not identify any significant known historic properties within the areas of disturbance for proposed NEON infrastructure and no known historic properties would be visible from the proposed NEON locations.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 5, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF’s Section 106 compliance can be carried out.

## Utilities

### *Affected Environment*

Overhead electric transmission lines and telecommunication lines are located along major thoroughfares adjacent to each of the proposed NEON locations.

### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the existing access road where access for maintenance activities would be available. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for impacts.

### Transportation

#### *Affected Environment*

The proposed UNDERC Core Site is near U.S. Highway 2 and contains numerous forest roads and trails. The proposed ONF Core Site would be adjacent to Sylvania Road near Gogebic County Road 535 (Thousand Island Lake Road). Treehaven and Steigerwaldt would be located along Lincoln County Roads D and H near Harrison, Wisconsin.

#### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and transported by hand from that point to the construction site. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur.

Materials would be transported by hand from the road to the proposed NEON location. Improved trails would be created to move from the road to a proposed NEON location. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

### Human Health and Safety

#### *Affected Environment*

All of the proposed locations, except the ONF Core Site, are within private property where access is limited to employees and researchers and there is no public access except with direct approval of the site operators. The proposed ONF Core Site is on public land and near areas frequented by the general public.

No human health and safety risks to the general public would be created at proposed NEON locations at UNDERC. This site is not accessible to the public and the public would not interact with NEON infrastructure. The proposed Aquatic Arrays at UNDERC and Treehaven would not create any health or safety risks.

The public would have limited access to the area where NEON infrastructure would be placed at ONF, Treehaven, and Steigerwaldt (USDA, 2009; Wiggin, 2009; Schiltz, 2009; Steigerwaldt, 2009).

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

Proposed site locations would have restricted public access. This would limit health and safety issues to the public. In addition, towers would be secured with fencing and locked gates to deter unauthorized access.

There would be potential for employees or researchers riding ATVs to strike guy wires during routine work or during NEON maintenance and data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

### Recreation

#### *Affected Environment*

UNDERC has strictly controlled access and no recreational activities occur on this property (UND, 2009). Recreational activities allowed in ONF include camping, hiking, fishing, hunting, cross-country skiing, horseback riding, and bird watching. There are only a few areas that are closed to hunting and have restricted vehicle use (USDA, 2009; Wiggin, 2009).

The proposed NEON sites on Treehaven would be in areas with limited public access. Hiking and snowshoeing are allowed recreational activities, but no hunting occurs on the property (Schiltz, 2009). Hunting is allowed on Steigerwaldt but is limited to a small number of people approved by the property owner (Steigerwaldt, 2009).

There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 5.

### *Environmental Consequences*

Minor short-term impacts to recreation could occur at some proposed NEON locations during construction. Long-term impacts on recreation would be negligible. Because the various subsystems of the NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would be likely.

Construction activities could result in temporary use restrictions near the proposed Relocatable Tower sites on ONF, Treehaven, and Steigerwaldt. Any impacts would be short–term and persons could conduct recreational activities in other parts of these properties. Any impacts would be negligible. To the extent practicable, NEON, Inc. would time construction to avoid peak recreational use times on Treehaven and Steigerwaldt.

The presence of the tower and guy wires could be visible to persons on ONF, Treehaven, and Steigerwaldt. It is likely that aesthetic impacts would be negligible due to the presence of intervening vegetation.

Towers would be secured with fencing and locked gates to deter unauthorized use. At proposed NEON locations where recreational vehicle activity could occur, guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

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**Figure 3.D05-1** Domain 5 Proposed Site Locations

**Figure 3.D05-2** Domain 5 Proposed Site Locations

**Figure 3.D05-3** Domain 5 Proposed Site Locations

**Figure 3.D05-4** Domain 5 Proposed Site Locations

### 3.5.6 Domain 6 Midwestern Prairie Peninsula

#### 3.5.6.1 Introduction

Domain 6 covers all of Iowa and Illinois, including the eastern areas of Kansas and Nebraska, the southern portion of Minnesota and Wisconsin, and the northern region of Missouri. The domain includes central tallgrass prairie, northern tallgrass prairie, prairie-forest border, and agriculture. Tallgrass prairie is dominated by a variety of tall, deeply rooted grass species. Fire and grazing are natural components of tallgrass prairie. However, agriculture, cultivation, and cattle overgrazing have eliminated much of the original tallgrass ecosystem. The Flint Hills region in Kansas is the largest tract of remnant tallgrass prairie. The geology, drought conditions, and landscape of the area have deterred cultivation and overgrazing (LandScope America, 2009; 2008a).

The Core Site infrastructure for Domain 6 would be placed at the Konza Prairie Biological Station (KPBS). The Advanced Tower (C-16, Figure 3.D06-1) would be placed in native tallgrass prairie habitat near a gravel road. Basic Tower C-18 (Figure 3.D06-1) would be in the same watershed as the Advanced Tower in a lower topographic position south of C-16. C-18 would be in a grassland area that is burned every 2 years. Basic Tower C-17 (Figure 3.D06-1) would be in a riparian forest that is a continuation of the riparian forest near the proposed location of Basic Tower C-18.

Relocatable Sites proposed for Domain 6 include the University of Kansas Field Station (KFS) and the KPBS Agricultural Lowland Site. The KFS Relocatable Site (R-11, Figure 3.D06-2) would be located in an upland area now dominated by woodlands with extensive tree cover. This area was largely tallgrass prairie prior to European settlement in the middle 19th Century

KPBS Agricultural Lowland Site (R-12, Figure 3.D06-1) would be in an area that has been in row crop agriculture for more than 50 years that would be converted to native perennial grasses after establishment of the R-12. The proposed McDowell Creek Aquatic Array (A-14, Figure 3.D06-1) would be approximately 1,600 m north of R-12 and approximately 750 m upstream of the confluence with Kings Creek. The proposed STREON Site (S-15, Figure 3.D06-1) would be on Kings Creek, which originates on KPBS and flows through it for 10 km. S-15 would be approximately 1 km southeast of R-12.

#### 3.5.6.2 Resource Areas Considered But Not Addressed for Domain 6

Preliminary analysis indicated that there would be no potential to significantly impact four of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Airspace: There is no special use or restricted airspace near any of the proposed NEON locations in Domain 6 (FAA, 2009). No potential for airspace constraints would be expected in this domain.
- Recreation: The proposed NEON sites would be located on private land with limited public access. There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 6. No recreational activities occur on these properties. No impacts would extend off-property, so there would be no potential to impact recreation.

- Environmental Justice: The proposed NEON sites would be located on private land with limited public access. All potential impacts would be confined to the private lands and there would be no potential to disproportionately impact minority or low-income populations.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 6 are designated research areas that are not routinely viewed for aesthetic quality. Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

#### 3.5.6.3 Resource Areas Considered in Detail for Domain 6

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 6 where site-specific conditions would influence the anticipated environmental consequences.

##### Geology/Seismicity

##### *Affected Environment*

The proposed NEON sites would be in the Flint Hills region of Kansas, which is highly dissected and overlain with shallow limestone- and chert-derived soils on steep slopes (Blair and Krishtalka, 2008). Alternating layers of Permian limestone and shale characterize the area and give the terrain a benched appearance (KEEP, 2004a and USGS, 2000). The Kings Creek basin, where the proposed Core Site, STREON Site and Relocatable Site R-12 would be located, is underlain with sedimentary rock from the Paleozoic (Jewett, 1947).

The Flint Hills region has relatively stable seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 4% pga to 12 % pga for short wave motion and 2% pga to 6% pga for long wave motion, with the exception of an area in southern Illinois where seismic activity is higher (USGS, 2009a, 2009b).

##### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites would not be placed in areas with geological features that influence surface activity, and NEON activities would not impact the underlying geology. The seismic hazard is low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

##### Soils

##### *Affected Environment*

Soils within the general area of the proposed locations in the KPBS would consist mostly of silty loams and silty clay loams. The soil at the proposed location for Core Site C-16 is

Benfield-Florence complex soil and Dwight-Irwin complex. Benfield-Florence complex is well drained with slopes ranging from 5 to 30 percent. The typical soil profile for this soil type is silty clay loam to 31 cm, silty clay to 66 cm, silty clay loam to 89 cm, and bedrock extending to 100 cm. Dwight-Irwin complex is a moderately well drained soil with slopes ranging from 1 to 3 percent. The typical soil profile for this soil type is silt loam to 10 cm, silty clay to 110 cm, and unweathered bedrock extending to 200 cm. This soil type is considered to be moderately susceptible to rill or sheet erosion (NRCS, 2009a; NRCS, 2009b; NRCS, 2009c; NRCS, 2009d; NRCS, 2009e).

The soil in the proposed area of Core Site C-17 consists mainly of Benfield-Florence complex. The soil at the proposed location for Core Site C-18 consists of Ivan and Kennebec silt loams and Ivan silty clay loams. Ivan and Kennebec silt loams and Ivan silty clay loams are both well drained soils. The typical soil profile for Ivan and Kennebec silt loams is silty clay loam to 165 cm. The typical soil profile for Ivan silty clay loams is silt loam to 152 cm. Each of these soils is considered mildly susceptible to rill or sheet erosion (NRCS, 2009a; NRCS, 2009b; NRCS, 2009c; NRCS, 2009d; NRCS, 2009e).

Soil within the general area of the proposed Relocatable Site R-12 is silt loams and silty clay loams. The soil at the proposed R-12 location is Chase silty clay loam, a somewhat poorly drained soil. The typical soil profile for this soil type is silty clay loam to 48 cm, silty clay to 120 cm, and silty clay loam to 203 cm. This soil type is considered to be mildly susceptible to rill or sheet erosion (NRCS, 2009f; NRCS, 2009g).

Soils near the proposed Relocatable Site R-11 (Figure 3.D06-3) are mostly silty clay loams and silt loams. The soil at the proposed R-11 site is Rosendale-Bendena, a moderately well drained soil with slopes ranging from 3 to 40 percent. The typical soil profile for this type of soil is silty clay to 100 cm and bedrock extending to 140 cm. This soil type is considered to be mildly susceptible to rill or sheet erosion (NRCS, 2009h; NRCS, 2009i).

The soils in the general area of the proposed Aquatic Array A-14 (Figure 3.D06-2) are mostly silty clay loams and silt loams. The soil along McDowell Creek is Ivan silty clay loam (NRCS, 2009j).

Soil within the general area of the proposed STREON Site S-15 is mostly silty clay loams and silt loams. The soil at the proposed STREON Site and along Kings Creek is Ivan silty clay loam (NRCS, 2009k).

### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

During construction of the project, soils would be disturbed as a result of clearing and grading for tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. Soil disturbance would include approximately 0.32 ha at C-16, 0.40 ha at C-17, 0.21 ha at C-18, 0.06 ha at R-11, 0.08 ha at R-12, 0.24 ha at A-14, and 0.21 ha at S-15. The majority of the disturbance would be associated with extending utilities along existing roads. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby water bodies.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

### Climate

#### *Affected Environment*

Domain 6 has a highly variable climate. Mean annual precipitation ranges from 54 to 150 cm, with most precipitation occurring during spring and summer as a result of frontal storms. These large frontal thunderstorms are major weather features in the late spring and early summer and occasionally produce tornados (Sakai, 2008a). Water deficits during the growing season are common, and long-term droughts are prominent in the history of the region. Snowfall events with accumulation occur sporadically in the winter (Sakai, 2008b).

The Konza Headquarters Meteorological Station records annual wind directions, mean temperatures, and mean precipitation. Winds are predominantly southerly in the summer months and northerly in the spring, fall, and winter months. The northerly winds bring colder air to the area. Mean annual temperatures range from 5 to 15 °C. The mean annual temperature at the KPBS is 13 °C and the annual mean precipitation is 52.1 cm. Rain is the primary precipitation type and seasonal peaks occur in June (Blair and Krishtalka, 2008).

#### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. There would be no potential for interaction with other projects and no cumulative impacts to climate would result.

Due to the potential for extreme wind conditions from severe storms and tornadoes, towers would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind. Site design would incorporate appropriate grounding and power filtering to protect instrumentation from damage from electrical surges due to intense lightning from severe storms.

## Air Quality

### *Affected Environment*

The KPBS and the University of Kansas Field Station (KFS) are in rural areas and the proposed NEON locations are within areas designated as in attainment. The metropolitan Kansas City area is the nearest area to the proposed NEON locations classified as in non-attainment (KDHE, 2007). There are no designated Federal Class 1 Wilderness Areas within 161 km of the proposed NEON locations (USEPA, 2008).

### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because the proposed NEON locations in Domain 2 are separated in space and emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed instruments would have short-term, negligible impacts on air quality. The amount of ground disturbance would be less than 0.01 ha and no large earthmoving equipment would be used. BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions during construction. Proposed NEON locations are on private property with no surrounding development. Therefore, human health and human nuisance values would not be impacted from fugitive dust generation.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze and would not impact visibility at any designated Class I Wilderness areas.

## Noise

### *Affected Environment*

The noise environments at KPBS and KFS would be similar. Both proposed sites are in rural areas with low surrounding populations. There are no residential areas near the proposed locations. A single residence is approximately 0.5 km southwest of the KPBS proposed Relocatable Site (R-12), and there is a residence approximately 0.7 km northeast of the proposed KFS location (R-11). Existing noise levels at both locations would likely be approximately 40 dBA (USEPA, 1974).

### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would cause no impacts to residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. No new roads would be constructed. During construction, noise levels would be elevated periodically during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations, depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar noise impacts would be expected at the time of site closure during removal of infrastructure.

Residents near KPBS and KFS could be impacted by noise from construction. Absent intervening vegetation, the sound would be reduced by natural attenuation to 67 dBA at the residence 0.5 km from KBPS and to 64 dBA at the residence approximately 0.7 km from KFS (Federal Highway Administration [FHWA], 2007). The vegetation present at KFS would be expected to further reduce the sound level by 8 dBA (Ward, 1984), bringing the outside noise as a result of NEON construction to 56 dBA. Persons inside of houses would experience a further reduction of 15 to 25 dBA (USEPA, 1974). Because of the distance and the presence of screening vegetation, construction-related noise would be perceptible to persons outdoors at the residence near KBPS, barely perceptible to persons outdoors in the residential area near KFS, and likely imperceptible to persons indoors at either location. The elevated outdoor noise would be below nuisance levels and would not impact residents during outdoor activities.

Wildlife in the immediate construction area would be exposed to the elevated noise levels and would be expected to temporarily relocate from the construction area, but to resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

The pumps for atmospheric sampling equipment on an FIU would operate continuously. Typically, these pumps produce noise of approximately 65 dBA. NEON, Inc. would place the pumps within noise shielding to reduce the sound to less than 60 dBA at 12 m. The residents near the KPBS and KFS sites would be unlikely to perceive noise from operation of the pumps.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at the Core Site and up to 5 years at Relocatable Sites).

Noise from the AOP would have potential to impact residents near KPBS and KFS. AOP flights at 1,000 m above the canopy would be expected to have no impact on residents. AOP flights at 150 m above the canopy would be a short-term nuisance, but any impacts to residents would be negligible. The potential for AOP flights to disturb wildlife is discussed below.

### Water Quality

#### *Affected Environment*

Kings Creek is characterized by periodic drought, intermittent flow, and flash flood events. Organisms found in prairie streams are able to withstand variable dry and wet conditions. Kings Creek flows into McDowell Creek, a tributary to the Kansas River. The Kings Creek watershed is entirely within the KPBS and it is the largest creek onsite (approximately 8 km long with a 1,509-ha watershed). Since the KPBS is a relatively undisturbed and unpolluted area, Kings Creek serves as a USGS Benchmark monitoring station (KEEP, 2004a).

USGS established Kings Creek sampling station in 1979 (USGS, 2000). The creek is an intermittent stream with sustained flow during spring and early summer and with flow generally absent from late summer through winter (USGS, 2000). Flow in ephemeral headwater tributaries occurs after rain events (USGS, 2000). During flash flood events, water rises quickly and can reach a 2.5-m height with a return time of 20 to 25 years (KEEP, 2004a; Sakai, 2008b).

Kings Creek water has high alkalinity and specific conductance, with elevated calcium and magnesium concentrations resulting from weathering of limestone. The mean annual transport of nutrients in Kings Creek is very low and low nitrate concentrations limit algal growth during summer months. The nutrient and sediment levels increase during high flow events, but both are low compared to other Kansas River tributaries (USGS, 2000).

The proposed STREON Site (S-15) would be on Kings Creek. Proposed Core Site C-17 would be adjacent to Kings Creek, and proposed Core Site C-18 would abut an ephemeral headwater tributary (Table 3.5.6.3-1). The proposed KPBS Relocatable Site (R-12) and Core Site C-16 also would be in the Kings Creek watershed. Kings Creek meets its designated use and is not included on the CWA Section 303(d) list (KDHE, 1996).

**TABLE 3.5.6.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 6, Midwestern Prairie Peninsula
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-16 | 33 | 0 | 5 | 0 | 1 | 0 |
| C-17 | 24 | 1 | 4 | 0 | 1 | 0 |
| C-18 | 29 | 1 | 5 | 0 | 0 | 0 |
| R-11 | 10 | 0 | 60 | 0 | 8 | 0 |
| R-12 | 18 | 0 | 8 | 0 | 4 | 0 |
| A-14 | 9 | 1 | 4 | 0 | 15 | 0 |
| S-15 | 15 | 1 | 8 | 0 | 3 | 0 |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009c.

The proposed Aquatic Array (A-14) for Domain 6 would be on McDowell Creek. McDowell Creek is a fifth-order stream and a tributary to the Kansas River. Streamflow is intermittent, generally occurring from March to April. Thunderstorms in late spring and early summer cause large flows and occasional flash flooding. Floods can reach 3 m with a 20- to 30-year return period. The variable flow also causes seasonal fish and crayfish migration (Sakai, 2008a). McDowell Creek meets its designated use and is not included on the CWA Section 303(d) list (KDHE, 1996).

The proposed KFS Relocatable Site (R-11) would be in the Mud Creek watershed (FEMA, 2001). Mud Creek is a tributary to the Kansas River. Mud Creek is listed for fecal coliform bacteria pollution under Section 303(d) of the CWA (KDHE, 1996).The proposed site would be approximately 3.3 km north of the Mud Creek levee.

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could from stormwater runoff during construction. Recurring short-term minor impacts to water quality would likely result from the STREON study. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils.

Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

There would be potential for in-stream monitoring equipment to be washed downstream during periods of heavy rain and strong currents. It is unlikely that this equipment would be recovered if washed away. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts to existing water quality if they were to be lost in the existing stream systems. There are no environmentally harmful components associated with this monitoring equipment.

Elevation of $NH_4NO_3$ or $H_3PO_4$ concentrations in Kings Creek to 5 times ambient concentrations for a 10-year period could result in long-term impairment of water quality in this stream and lead to eutrophication within the experimental reach. Because the stream reach is in a hardwood forest area, nutrient additions in winter and early spring, prior to canopy leaf-out, would likely result in increased growth of algae and periphyton due to the direct exposure to sunlight and greater nutrient availability. Once the canopy closes and shades the stream, lack of sunlight would be expected to slow growth of algae and periphyton, which could lead to greater downstream transport of soluble nitrogen and phosphorus, which could impact downstream waters, particularly lakes and impoundments. There also could be a die-off of algal and periphyton biomass, which could lead to oxygen depletion in the stream from aerobic decomposition. Oxygen depletion could in turn result in changes to vertebrate and invertebrate communities in the immediate area (Hauer and Lamberti, 2006). However, it is likely that any impacts would be short-term and would recur throughout the duration of the STREON experiments. Due to the seasonal nature of the stream, aerobic decomposition of algal and periphyton detritus would proceed more rapidly during dry periods, which would lessen the potential for long-term oxygen depletion. Impacts would likely be minor and recur from year to year. No impacts would be expected from the recirculation tracer experiments.

There would be potential for transport of soluble nitrogen and phosphorus to incrementally interact with other human and natural events and produce cumulative impacts to downstream water quality, including accelerated eutrophication of ponds and lakes. The seasonal nature of Kings Creek and McDowell Creek and the proximity to the Kansas River and its greater assimilative capacity would prevent the STREON Study from interacting with other actions. No cumulative impacts would be expected.

### Wetlands

#### *Affected Environment*

No wetland areas are present around the proposed NEON locations (Table 3.5.6.3-1). Because of the dry climate and permeable limestone geological features, wetlands are essentially absent from the KPBS and KFS areas. Several small man-made impoundments are present in the KPBS area, but none are near the proposed NEON sites (Table 3.5.6.3-1).

The proposed KFS Relocatable Site (R-11) is approximately 0.8 km south of the Kansas Aquatic Mesocosm Program (KAMP) area. The KAMP facilities include 100 experimental man-made ponds and aquatic enclosures, as well as the Frank B. Cross Reservoir (KSR, 2008a). Several other small man-made farm ponds are also found in the vicinity (Table 3.5.6.3-1). However, no wetlands are present in the immediate area surrounding the proposed KFS Relocatable Site.

#### *Environmental Consequences*

No direct or indirect wetland impacts would be likely from implementation of NEON in Domain 5. No cumulative impacts to wetlands would be expected from this project.

No wetlands exist on KPBS and KFS near the proposed NEON locations. Therefore, no wetland impacts are anticipated as a result of the proposed site construction and operation. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for indirect impacts to offsite wetlands as a result of erosion and sedimentation from the construction sites. No indirect impacts to offsite wetlands would be expected.

### Floodplains

#### *Affected Environment*

Floodplains in the KPBS are small and limited to creeks. The proposed STREON Site (S-15) and the C-17 Core Site would be in the Kings Creek floodplain (FEMA, 2003). The proposed Aquatic Array (A-14) would be in the McDowell Creek floodplain (FEMA, 2003). The proposed locations of C-16 and C-18 would be outside designated floodplains (FEMA, 2003). The proposed KFS Relocatable Site (R-11) would also be outside a designated floodplain (FEMA, 2001).

#### *Environmental Consequences*

There would be negligible direct impacts to flood prone areas as a result of implementation of NEON. One Basic Tower, one Aquatic Array, and a STREON Site would be placed in areas prone to flooding. The minimal displacement of the proposed equipment would result in a negligible impact on flood storage, flood elevations, and flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected.

At KPBS, only C-17 (including tower, pad, and fencing) and the STREON instrumentation (S-15) would be placed within the floodplain. All of the supporting infrastructure would be located outside the floodplain. No increase in flood elevations would result from this array and the change in flood storage capacity would be negligible.

The Aquatic Array (A-14) would be placed in the McDowell Creek floodplain located outside of KPBS property. No increase in flood elevations would result and the change in flood storage capacity and flood conveyance would be negligible.

There would be the potential for equipment to be damaged during flood events. NEON, Inc. would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage.

### Common Vegetation and Plant Communities

#### *Affected Environment*

The Flint Hills region maintains native characteristics because the rocky soils and steep topography prevented historic cultivation (Knapp et al., 1998). The KPBS staff uses annual prescribed fire to control woody vegetation and maintain the native tallgrass community. Heavily burned areas are dominated by warm-season grasses, while variable burning patterns and areas with less frequent burning have greater plant diversity (USGS, 2000). The proposed Basic Tower site (C-18), the Advanced Tower site (C-16), and the KPBS Relocatable Site (R-12) would be in tallgrass prairie habitat.

Common tallgrass species found in the area include big bluestem, Indian grass, switchgrass, little bluestem, Kentucky bluegrass, and Junegrass. Other herbaceous non-grass species include heath aster, dotted gayfeather, ironweed, and several goldenrods. Woody vegetation in unburned areas includes smooth sumac, dogwood, and eastern red cedar (USGS, 2000 and KEEP, 2004b).

Gallery forests, which are forests growing along a watercourse in a region otherwise devoid of trees, occur in the Kings Creek floodplain. These forests cover approximately 7 percent of the KPBS preserve area and are dominated by bur oak, chinaquapin oak, American elm, and hackberry (USGS, 2000 and KPBS, 2004a). Understory species include poison ivy and grapes (Sakai, 2008b). A few agricultural fields and restored prairie areas occur in lowlands on Kings Creek (KPBS, 2004a). The proposed Basic Tower C-17 and the STREON Site (S-15) would be in gallery forest habitats.

The KFS Relocatable Site (R-11) would be in an upland area now dominated by woodland with extensive tree cover. This area was tallgrass prairie prior to European settlement in the early to middle part of the 19th Century, but the prairie was replaced by woody vegetation due to fire suppression and human activity.

#### *Environmental Consequences*

There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs. There would be negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation (less than 0.1 ha) would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to approximately 5 years at Relocatable Sites and 30 years at the Core Site. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate. KPBS requires all utility lines to be underground and any overhead utility lines extended at KFS would be in treeless areas. Because no utility overhead lines would be extended through wooded areas, there would be no tree removal as a result of NEON implementation.

### Common Fauna

#### *Affected Environment*

The fauna at KPBS includes 40 mammal, 200+ bird, 34 reptile and amphibian, 20 fish, and over 700 invertebrate species (KPBS, 2004b). Commonly observed large mammals in tallgrass habitat are white-tailed deer, coyote, striped skunk, Virginia opossum, American badger, bobcat, and raccoon (NPS, 2008a and KEEP, 2004b). Common small mammals include the fox squirrel, plains pocket gopher, Eastern cottontail, prairie vole, Eastern woodrat, deer mouse, white-footed mouse, western harvest mouse, and Elliot's short-tail shrew (NPS, 2008a and KEEP, 2004b). Bison are native to the prairie and were re-introduced in 1987 (USGS, 2000).

In the spring and summer, neotropical migratory birds nest in the tallgrass prairie. Common migrants include the upland sandpiper, blue grosbeak, grasshopper sparrow, Eastern kingbird, scissor-tailed flycatcher, loggerhead shrike, and dickcissel. Eastern phoebes, red-headed woodpeckers, and summer tanagers also migrate to the gallery forest habitats in the area. Common tallgrass wintering birds include the rough-legged hawk and Harris's sparrow. Tallgrass areas also provide the last remaining habitats for the greater prairie chicken. Kansas is part of the Central Flyway, and a variety of egrets, herons, ducks, and geese are observed during migrations (KBNHT, 2009 and KEEP, 2004b).

Relatively few species of amphibians and reptiles occur in tallgrass prairie habitats. However, frogs and toads are common around streams and farm ponds. Common species include the western chorus frog, plains leopard frog, northern cricket frog, and bullfrog. The tiger salamander is the only salamander species known to occur at KPBS. Venomous snakes are relatively rare in tallgrass habitat, and the copperhead is the only recorded species at KPBS. Common grassland snakes include the Great Plains rat snake, the plains blackhead snake, the plains garter snake, and the prairie kingsnake. Other noteworthy reptile species of the tallgrass prairie are the collared lizard and the ornate box turtle (KBNHT, 2009 and KEEP, 2004b).

Because prairie streams have intermittent flow, relatively few fish species are present. Minnow species are commonly observed in prairie streams, and the Topeka shiner is particularly noteworthy (KBNHT, 2009). Fish also migrate into tributaries from the Kansas River during seasonal flows (Sakai, 2008b).

The Konza prairie has a variety of insect species. Grasshoppers are the second largest grazer on the tallgrass prairie (next to the bison). There are 100 species of grasshoppers in Kansas, more than 40 of which occur on the Konza prairie. Grasshoppers recycle grass nutrients and provide an abundant food source to birds and local fauna, making them an important asset to the prairie ecosystem (KEEP, 2004c). Dragonflies, robberflies, and praying mantis are other common tallgrass prairie insects. The proposed NEON Core Site (C-16, C-17, C-18), STREON Site (S-15), and Relocatable Site (R-12) would be located in and around KPBS on the tallgrass prairie.

The KFS species observations are similar to those of KPBS. Forty species of reptiles and amphibians have been recorded at KFS (KFS 2008d). A total of 237 birds have been observed on KFS lands since 1948 (KSR, 2008e). Approximately 20 percent of the bird species are year-round residents, 25 percent are summer only visitors, 10 percent are wintering species, and 45 percent are strictly migrant species (KSR, 2008e). KSF researchers have recorded 39 mammal species since 1948 (KSR, 2008f). Many of the reptile, bird, and mammal species observed at KFS match those observed at KPBS. KFS has also studied invertebrate species, particularly spiders (KSR, 2008g). The proposed KFS Relocatable Site (R-11) would be under tree canopy, and mostly woodland species would occur near the proposed tower.

### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide wildlife refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding is expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

There would be a long-term loss of habitat at towers and IHs, though the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall, impacts to wildlife would likely be negligible.

Towers placed in prairie habitat would be relatively short (approximately 8 m) and would not be expected to pose a risk to flying mammals or birds.

At KFS and in the gallery forest on KPBS, the towers and guy wires would pose a minimal risk to common birds and flying mammals. In these areas, towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population risk standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Kansas Department of Wildlife and Parks prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). At KPBS, responses would likely be greatest in the prairie areas where there would be no canopy cover. Animals may startle and it is possible that a flight response would occur. The response would likely be greater for flights that are proposed at 150 m above the canopy. Because the flights would occur only once per year, any impact would be considered minor and no population-level impacts would be expected.

Flights would be conducted after canopy leaf-out, so visual stimuli would be minimal at KFS and the closed canopy could reduce airplane noise. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight.

Because impacts would be separated in space and time, no potential for interaction among proposed NEON projects or between NEON projects and other projects would be expected.

### Sensitive Ecological Communities

#### *Affected Environment*

The Kansas Natural Heritage Program maintains an inventory of state protected natural communities. Only one listed community, the Flint Hills Tallgrass Prairie, occurs at a proposed NEON location. The proposed Advanced Tower (C-16) would be placed in tallgrass prairie habitat (Blair, 2008, personal communication). Tallgrass prairie once covered over 56.7 million ha of the United States' Great Plains, but agriculture (especially plowing) has eliminated most of the habitat. The Flint Hills Tallgrass Prairie is one of the few remaining unplowed tallgrass areas. Several hundred species, particularly birds and insects, rely on tallgrass prairie habitats for food, nesting, and survival (NPS, 2008b). The Flint Hills tallgrass prairie is representative of pre-settlement tallgrass prairie, with fire and large native herbivores incorporated as parts of a shifting mosaic (KPBS, 2004b).

#### *Environmental Consequences*

Minor direct impacts to sensitive ecological communities would occur from construction and operation of NEON infrastructure. There would be no potential for cumulative impacts.

Flint Hills Tallgrass Prairie habitat would be disturbed at KBPS, but only at the proposed Advanced Tower (C-16). Construction, including access trails and installation of fencing around towers, would occur within the tallgrass prairie community at this site. Because the expected impacts would be less than 0.01 ha, the impact to this sensitive habitat at KBPS would be minor.

### Sensitive Species

#### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 6 (Table 3.5.6.3-2). However, there are known occurrences of either state or federal protected species within 5 km of all proposed sites. In addition, potentially suitable habitat for protected species is present at or adjacent to all of the proposed NEON locations (Table 3.5.6.3-2).

**TABLE 3.5.6.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 6, Midwestern Prairie Peninsula
*National Ecological Observatory Network (NEON) EA*

| | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-16 | 1-ESA | 0 | 0 | 4 | 0 | 4 |
| C-17 | 1-ESA | 0 | 1-ESA | 4 | 0 | 4 |
| C-18 | 1-ESA | 0 | 0 | 4 | 0 | 4 |
| R-11 | 4-ESA | 0 | 0 | 4 | 0 | 4 |
| R-12 | 1-ESA | 0 | 0 | 4 | 0 | 4 |
| A-14 | 1-ESA | 0 | 1-ESA | 4 | 0 | 4 |
| S-15 | 1-ESA | 0 | 1-ESA | 4 | 0 | 4 |

Source: Appendix B Domain 6

All sensitive species identified as having potential to occur on or near KPBS or KFS are identified in Table Domain 6, Appendix B, along with their legal status and preferred habitat types. The following discussion is limited to those species that may occur in or near the proposed project locations.

### Federally Protected Species

One federally endangered species, the Topeka shiner, could occur at or adjacent to proposed NEON sites on KPBS (Table 3.5.6.3-2). The Topeka shiner has been documented in small tributary streams of the Flint Hills (GPNC, 2008a). The Topeka shiner prefers quiet, open, permanent pools of small, clear, high-quality headwaters and creeks that drain upland prairie areas. Swede Creek in Geary County is designated as critical habitat for the Topeka shiner under ESA. Swede Creek is located directly south of KPBS and is a tributary of McDowell Creek. This species could occur at the proposed S-15, C-17, and A-14.

### State Protected Species

There are four documented occurrences of state-protected species within a 5-km radius of the proposed NEON locations at KPBS (C-16, C-17, C-18, R-12, A-14, S-15). These species are all designated as State Species in Need of Conservation (SC) and include

Henslow's sparrow, Southern bog lemming, bobolink, and blue sucker. All these species could occur at or adjacent to the proposed NEON locations.

The Henslow's sparrow prefers breeding habitats of open fields and meadows with grass and weeds or shrubby vegetation. Typical non-breeding habitat includes grassy areas adjacent to pine woods or second-growth woods. Henslow's sparrows are known to nest in the western tallgrass areas of Kansas. Their nests are commonly open bowls of woven dry grass found just off the ground in grass litter. This species may occur at or adjacent to two proposed Core Site towers (C-18 and C-16), and at Relocatable Site R-12 (All About Birds, 2003).

The Southern bog lemming prefers boggy habitat, marshes, meadows, upland forests with thick humus layer, and areas with an intermixture of herbaceous/shrubby vegetation. Southern bog lemmings are colonial and occur in areas with dense vegetation. They are active year-round and typically breed during summer and winter months. The nest is built below ground in the winter and under logs and in thick grasses during the summer. The female has litters of one to seven young and produces three or four litters a year. The Southern bog lemming may occur at or adjacent to two proposed Core Site towers (C-18 and C-16) and at Relocatable Site R-12 (Kansas Department of Wildlife and Parks [KDWP], 2005a).

The bobolink occurs in tall grassy areas, flooded meadows, prairie, deep cultivated grains, hayfields, rice fields, and open woody areas. The bobolink nests in Canada and the northern United States, including Kansas. Nests are present in shallow depressions on the ground and are made of grasses. The bobolink may occur at all the proposed NEON sites in KPBS (KDWP, 2005b).

The blue sucker prefers large rivers and lower parts of major tributaries. The blue sucker lives and breeds in the swift current, rocky bottom channel of the Kansas River. The young feed in shallow gravel bars with less current. The blue sucker could occur at the proposed location of A-14 on McDowell Creek (KDWP, 2005c).

There are four documented occurrences of state protected species within a 5-km radius of the proposed KFS Relocatable Tower (R-11) that could occur in the habitat present at the tower. These species are the smooth earth snake, the redbelly snake, Henslow's sparrow, and the bald eagle.

The state threatened smooth earth snake occurs in deciduous woods, exposed rocky slopes in mixed deciduous-pine associations, pine woodland, grassy slopes with rocks in areas of deciduous forest, mesic hammocks, moist woodland, old fields, and vacant lots. The smooth earth snake typically occurs in leaf litter or logs under sparse tree cover. The snake does not lay eggs but gives live birth to six or seven young. The smooth earth snake may occur at the proposed Relocatable Tower (R-11) (KDWP, 2005d and GPNC, 2008b).

The state threatened redbelly snake prefers mountainous or hilly woodland/forest, upland meadows, and swamp and bog edges. They typically occur among damp leaf litter in dense wooded areas. The females give birth to 5 to 10 young. The redbelly snake may occur at the proposed Relocatable Tower (R-11) (KDWP, 2005e and GPNC, 2008c).

The state threatened bald eagle prefers tall deciduous and coniferous trees near water bodies. The bald eagles are winter residents in Kansas. Bald eagle nests typically produce two fledglings, but immature eagles do not reach full adulthood for 4 to 5 years. The bald eagle could occur at the proposed Relocatable Site (R-11) because the Kansas River is nearby (KDWP, 2005f and GPNC, 2008d).

### *Environmental Consequences*

Minor short-term and long-term impacts to sensitive species would result from installation of NEON infrastructure. No cumulative impacts to sensitive species would be expected.

NEON, Inc. would work with property owners and site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted to avoid any such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility to avoid impacts to the species or its required habitat.

There would be the potential to disturb sensitive wildlife in the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Towers placed in prairie habitat would be relatively short (approximately 8 m) and would not be expected to pose a risk to sensitive bird species on KPBS.

The tower and guy wires would pose a minimal risk to sensitive bird species at KFS and in the Gallery Forest on KPBS. In these areas, towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

AOP overflights would be expected to have impacts to sensitive wildlife species to those described above for common fauna. Any impacts would likely be negligible in forested areas and minor in areas with no tree canopy.

One small mammal species of concern, the Southern bog lemming, could be inadvertently captured in small mammal traps deployed as part of an FSU at the proposed Core and Relocatable Sites in Kansas. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. An animal handling permit would be obtained from the Kansas Department of Wildlife and Parks as described in Section 5.6 and all specified conditions would be followed to ensure proper treatment and handling of captured animals. If inadvertently captured, this sensitive species would be released. Any impacts would be short-term and minor. No population level impacts would be expected.

State or federal- protected birds and MBTA listed birds would have the potential to be disturbed during construction and operation. Foraging or migrating birds would be expected to avoid areas adjacent to construction activity for the period of construction, but would likely resume use of the area following construction. Should nesting MBTA species be found in or adjacent to a planned construction area, work would be delayed until after the young have fledged. Similar impacts would be expected at site closure and work during the nesting and pre-fledging period would be avoided.

### Cultural Resources

#### *Affected Environment*

Most of the proposed NEON locations for Domain 6 are within the Konza Prairie Biological Station (KPBS) in a rural area of native tallgrass prairie in the Flint Hills of northeastern Kansas in Riley County. The 3,400-ha area is owned by The Nature Conservancy and Kansas State University and is operated as a field research station. The proposed NEON locations within the KPBS are approximately 8 km south of Manhattan, Kansas and adjacent to historic Ashland, Kansas. One proposed location, site R-11, is within the undeveloped University of Kansas Field Station & Ecological Reserves, a 1,214-ha reserve within the transition zone between the eastern deciduous forest and the tallgrass prairie biomes. The site is located at the junction of Leavenworth, Jefferson, and Douglas Counties in Kansas.

### Prehistoric Context

During the past several years, more evidence is being gathered that human occupation of North and South America began earlier than the Terminal Pleistocene ca. 12,000 BP. In the Prairie Peninsula domain, the Kanorado site is currently under investigation as a pre-Clovis site (Blackmar and Hoffman, 2006). Clovis sites, which are found across the continent, are found in Kansas and assigned to the early part of the Paleoarchaic Period. This first part of the period, sometimes referred to as the Paleoindian Period, dates from approximately 13,000 to 8,000 years ago. The later Paleoarchaic Period, also referred to as the Archaic, dates from approximately 8,000 years ago to 500 B.C. (Blackmar and Hoffman, 2006) and includes new adaptations by the early people related to the change from the cold, moist climate of the Pleistocene Age to a warmer, drier one as warm winds melted the glaciers to the north and warmed the ocean water. Increased use of plant resources and the hunting of smaller game became more prevalent and populations became more sedentary, as evidenced by seasonal or semi-permanent structures (Adair, 2006). The Woodland Period lasted from approximately 500 B.C. to 1000 A.D. The early Woodland is known in Kansas predominantly from sites in the northeastern portion of the state, including the Flint Hills (Logan, 2006). By A.D. 1000, most of the native population in Kansas had shifted to a more permanent settlement pattern dependent upon the cultivation of corn, beans, and squash and bison hunting (Adair, 2006). This period, referred to as the Village Gardener Period, lasted from approximately A.D. 1000 to 1500, and saw the advance of ceramic technology and the establishment of trade with the Pueblo Indians of the Southwest. The Prehistoric Period ended with the arrival of Coronado's expedition in 1541, but, with the notable exception of the introduction of the horse, European influence was limited until the late 1700s. Native populations became more organized and the historically known tribes can be traced to the Protohistoric Period, including the Pawnee, the Kansa, the Wichita, and the Apache. Most tribes still relied on a combination of agriculture and bison hunting; however, some groups were more sedentary than others (Adair, 2006).

### Historic Context

The first Europeans to reach Kansas were the men of Francisco Vasquez de Coronado's expedition to search for Cibola in 1541, thus beginning the Historic Period in Kansas. Although Europeans occasionally traveled through the area, no Europeans settled in the area until the French commander at Fort Orleans, Etienne de Bourgmont, established a trading post near the Kansas River in 1724 (Cutler, 1883). Present day Kansas was acquired by the United States as "unorganized territory" within the Louisiana Purchase of 1803. The unorganized territory, known in the 1800s as the Great American Desert, was set aside as Indian Territory in the 1820s and tribes from all parts of the U.S. were moved into Kansas during the 1830s (Cutler, 1883). In 1854, the Kansas-Nebraska Act officially established the Kansas Territory and the Nebraska Territory. Between 1855 and 1858, a period known as "Bleeding Kansas," several conflicts and open battles marked the struggle between pro-slavery and abolitionist settlers (Miner, 2003). Kansas was admitted into the Union as the 34$^{th}$ state in 1861, 3 months before the start of the Civil War and fought with the Union during the Civil War. After the Civil War, Kansas was characterized by Texan cattle drives up the Chisholm Trail, Wild West towns, railroads, farming, and the immigration of former slaves.

During the 1910s and 1920s, Kansas provided vast amounts of wheat to both the United States and the world (Miner, 2003); however, a massive drought lasting from 1930 until 1941 coupled with decades of land clearing for wheat growing and other farming resulted in a series of dust storms, and the term "Dust Bowl" was coined to describe the area as well as the storms (De Angelis and De Angelis, 2002). The drought ended near the start of World War II and the economic boom that pushed the rest of the United States out of the Great Depression was felt in Kansas as well. Since WWII, Kansas has been characterized by a rapidly changing landscape of rural farms to urban centers and commercial industry. Nuclear power plants are situated next to open prairies where cattle graze. By the 1960s much of the tallgrass prairie of Kansas had disappeared and suburban vacation properties abounded. By 1990, agriculture employed less than 6 percent of Kansans and other industries, such as meat packing, hog-raising, aircraft construction, government, and services employed most Kansans (Miner, 2003).

### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 6, including a 1.6-km radius study area around the proposed locations. A literature search was requested of the Kansas State Historical Society (KSHS) on November 26, 2008. The files at the KSHS Kansas Historic Resources Inventory (KHRI) contain information on surveyed historical resources in the State of Kansas, and included a search of the NRHP. Additionally, the following historic maps were reviewed: Samuel N. Gaston and Charles W. Morse's 1857 *Kansas and Nebraska*, George

F. Cram's 1883 *Kansas*, the 1922 *State of Kansas* USGS survey map, and the 1947 *Manhattan, Kansas,* 15' USGS topographic quadrangle map.

None of the proposed NEON locations in Domain 6 have been previously surveyed for cultural resources, although one previous study has been conducted within a 1.6-km radius of some of the locations within the KPBS.

Resources previously documented near the proposed NEON locations include artifact scatters, lithic scatters, ceramic scatters, and mound sites (Table 3.5.6.3-3). The literature and map review revealed that several historic features are present in the vicinity of the proposed NEON locations, including roads, historic buildings, one historic mine, and visible on the 1947 *Manhattan, Kansas* topographic quadrangle map. The historic town of Ashland, the first town organized in the territorial county of Riley in 1853 (Blackmar, 1912), is in the vicinity of several proposed NEON locations in Domain 6. The study areas for the NEON locations within the KPBS significantly overlap due to the proximity of the proposed facilities. A total of 12 resources are located within the combined study area of C-16, C-17, and C-18. Specifically, one historic resource is located within the study area of C-16, a total of 12 resources are located within the study area of C-17, and one resource is located within the study area of C-18. Additionally, a total of 40 resources are located within the combined study area of Relocatable SiteR-12, A-14, and S-15. Specifically, a total of 33 resources are located within the study area of R-12, a total of 40 resources are located within the study area of A-14, and a total of 25 resources are located within the study area of S-15. None of these sites have been formally evaluated and none are listed or have been recommended eligible for the NRHP or any other state or local register.

**TABLE 3.5.6.3-3**
Literature Search Results—Domain 6, Midwestern Prairie Peninsula
*National Ecological Observatory Network (NEON) EA*

| | | **Number of Archaeological Resources Present** | | **Number of Historic Resources, including Architecture Present** | | | |
|---|---|---|---|---|---|---|---|
| **NEON Site Number** | **Previously Surveyed** | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | **Number Evaluated** | **Number Eligible** |
| C-16 | No | 0 | 0 | 0 | 1 | 0 | n/a |
| C-17 | No | 0 | 0 | 0 | 12 | 0 | n/a |
| C-18 | No | 0 | 0 | 0 | 1 | 0 | n/a |
| R-11 | No | 0 | 1 | 0 | 0 | 0 | n/a |
| R-12 | No | 0 | 17 | 0 | 16 | 0 | n/a |
| A-14 | No | 0 | 24 | 0 | 16 | 0 | n/a |
| S-15 | No | 0 | 9 | 0 | 16 | 0 | n/a |

Source: Kansas State Historical System (KSHS), National Register Information System (NRIS), 1947 *Manhattan, Kansas* USGS topographic quadrangle map; n/a = not applicable

The majority of the archaeological resources found within the 1.6-km study area of the proposed NEON sites are along McDowell Creek or Kings Creek. These areas directly along the creeks appear to be of higher sensitivity for cultural resources. The Flint Hills are so named for the abundant chert, a favorite prehistoric lithic material, scattered across the hills. Lithic quarries, scatters, stations, and workshops are found in numbers in the Flint Hills and the chert from these hills occurs at archaeological sites throughout Kansas as well as surrounding states (Stein, 2006). Areas within the Flint Hills, which includes four proposed facility locations for the Domain 6 Core Site, also appear to be of higher sensitivity for cultural resources.

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 6 did not identify any significant known historic properties within the areas of disturbance for any of the proposed NEON facilities. Additionally, there are no known NRHP eligible cultural resources located within the study areas.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 6, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

## Utilities

### *Affected Environment*

The KPBS has electric power throughout its Headquarters area, with separate transformers and meters used to supply electricity to experimental facilities in the area. The KPBS offers onsite housing with internet access and phone service (Blair and Krishtalka, 2008).

KFS facilities include the Armitage Education Center, which has electric power and telecommunications service (KSR, 2008b).

### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power at the KPBS proposed NEON locations would be extended from the grid terminus, with buried utility lines along existing roads to the proposed tower location. All power lines would have to be underground at KPBS because of burning activities and to preserve the natural landscape (Sakai, 2008c). Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for environmental impacts.

Power at the proposed KFS Relocatable Site (R-11) would extend from the grid terminus, with underground lines placed along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the existing access road where access for maintenance would be available. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Erosion control

BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for environmental impacts. Extended overhead lines would be kept clear of trees by hand clearing saplings, as necessary, for the duration of the NEON project at a location.

### Transportation

#### *Affected Environment*

KPBS is bounded by interstate 70 (I-70), state highway 177 (KS 177), and McDowell Creek Road. The main entrance to the site is located on McDowell Creek Road, a two-lane asphalt road. Additional access points are also located on I-70 and KS 177. KPBS maintains approximately 20 km of gravel roads and 61 km of mowed fireguards for access to onsite locations. (Blair and Krishtalka, 2008)

KPBS is owned by Kansas State University and The Nature Conservancy, and there is no unescorted access to research sites. All entrances to the site are gated and locked, and a resident onsite staff member is present year-round. (Blair and Krishtalka, 2008)

The KFS is easily accessed from Highway 40 and East 1600 Road (KSR, 2008c). The site is owned by the University of Kansas. Access to the proposed tower site (R-11) would be limited, but the KFS Headquarters, located north of the proposed site, allows public access for school and research groups (KSR, 2008b).

#### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and transported by hand from that point to the construction site. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur. Improved trails would be created to move from the road to a proposed NEON location. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access.

Both the KPBS and the KFS have an extensive network of roads and the proposed locations are within a short distance of a field road. Existing field roads may be improved to facilitate year-round access, but no new roads would be constructed.

Improvements may include the addition of gravel in some locations, but no additional paving would occur. Trails would be made from the road to proposed NEON sampling locations to provide access. (Sakai, 2008a; Sakai, 2008b; Sakai, 20087c; Kettle, 2008, personal communication)

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

### Human Health and Safety

#### *Affected Environment*

All of the proposed locations are within private property with restricted public access. KPBS access is limited to staff and researchers. Most areas of KFS have restricted access, but the outdoor shelters, onsite classrooms and laboratories, and interpretative trails are open to public education groups (KSR, 2008b). Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

Proposed NEON locations would have restricted access to the public, which would limit public health and safety issues. In addition, towers would be fenced and locked to deter unauthorized access.

Because there is no public access, the general public would have no risk of striking guy wires. However, there would be the potential for staff or researchers riding ATVs to contact the guy wires during routine OSBS work or during NEON maintenance or data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential of an injury.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety.

Appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

### Protection of Children

#### *Affected Environment*

There would be no environmental health or safety risks to children as a result of proposed NEON, Inc. activities on KPBS because children do not have routine access to this property.

The proposed NEON Relocatable Tower at KFS (R-11) would be near the Armistead Education Center, the Fitch Natural History Reservation, and the McColl Nature Reserve (KSR, 2008b). All of these areas offer public classrooms, outdoor shelters, and hiking trails that would attract children to the area. In addition, KFS hosts educational activities that involve children.

#### *Environmental Consequences*

No impacts to the environmental health and safety of children would be expected. Because NEON projects would be separated spatially, no cumulative impacts on the environmental health and safety of children would be likely.

Educational activities at KFS would not routinely put children in contact with the proposed Relocatable NEON tower (R-11). Children coming into the vicinity of the tower would be chaperoned and contact with the NEON facilities would be prohibited. Access to the tower would be restricted with fencing and secure gates. No pathway of direct exposure to an environmental health or safety risks would exist.

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**Figure 3.D06-1** Domain 6 Proposed Site Locations

**Figure 3.D06-2** Domain 6 Proposed Site Locations

### 3.5.7 Domain 7 Southern Appalachians and Cumberland Plateau

#### 3.5.7.1 Introduction

Domain 7 stretches from northern Alabama to southern Pennsylvania and west to the Ohio River Valley, encompassing portions of the Cumberland and Southern Ridge and Valley (CSRV) ecoregion, Central Appalachian Forest ecoregion, and the Southern Blue Ridge ecoregion (Figure 2-1). Domain 7 encompasses diverse geology, soil, topography, and climate components that provide a variety of habitats for animal species and plant communities (LandScope America 2008a, 2008b, 2008c). The proposed NEON sites would be in the Central Appalachian Forest, CSRV, and Blue Ridge ecoregions at Oak Ridge Reservation (ORR) and the Great Smoky Mountains National Park (GSMNP) in Tennessee and near the Mountain Lake Biological Station (MLBS) in Virginia.

#### 3.5.7.2 Resource Areas Considered But Not Addressed for Domain 7

Preliminary analysis indicated that there would be no potential to significantly impact three of the resource areas and part of one resource area that were considered for Domain 7. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Airspace: The proposed NEON sites have not been deemed restricted or special use airspace by the FAA (FAA, 2009). No impacts are anticipated with regard to restricted airspace.
- Environmental Justice: The locations of the proposed NEON sites are on private and federal land. Some is this restricted land and some is land that is used by the public for recreational purposes; however, the sites would have restricted access by means of fences or gates. All potential impacts would be confined to the restricted areas and would not create a potential to disproportionately impact minority or low-income populations.
- Protection of Children: The locations of the proposed NEON sites are on private and federal land that is used by the public for recreational purposes; however, the towers would have restricted access by means of fences with locked gates. All potential impacts would be confined to the restricted areas and there would be no environmental health and safety risks to children.
- Hazardous Materials: The historical use of land near the proposed Relocatable Tower in GSMNP as an orchard may have resulted in application of pesticides and fungicides in the area. These chemicals would not have been applied since the formation of the park, but may be present in residual concentrations. Any residual concentrations of these types of chemicals would be considered part of the existing conditions at the site. Also, GSMNP is treating eastern hemlock with chemicals to protect the trees from the hemlock woolly adelgid, which is killing this species throughout the eastern United States. Chemicals (such as imidachloprid) are applied directly to the trees or the soil immediately around trees and would neither affect nor be affected by proposed NEON studies. Neither historical chemical use nor ongoing treatments for the hemlock woolly adelgid are further considered in this document.

### 3.5.7.3 Resource Areas Considered in Detail for Domain 7

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 7 where site-specific conditions would influence the anticipated environmental consequences.

The primary potential for interaction between NEON and other past, present, and reasonably foreseeable projects in Domain 7 would occur in GSMNP and relate to actions that could occur simultaneously with NEON construction and result in cumulative negative impacts to recreational traffic using the Roaring Fork Motor Nature Trail and are discussed under Recreation. Other potential cumulative impacts are discussed, as appropriate, under specific resource areas.

#### Geology and Seismicity

##### *Affected Environment*

The proposed Core Site towers (C-19, C-20, C-21; Figure 2–07-01) and a proposed STREON Site (S-18, Figure 3.07-01) would be located on the ORR. These proposed sites are underlain by siliceous dolostones, including the Knox Group. Knox Group carbonates include karst features which result in the potential for ground collapses. Ground collapses are usually human induced and result from groundwater pumping and uncontrolled surface drainage input and are rare in natural karst landscapes (Waltham, 2008). Known karst features on ORR range from fractures to enterable caves (Oak Ridge National Laboratory (ORNL), 2006). From 1991 to 2005, seismic reflection and refraction studies were conducted at ORR to map karst features (Doll et al., 2005).

A Relocatable Tower (R-14, Figure 3.07-03) and Aquatic Array (A-17, Figure 3.07-04) would be located in GSMNP, which is part of the ridge and valley system of the Appalachians. GSMNP is underlain by the Ocoee Supergroup, which comprises layers of clay, silt, sand, gravel, and calcium carbonate that settled and cemented together over millions of years (NPS, 2006).

A Relocatable Tower (R-13, Figure 3.07-05) would be placed in the mountains of Virginia in an area underlain by limestone bedrock with karst. Karst features in the area are exemplified by Mountain Lake, which is located on a large fracture (USFS, 2007).

The Appalachian/Cumberland Plateau is fairly stable from the standpoint of seismicity. Throughout the ORR and GSMNP, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 10 to 12 % pga for short wave motion and 36 to 40% pga for long wave motion (USGS, 2008a, 2008b). In the area surrounding MLBS, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 6 to 8 % pga for short wave motion and 24 to 28 % pga for long wave motion (USGS, 2008a, 2008b).

##### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

NEON activities would not impact the underlying geology. The proposed NEON sites are in areas with geological features that could influence surface activity. Infrastructure would be located away from known karst features (e.g. sinkholes and faults). The seismic hazard is fairly low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

### Soils

#### *Affected Environment*

The soils at the proposed Core Site towers consist of Fullerton cherty silt loam occurring on two slope types: slopes ranging from 5 to 12 percent and slopes ranging from 25 to 45 percent. Fullerton cherty silt loams are generally gravelly silt loam from 0 to 30 cm, gravelly silty clay loam from 30 to 69 cm, and gravelly clay from 69 to 163 cm. This soil series is well drained and is typically associated with the side-slope and ridge crests and can be susceptible to slight to moderate erosion (NRCS, 2008; ORNL, 1968).

The soils along Walker Branch at the proposed STREON Site and the proposed Aquatic Array site consist of Collegedale-Rock outcrop complex and Bodine cherty silt loam. Collegedale-Rock outcrop complex is weathered from limestone and shale and the soils are a silt loam from the surface to a depth of 13 cm and silty clay extending from 13 cm to a depth of 163 cm (NRCS, 2008). Bodine soil series can be susceptible to slight erosion (ORNL, 1968).

The soil along LeConte Creek of Aquatic Array A-17 in GSMNP consists of Spivey-Santeetlah-Nowhere Complex. This complex is very stony and is derived from weathered loamy colluviums and sandstones. The slope for the immediate area around the Aquatic Array is 5 to 8 percent. The soil complex is well drained with a very bouldery sandy loam in the upper and middle layer (NRCS, 2008). The potential for soil erosion in the area is low.

The soil at the proposed location for R-14 site in GSMNP consists of Snowbird loam. Slopes near the proposed tower location range from 30 to 95 percent. The soil is well drained with a sandy clay loam in the upper layer, very gravelly sandy loam in the middle layer, and weathered bedrock beneath (NRCS, 2008). The potential for soil erosion in the area is low.

The soil at the proposed location of R-14 on MLBS consists of a Lily-Bailegap Complex. This complex is very stony and is derived from sandstone, siltstone, and interbedded shale. The slope for the immediate area around R-14 is 2 to 35 percent. The soil is well drained with a flaggy/gravelly sand loam in the upper layer, gravelly/clay/cobbley silt loam in the middle layer, and bedrock beneath (NRCS, 2009). The potential for soil erosion in the area is very high.

#### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

During construction of the project, soils would be disturbed as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would be approximately 0.11 ha at C-19.  Soil disturbance would be less than 0.02 ha at C-20, C-21, and A-17. It would be less than 0.03 ha at R-13 and approximately 0.04 ha at R-14. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. Proposed NEON towers would be constructed in relatively flat areas to minimize the potential for instability and increased impacts due to site slope. None of the soils that would be disturbed are prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and also for indirect impacts to surface waters from transport of eroded materials into nearby waterbodies.

A similar potential for impacts to soils would occur during site closure. Soils at areas covered by buildings and tower pads would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

### Climate

#### *Affected Environment*

The mean annual precipitation on ORR is 137 cm, including about 27.4 cm of snowfall. The mean annual air temperature is 14.4˚C. Minimum and maximum temperature variations are influenced by changes in elevations. The ridge and valley terrain reduces average wind spends in valley bottoms.

GSMNP is located approximately 80 km southeast of ORR. The NEON infrastructure would be placed in the lower elevations of the park where the mean temperature and rainfall are comparable to those of ORR. The higher elevations of the park receive mean annual precipitation in excess of 216 cm (NPS, 2006b).

Proposed Relocatable Tower R-13 would be near MLBS in the Jefferson National Forest, at a higher elevation than the other proposed Domain 7 NEON sites. The mean annual temperature at MLBS is lower than at ORR and the site receives more precipitation.

#### *Environmental Consequences*

NEON would not impact regional climate. Climate at the proposed locations would not require special design or construction to accommodate extremes. There would be no potential for interaction with other projects and no cumulative impacts to climate would result.

### Air Quality

#### *Affected Environment*

ORR is located in Anderson and Roane Counties, approximately 30 km west of metropolitan Knoxville. Anderson County is included in the Knoxville nonattainment area and is classified as in basic nonattainment for the 8-hr Ozone standard and in nonattainment for PM 2.5 (USEPA, 2008; ORNL, 2006). ORR also is within 100 km of GSMNP, which is a designated Federal Class I Wilderness Area.

GSMNP is downwind from developed areas and wind currents transport pollutants from urban areas, industrial sites, and power plants that become trapped in and around the park due to terrain and weather (NPS, 2008a). These pollutants contribute to dense haze that impairs visibility in the park.

The proposed locations for the Relocatable Tower and Aquatic Array in GSMNP are in Sevier County, approximately 45 km southeast of metropolitan Knoxville. Sevier County is included in the Knoxville nonattainment area and is classified as in basic nonattainment status for the 8-hr Ozone standard (USEPA, 2008).

MLBS is located in a rural area of Virginia and the proposed site for the Relocatable Tower is classified as in attainment for all criteria pollutants (USEPA, 2008).

### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts on air quality at each location. The construction area would be less than 0.01 ha and no large land clearing equipment would be used. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze or deterioration of air quality and would not impact visibility in GSMNP.

## Noise

### *Affected Environment*

The noise environments at ORR and MLBS would be similar because they are in rural areas with low surrounding populations. The existing noise level at these two locations would likely be approximately 40 dBA (USEPA, 1974). The proposed Relocatable Tower and Aquatic Array in GSMNP would be near the Roaring Fork Motor Nature Trail. This road receives a large amount of recreational automobile and motorcycle traffic that results in noise levels that are typically elevated somewhat above rural levels during daytime, with intermittent elevated noise that can exceed 85 dBA for large groups of motorcycles (USEPA, 1974).

### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would cause no impacts to residents. No interaction among sites or with other projects would occur, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand with as little impact as possible. No new roads would be constructed. During construction, noise levels would be elevated periodically only during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc. Undated). People working onsite at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. Elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to temporarily relocate from the construction area, but to resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

The pumps for atmospheric sampling equipment on an FIU would operate continuously. Typically, these pumps produce noise of approximately 65 dBA. NEON, Inc. would place the pumps within noise shielding to reduce the sound to less than 60 dBA at 12 m. Noise exposure to pumps in GSMNP would occur during daytime hours and be limited to park users on trails near the proposed Relocatable Tower. Any impacts would be long-term and minor.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an

FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at the Core Site and up to 5 years at Relocatable Sites

Noise from the AOP would have potential for negligible impacts to the visiting public at GSMNP and to residents in Gatlinburg. None of the other proposed NEON sites have potential sensitive receptors living nearby. AOP flights at 1,000 m above the canopy would be expected to have no impact on residents. If NEON, Inc. conducts AOP flights at 150 m above the canopy, the flights would be a short-term nuisance to park visitors and Gatlinburg residents, but any impacts would be minor. NEON, Inc. would coordinate AOP overflights at R-13 with GSMNP and comply with all NPS policies and regulations on aircraft overflights. Overflights of the proposed Core Site would be coordinated with ORR. The potential for AOP flights to disturb wildlife is discussed below.

### Water Quality

#### *Affected Environment*

ORR is in the Tennessee River drainage and contains multiple streams, ponds, and wetlands (Table 3.5.7.3-1). ORR is bordered on the west and south by the Clinch River. Surface water on ORR consists of a network of small streams that drain to the Clinch River. The ridge and valley terrain results in many small sub-watersheds (ORNL, 2006).

The Core Site towers, Aquatic Array, and STREON Site would be located in the Walker Branch watershed. Walker Branch is not listed as a 303(d) listed stream. Walker Branch flows into Melton Hill Lake, which is listed as a 303(d) listed waterbody for PCBs and chlordane in Anderson County (TDEC, 2008).

GSMNP includes over 3,200 km of streams and rivers (Table 3.5.7.3-1). In the higher elevations, streams are primarily fed by rainwater (NPS, 2006b). The Aquatic Array and Relocatable Tower would be located near multiple streams. The Aquatic Array would be placed on a tributary of LeConte Creek near the Relocatable Tower, just upstream of its confluence with LeConte Creek. LeConte Creek is not listed as a 303(d) stream. LeConte Creek flows to the Little Pigeon River, which is listed as a 303(d) listed stream for *Escherichia coli*, loss of biological integrity due to siltation, and total phosphorus (TDEC, 2008).

**TABLE 3.5.7.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 7, Appalachian/Cumberland Plateaus United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-19 | 43 | 0 | 13 | 0 | 1 | 0 |
| C-20 | 43 | 0 | 13 | 0 | 1 | 0 |
| C-21 | 43 | 0 | 15 | 0 | 1 | 0 |
| R-13 | 8 | 0 | 3 | 0 | 0 | 0 |
| R-14 | 16 | 1 | 2 | 0 | 0 | 0 |
| A-17 | 15 | 1 | 2 | 0 | 0 | 0 |
| S-18 | 36 | 1 | 14 | 0 | 5 | 0 |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009.

The area surrounding MLBS contains a variety of streams, lakes, ponds, and wetlands (Table 3.5.7.3-1). The Relocatable Tower would be located adjacent to Hunter's Branch in the Middle New River watershed (USEPA, 2009). Hunter's Branch is not listed as a 303(d) listed stream (VDEQ, 2008).

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur during construction from stormwater runoff. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

With the exception of Melton Hill Lake, all waterbodies near the proposed NEON locations in Domain 7 meet their designated uses and none have been placed on either the Tennessee or Virginia CWA Section 303(d) list of impaired waters (TDEC, 2008; VDEQ, 2008).

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

Elevation of $NH_4NO_3$ or $H_3PO_4$ concentrations in Walker Branch to 5 times ambient concentrations for a 10-year period could result in long-term impairment of water quality in this stream and lead to eutrophication within the experimental reach. Because the stream reach is in a hardwood forest area, nutrient additions in winter and early spring, prior to canopy leaf-out, would likely result in increased growth of algae and periphyton due to the direct exposure to sunlight and greater nutrient availability. Once the canopy closes and shades the stream, lack of sunlight would be expected to slow growth of algae and periphyton, which could lead to greater downstream transport of soluble nitrogen and phosphorus, which could impact downstream waters, particularly lakes and impoundments. There also could be a die-off of algal and periphyton biomass, which could lead to oxygen depletion in the stream from aerobic decomposition. Oxygen depletion could in turn result in changes to vertebrate and invertebrate communities in the immediate area (Hauer and Lamberti, 2006). Impacts would likely be long-term and moderate. No impacts would be expected from the recirculation tracer experiments.

There would be potential for transport of soluble nitrogen and phosphorus to incrementally interact with other human and natural events and produce cumulative impacts to downstream water quality, including accelerated eutrophication of ponds and lakes. However, Walker Branch flows into the Melton Hill Lake, which would be capable of assimilating the increased nutrient load from Walker Branch. No cumulative impacts would be expected.

### Wetlands

#### *Affected Environment*

ORR contains approximately 235 ha of palustrine forested, scrub shrub and emergent wetlands that occur primarily in low elevation areas along streams and adjacent to Clinch River embayments (Table 3.5.7.3-1; ORNL, 2006). The proposed NEON locations would be in upland ridge areas and away from any wetlands. The proposed Core Site towers, Aquatic Array, and STREON Site would be at lower elevations, but would not be in or adjacent to any wetlands.

GSMNP contains few wetlands. The proposed Relocatable Tower (R-14) would be on an upland ridge with no wetlands in the vicinity (Table 3.5.7.3-1). The proposed Aquatic Array would be along a stream, but would not be in or adjacent to any wetlands.

The MLBS property includes a pond and any wetlands are limited to the fringe of the pond (Table 3.5.7.3-1). The proposed Relocatable Tower (R-13) would be at a lower elevation than the pond and below any wetlands.

#### *Environmental Consequences*

No direct impacts to wetlands would occur as a result of implementation of the NEON project in Domain 7. There would be no interaction with other projects. Therefore, no cumulative impacts to wetlands would occur.

NEON, Inc. would implement and maintain appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for indirect impacts to wetland areas as a result of erosion and sedimentation.

### Floodplains

#### *Affected Environment*

The proposed NEON Core Site infrastructure would be in unpopulated areas where FEMA has not designated floodplains or floodways. Water levels in the Clinch River are regulated by Tennessee Valley Authority dams and fluctuations in river level can result in backwater in tributaries. However, the proposed ORR NEON infrastructure would be placed at elevations that would not flood from Clinch River backwater (ORNL, 2006). Flooding could occur at the proposed Aquatic Array and STREON locations from high flow in the stream.

FEMA has not determined flood elevations, floodplains, or flood prone areas at the proposed locations of GSMNP and MLBS Relocatable Sites. Both proposed tower locations are in areas that would not flood from elevated flows in nearby streams. Flooding could occur at the proposed Aquatic Array in GSMNP from high flow in the stream. The proposed tower location at MLBS is adjacent to Hunter's Branch and flooding could occur as a result of high flow in the stream.

#### *Environmental Consequences*

No impacts to floodplains or flood prone areas would result from the implementation of NEON in Domain 7. NEON infrastructure placed in the floodplain would include sensors and dataloggers associated with the Aquatic Array. This equipment would result in a negligible amount of material added to the floodplain. Placement of NEON infrastructure would not result in increases in flood elevations, flood conveyance, or flood storage at any of the proposed locations. No indirect or cumulative impacts to flood prone areas would be expected.

There would be the potential for equipment to be damaged during flood events. NEON, Inc. would design infrastructure in floodplains to withstand expected flood levels and current velocities and thus minimize the potential for damage. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts on existing water quality if they were to be lost in streams. There are no environmentally harmful components associated with this monitoring equipment. NEON, Inc. would temporarily remove equipment from flood prone areas when flooding is forecast for the area.

### Common Vegetation

#### *Affected Environment*

ORR includes approximately 15,000 ha of native deciduous forest with less than 2 percent of its area as open agricultural fields (Mann et al., 1996). The dominant forest types are oak-hickory, pine-hardwood, and pine. There are also minor, smaller areas of other forest types, such as hemlock and white pine. ORR also contains seminatural grasslands in maintained fields and forest edge habitat (ORNL, 2006). The proposed Core Site towers would be in an interior upland closed canopy oak-hickory forest. Each tower would be placed in areas with different age structures or topographic positions (ORNL, 2006). The proposed STREON Site and the Aquatic Array would be located in upland hardwood forest (ORNL, 2006). Typical hardwood species include bitternut hickory, pignut hickory, shagbark hickory, red oak, black oak, white oak, and pin oak (ORNL, 2006).

GSMNP contains five major forest types with approximately 100 native tree species and 100 native shrub species. Forest types include cove hardwood system, dominated by red maple, tulip poplar, and oak. Table Mountain, pitch, and white pine are more characteristic of the higher elevations on the ridge (NPS, 2006c). GSMNP contains diverse habitats that support approximately 1,600 species of flowering plants and 500 species of non-flowering plants (NPS, 2007). The proposed Relocatable Tower would be in pine and oak forest. Typical species in this forest type include red oak, black oak, scarlet oak, and chestnut oak, table mountain pine, pitch pine, and white pine (NPS, 2006c). The proposed Aquatic Array would be placed on a tributary to LeConte Creek. Eastern hemlock trees dominate stream sides and moist, shady slopes.

There are over 40 tree species and more than 2,000 species of shrubs and herbaceous plants known in the Jefferson National Forest (USFS, 2005a). Common species include oak, post oak, blackjack oak, chestnut oak, scarlet oak, and white oak. The MLBS would be near the Jefferson National Forest in second growth oak-hickory forest (Nagy, 2008 personal communication).

#### *Environmental Consequences*

The eastern hemlock is in peril in GSMNP due to the presence of an exotic invasive pest insect, the hemlock woolly adelgid. GSMNP is treating living eastern hemlock trees to delay or prevent loss of this species from the park. Therefore, NEON, Inc. would not remove any live eastern hemlock to install utility lines or other infrastructure. Routes and locations would be adjusted slightly, as necessary, to avoid impacts to this species. GSMNP is also protecting dogwoods, as the population in and near the proposed site in GSMNP has displayed some resistance to dogwood anthracnose. Thus, the dogwood population in that area may be important in future efforts to protect the species park-wide. Utility routes and locations would be adjusted slightly when feasible, to avoid impacts to this species.

Tree removal along utility lines would be a minor long-term impact to vegetation and plant communities. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation (less than 0.1 ha) would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site.

Areas disturbed for trenching would be stabilized and allowed to naturally revegetate. Where overhead utility lines are extended, there could be limited removal of trees along the route. Because of the need to keep the utility lines clear of woody vegetation, these would be kept free of trees by hand removal of saplings, as necessary, until the end of the NEON project.

### Common Fauna

#### *Affected Environment*

Approximately 350 species of vertebrates, including more than 70 species of fish, 45 reptile and amphibian species, more than 200 species of birds, and more than 30 species of mammals, occur on ORR. Common wildlife species include gray squirrel, white-tailed deer, raccoon, opossum, fox, and a variety of rodents.

GSMNP has an inventory of approximately 50 native species of fish, more than 80 species of reptile and amphibian, more than 200 species of birds, and 66 species of mammals. The white-tailed deer, groundhog, chipmunk, and some squirrel and bat species are common. In addition, GSMNP provides protected habitat for the American black bear (NPS, 2008b).

MLBS and the Jefferson National Forest have an inventory of 70 species of reptiles and amphibians, 175 species of birds, and 55 species of mammals. White-tailed deer, raccoon, and fox are common species (NPS, 2006b, 2006c, and 2007).

### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding would be expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. Electric fences would be installed around towers and other infrastructure in GSMNP to deter black bears from destroying equipment. The fenced areas would be small and no impact to wildlife populations would be expected.

GSMNP conducts ongoing brook trout management actions on LeConte Creek upstream of the proposed Aquatic Array. Information from the inventory and monitoring of the brook trout population and other fish species diversity information is collected through electroshocking and other means. These ongoing park management actions are compatible with proposed NEON studies.

There are several All Taxa Biodiversity Index (ATBI) plots near the proposed location of R-14 in GSMNP, including an original pilot plot for the ATBI work. The ongoing data collection efforts associated with ATBI would be compatible with proposed NEON studies.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Towers and guy wires would pose a minimal risk to common birds and flying mammals. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Tennessee Wildlife Resources Agency and Virginia Department of Game and Inland Fisheries prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because flights would be conducted after canopy leaf-out, visual stimuli would be minimal and the closed canopy could reduce airplane noise. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight.

Because impacts would be separated in space and time, no potential for interaction among proposed NEON projects or between NEON projects and other projects would be expected

### Sensitive Ecological Communities

#### *Affected Environment*

ORR is designated as a unit of the Southern Appalachian Biosphere, along with GSMNP, and is part of the National Environmental Research Park Biosphere Reserve (ORNL, 2006). There are 11 rare community types on ORR, but none occur at or adjacent to proposed NEON locations (ORNL, 2006).

GSMNP contains many unique and sensitive ecological communities. The proposed location for the Relocatable Tower was changed after determination of unacceptable impacts to a sensitive community at the originally proposed location. No sensitive ecological communities occur near the proposed Relocatable Site.

There are no sensitive ecological communities near the proposed MLBS Relocatable Site.

#### *Environmental Consequences*

Because there are no sensitive ecological communities near the proposed NEON locations in Domain 7, no impacts to sensitive ecological communities would occur. No cumulative impacts to sensitive ecological communities would result.

NEON, Inc. would implement BMPs, as discussed in Section 2.2.2, to minimize the potential for indirect impacts to offsite sensitive ecological communities.

### Sensitive Species

Sensitive species identified as having the potential to occur on or near ORR, GSMNP, or MLBS are identified in Table Domain 7, Appendix B. This appendix includes information, including scientific names, legal status, and preferred habitats for these species. The following discussion is limited to those species that may occur at or adjacent to proposed project locations where disturbance would occur.

#### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 7 (Table 3.5.7.3-2). However, there are known occurrences of state protected species within 5 km of all the proposed Core Sites, Relocatable Site (R-13), and STREON site. In addition, potentially suitable habitat for protected species is present at or adjacent to all of the proposed NEON locations, excluding the proposed Relocatable Site (R-13) (Table 3.5.7.3-2). The following sections discuss the species with potential to occur at or adjacent to proposed NEON sites in Domain 7.

**TABLE 3.5.7.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 7, Southern Appalachians and Cumberland Plateau
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-19 | 0-ESA | 0 | 1-ESA | 9 | 0 | 4 |
| C-20 | 0-ESA | 0 | 1-ESA | 9 | 0 | 4 |
| C-21 | 0-ESA | 0 | 1-ESA | 9 | 0 | 4 |
| R-13 | 0 | 0 | 0 | 3 | 0 | 0 |
| R-14 | 0-ESA | 0 | 3-ESA | 0 | 0 | 0 |
| A-17 | 0-ESA | 0 | 3-ESA | 0 | 0 | 0 |
| S-18 | 0-ESA | 0 | 1-ESA | 9 | 0 | 4 |

Source: Appendix B Domain 7

### Federal Species

The gray bat may occur near proposed NEON locations on ORR. This species occupies caves year-round, migrating between different caves for summer and winter use. Gray bats forage on aquatic and terrestrial insects, primarily along waterways.

The Indiana bat roosts in caves and tree cavities or under loose bark of dead or dying trees. This species typically forages in riparian areas, upland forests, ponds, and fields. This species could roost or forage near the NEON infrastructure in GSMNP.

The Carolina northern flying squirrel lives in coniferous forest and mixed forest, deciduous riparian woods, and any mature forest that is cool and moist with abundant snags. This species could occur at or adjacent to the NEON infrastructure in GSMNP.

#### State Species

The tall larkspur prefers upland rich woods with rocky slopes and could occur near the proposed NEON infrastructure on ORR.

The mountain witch-alder prefers dry ridgetop forests of middle elevation ridges and could occur near the proposed tower locations on ORR.

The tubercled rein-orchid occurs in low, wet woods and meadows with sandy soils and leaf litter. Potential habitat could be located downslope of proposed NEON locations near the Clinch River.

#### *Environmental Consequences*

Proposed NEON construction activities would not be expected to impact sensitive species. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for indirect impacts to sensitive species. No cumulative impacts to sensitive species would be expected.

NEON, Inc. would work with property owners and site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid any such disturbance while retaining the scientific merit of the location. In some situations, a sensitive species or its required habitat is known to occur at a site or surveys for such species may be incomplete in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted. In such situations, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat.

There is the potential to disturb sensitive wildlife in the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns. Should any trees need to be removed at the GSMNP Relocatable Site, the trees would be assessed for suitability as summer roosts for Indiana bat. No potentially suitable trees would be cleared during the period when the Indiana bat may roost there.

Towers and guy wires would pose a minimal risk to sensitive birds and flying mammals. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Several sensitive small mammal species that occur in GSMNP and on the ORR could be inadvertently captured in small mammal traps deployed as part of an FSU at the proposed ORR and GSMP Relocatable Sites. These species include the common shrew, Southern bog lemming, woodland jumping mouse, rock shrew, Southeastern shrew, smoky shrew, meadow jumping mouse, water shrew, and Appalachian cottontail. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. An animal handling permit would be obtained from the Tennessee Wildlife Resources Agency and Virginia Department of Game and Inland Fisheries as described in Section 5.7 and all specified conditions would be followed to ensure proper treatment and handling of captured animals. If inadvertently captured, these sensitive species would be released. Any impacts would be short-term and minor. No population level impacts would be expected.

## Cultural Resources

### *Affected Environment*

The proposed NEON locations for Domain 7 are widely dispersed throughout the Appalachian-Cumberland Plateau. The Core Site for this domain is near Oak Ridge, Tennessee. The locations of the proposed facilities associated with this domain are in an open area near the Oak Ridge National Laboratory. The location of one proposed Relocatable Site, with an associated Aquatic Array, is within GSMNP near Gatlinburg, Tennessee. GSMNP encompasses 210,140 ha in two states: Tennessee and North Carolina. The park maintains 78 historic structures within its boundaries in five historic districts. The location of the other proposed Relocatable Site in Domain 7 is in a rural area within the Mountain Lake Biological Station (MLBS) in the Shenandoah Valley in southwest Virginia. The MLBS is a field research and teaching facility that is within the deciduous hardwood forest of the Appalachian Mountains.

### Prehistoric Context

During the past several years, more evidence is being gathered that human occupation of North and South America began earlier than the Terminal Pleistocene ca. 12,000 before present (BP). Within the Appalachian-Cumberland Plateau domain, the Saltville, Virginia, site is currently under investigation as a Pre-Clovis site. Clovis sites, which are found across the continent, are represented by a general hunter and gatherer strategy employed by small, highly mobile groups and date to approximately 12,000 years ago in Domain 7 (Funk, 1978). The Archaic Period for this region dates from approximately 10,000 years ago to approximately 3,000 years ago and includes new adaptations by the early people related to the change from the cold, moist climate of the Pleistocene Age to a warmer, drier one as warm winds melted the glaciers to the north and warmed the ocean water. Researchers generally agree that Archaic cultures evolved from Late Paleoindian groups in the Southeast and Midwest. By the end of the Archaic, people had become more sedentary, had begun raising varieties of squash, and trade routes were established between people in the mountains of Virginia and Tennessee and the coast (Chapman, 1985).

The Woodland Period in the Cumberland Plateau dates from approximately 1000 B.C. to approximately A.D. 900 and refers to the sedentary cultures of the extensive eastern United States woodlands. Pottery was introduced into Virginia from peoples along the coasts of present day South Carolina and Georgia during the early Woodland. Technological advances that first appeared during the Woodland include the bow and arrow, the ungrooved axe, and artistic curved or effigy tobacco pipes. Corn, beans, and squash were cultivated, as was tobacco. Hunting and gathering was still practiced. Burial mounds first appear during the Woodland Period. The Mississippian Period dates from approximately A.D. 900 to 1600. The Mississippian Period is characterized by monumental architecture, including earthen platform mounds with temples, residences, and political buildings, large, stable sedentary populations, organized chiefdoms, well developed religious ceremonies, increased warfare and territoriality, and craft specialization. Mississippian sites from the east Tennessee region are considered a part of the Dallas culture (Chapman, 1985). During the subsequent Protohistoric Period, native populations shifted due to the presence of the Europeans. The Europeans introduced a range of diseases to the local native populations. Native populations also joined the European fur trade, which further disrupted their previous lifeways and resulted in a greater awareness of territorial boundaries among native groups (Brasser, 1978). Throughout the 17th Century, however, these populations continued to decline rapidly due to the aforementioned diseases and conflicts with Europeans. The last group to inhabit the Cumberland region was the Overhill Cherokee (Chapman, 1985).

### Historic Context

The first Europeans to reach present day east Tennessee were the men of Hernando de Soto's inland expedition in the mid-1500s. It is unlikely they traveled as far as southwestern Virginia, but between 1566 and 1568, Captain Juan Pardo followed the previous route of de Soto into the Cumberland area (Chapman, 1985). Although the first successful European settlement along the east coast of the present day United States was established in 1607 in Virginia, the Shenandoah Valley was not settled early by the British. Rather, it was the French who entered the Cumberland Plateau and the Appalachian area in 1673 in the personages of Lois Jolliet, a fur trader, and Father Jacques Marquette, a missionary. The British finally followed in the early 1700s. Construction of the British Fort Loudon, a fort originally requested by the Overhill Cherokee, was begun in 1754; this fort was the westernmost British fort in the colonies in the 1700s (Dykeman, 1975). After the Revolutionary War, land in the Territory of the United States south of the Ohio River, now Tennessee, was distributed as land bounties for soldiers who had fought for the colonies during the war. Virginia ratified the Constitution in 1788 and became the 10th state in the new Union. In the late 1700s, a western portion of North Carolina seceded and created the new state of Frankland, later renamed Franklin. Franklin lasted for 4 years before reverting back to a territory. Finally in 1796, Tennessee became the 16th state to join the Union.

In 1861, Virginia and Tennessee seceded from the Union, two of the last states to join the Confederacy. More battles were fought in Virginia and Tennessee during the Civil War than in the other southern states and by the end of the war, the roads, rail lines, and overall infrastructure of the two states were largely destroyed (Dykeman, 1975). Reconstruction followed the end of the Civil War. Tennessee was the only Confederate state where a military governor was not installed, while neighboring Virginia was a part of Military District Number One (Rubin, 1977). The years between Reconstruction and World War II were years of rebuilding. Virginia developed a diversified economy, balancing agriculture and industry. In Tennessee, the Tennessee Valley Authority (TVA) was created during the Great Depression and TVA power projects soon supplied more power to the United States than any other provider. During World War II, the U.S. government created the Oak Ridge community, with the Oak Ridge National Laboratory, the Y-12 National Security Complex, and the East Tennessee Technology Park approximately 48.3 km northwest of Knoxville, Tennessee. This facility was one of the principal production sites for the Manhattan Project (Dykeman, 1975). After the bombing of Pearl Harbor, the primary location for the U.S. Navy fleet was moved to Norfolk, Virginia. Today, Tennessee is characterized by cattle-raising, soybean cultivation, textiles, cotton, and electric power. The Oak Ridge facilities are still recognized as among of the leading laboratories in the U.S. Popular tourist attractions include Dollywood and GSMNP, which is the most heavily visited national park in the U.S. Virginia is characterized by a very diverse economy, which includes tourism, coal, tobacco, software manufacture, communication technology, military installations, cattle-raising, peanut, tomato, and soybean farming, and wineries.

### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 7, including a 1.6-km radius study area around the proposed locations. A literature search was conducted at the Tennessee Division of Archaeology and at the Tennessee Historical Commission in Nashville. The files at the Tennessee Division of Archaeology contain all information about known archaeological sites and studies conducted within the state of Tennessee, while the files at the Tennessee Historical Commission contain all information about NRHP listed sites and historic built resources in the state. Additionally, a literature search of the Virginia Department of Historic Resources (DHR) was conducted on November 25, 2008. The DHR serves as the official state repository for historic resources, including architectural and archaeological resources. The DHR also provides information regarding eligibility for inclusion on the Virginia Landmarks Register (VLR) and the NRHP. Finally, the following historic maps were reviewed: the 1895 *Loudon, Tennessee,* 30′ USGS topographic quadrangle map and the 1926 *Proposed Great Smoky Mountains National Park, North Carolina-Tennessee* USGS topographic map.

None of the proposed NEON locations in Domain 7 have been previously surveyed for cultural resources, although two previous studies has been conducted within the 1.6-km study areas of the proposed NEON locations within GSMNP.

Resources previously documented within the vicinity of the proposed NEON locations include prehistoric lithic scatters, the remains of historic residences, a Civil War era army encampment and wagon trail, a historic district, and the historic buildings and trash deposits associated with two farms (Table 3.5.7.3-3). R-13 is situated within a historic architectural district listed on the NRHP. The Greater Newport Rural Historic District includes 21 structures within the University of Virginia Mountain Lake Biological Station. The R-13 facility also appears to be within the boundaries of a Civil War era army encampment and wagon trail. The trail has not been formally recorded or evaluated for the VLR or NRHP. The literature and map review revealed that one unrecorded historic road is present in the vicinity of R-14 and A-17. This road is visible on the 1926 *Proposed Great Smoky Mountains National Park, North Carolina-Tennessee* topographic map.

**TABLE 3.5.7.3-3**
Literature Search Results—Domain 7, Southern Appalachians and Cumberland Plateau
*National Ecological Observatory Network (NEON) EA*

| NEON Site Number | Previously Surveyed | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | Number Evaluated | Number Eligible |
|---|---|---|---|---|---|---|---|
| | | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | | |
| C-19 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-20 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-21 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R-13 | No | 1 | 0 | 2 | 0 | 1 | 1* |
| R-14 | No | 0 | 9 | 0 | 2 | 1 | 1* |
| A-17 | No | 0 | 9 | 0 | 2 | 1 | 1* |
| S-18 | No | 0 | 0 | 0 | 0 | 0 | n/a |

Source: Tennessee Division of Archaeology archives, Tennessee Historical Commission, Virginia Department of Historical Resources, 1926 *Proposed Great Smoky Mountains National Park, North Carolina-Tennessee* USGS topographic quadrangle map
*Listed on the NRHP

The study areas for the proposed NEON locations within GSMNP overlap due to the proximity of R-14 and A-17. A total of 11 resources are located within the combined study area of R-14 and A-17, as the same 11 resources were identified for each location. Of these 11 resources, only 1 has been evaluated for the NRHP. The remaining ten resources have not yet been evaluated for inclusion on the NRHP.

### *Environmental Consequences*

The literature search revealed that R-13 would be within the Greater Newport Rural Historic District, a historic property listed on the NRHP that includes 21 structures within the University of Virginia Mountain Lake Biological Station. The current placement of R-13 could result in an adverse impact to this significant historic property. The proposed location would be near existing antennas and towers that serve MLBS to minimize the potential for impacts to historic properties. It is NEON, Inc.'s intention to avoid impacts to sensitive resources through final siting of facilities. After completion of this process, the R-13 facility would be placed in an area that minimizes or completely avoids any adverse impact to the historic district. If siting is not feasible to avoid specific environmental impacts mitigation would be performed to ensure any impact is less than significant.

A total of 11 cultural resources have been documented outside the area of disturbance, but within the 1.6-km study areas, of R-14 and A-17. One of these sites is listed on the NRHP; however, this site is well outside of the area of potential impact. There are several cultural resources that contribute to GSMNP in the area near the proposed Relocatable Tower, including the historical apple orchard area.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 7, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

### Utilities

#### *Affected Environment*

ORR has substantial power and telecommunications infrastructure and is supplying the power grid.

The Twin Creeks Science and Education Center in GSMNP is within 0.5 km of the proposed sites for the Relocatable Tower and Aquatic Array. Telecommunications and power infrastructure is available within 300 m of the proposed AP.

MLBS has a fully functioning biological research station less than 0.5 km from the proposed Relocatable Tower site. MLBS would serve as the source of power and telecommunications for the NEON infrastructure.

#### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the existing access road where access for maintenance activities would be available. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for impacts. Extended overhead lines would be kept clear of trees by hand clearing saplings, as necessary, for the duration of the NEON project at a location.

### Human Health and Safety

#### *Affected Environment*

All of the proposed locations on ORR are within Department of Energy property where access is restricted from the public. Access is limited to staff and researchers. There is public access to the area near the proposed locations for NEON in GSMNP and MLBS.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

Because the proposed sites on ORR would have no public access, there would be no health or safety issues related to public use of these areas. Towers would be secured with fencing and locked gates to deter unauthorized access.

The proposed GSMP sites would be on public land and near a publicly accessible road and the Twin Creeks picnic pavilion. The picnic pavilion receives use, but there are no other incentives for the public to use this part of the park because there are no pull-offs for drivers and no hiking trails at the proposed NEON locations. Towers would be secured with fencing and locked gates to deter unauthorized access. No public health or safety impacts would be expected in GSMNP as a result of NEON.

The GSMNP Fire Management Office is adjacent to the area proposed for NEON infrastructure. Construction and operation of NEON would not interfere with the Fire Management Office or affect response times.

There would be the potential for the public to be active in the vicinity of the proposed NEON tower at MLBS. The tower would be secured with fencing and locked gates to deter unauthorized access. Signage would be placed to deter use of trails created to access NEON infrastructure. However, guy wires would be exposed and could be contacted by hikers or persons operating recreational vehicles. Guy wires would be clearly marked and flagged to reduce the potential for accidental contact and injury. Any impacts to site users would likely be negligible.

### Recreation

#### *Affected Environment*

All of the proposed locations on ORR are within Department of Energy property where access is restricted from the public. Access is limited to staff and researchers.

GSMNP offers many activities, including auto touring, fishing, biking, hiking, and picnicking. No recreation occurs at the proposed sites for the Aquatic Array and Relocatable Tower. There is a hiking trail that generally follows LeConte Creek and passes between the proposed tower and the Twin Creeks Science and Education Center. The Roaring Fork Motor Nature Trail has specific attractions farther in the park and there is no reason for recreational drivers to stop at the Twin Creeks Science and

Education Center, as no roadside pull-offs are located in the immediate area proposed for NEON sites. The Twin Creeks picnic pavilion is near the proposed NEON locations.

The area surrounding the MLBS is also open to public and managed by the Mountain Lake Conservancy. Hiking and biking are offered recreational activities in this area.

There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 7.

### *Environmental Consequences*

Minor short-term impacts to recreation could occur at some proposed NEON locations during construction. Long-term impacts on recreation would be negligible. Because the NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would be likely.

No impacts to recreation in GSMNP would result. The Twin Creeks Science and Education Center would be more visible to hikers than the proposed NEON tower and IH. The sites are remote enough from the Science and Education Center that they would not likley be detected by passers-by. Therefore, no impacts to hikers would be expected. There would be no disruption of recreational traffic on the Roaring Fork Motor Nature Trail. Construction and operation of NEON would not interfere with use of the Twin Creeks picnic pavilion. Transport of materials to the Twin Creeks Science and Education Center during construction would not interfere with recreational traffic on the Roaring Fork Motor Nature Trail. The tower would be located near the research lab and not far outside Gatlinburg.

GSMNP is planning repairs to Cherokee Orchard Road and the Roaring Fork Motor Nature Trail. These repairs are expected to take up to one month to complete and would result in temporary closure of the roads in the park. This work would be done during off-peak visitation periods to minimize the impact to park visitors. Because the roads would be closed, there would be no potential for interaction with NEON construction or operation to affect recreational traffic. NEON would time construction to avoid periods when the roads would be repaired. If possible, NEON would also time construction to avoid periods of peak park usage (July, October, and November).

There also are plans to repair the access to Twin Creeks. If this work occurs simultaneously with NEON construction, there could be temporary negative cumulative traffic impacts.

The City of Gatlinburg may implement water and sewer service upgrades to an area off of Cherokee Orchard Road. Any such work could result in interaction with NEON construction and could result in temporary negative cumulative impacts to traffic. NEON, Inc. would coordinate with the City to avoid scheduling NEON construction during implementation of water and sewer service upgrades.

Minor impacts to recreational users could occur in the vicinity of the NEON infrastructure at MLBS during construction. Hikers would likely be prohibited from entering trail segments that abut active construction areas. The appearance of the tower and guy wires could create minor impacts to the aesthetics of the trails.

At proposed NEON locations where recreational vehicle activity could occur, guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

### Aesthetics and Visual Resources

#### *Affected Environment*

ORR and MLBS are not visited for their aesthetic and scenic values. Scenic value is very high in GSMNP, which offers visitors many overlook areas that feature expansive views of the park and surrounding areas.

#### *Environmental Consequences*

The location selected for R-14 in GSMNP would be visible from a short portion of the U.S. 441 Bypass northwest of the proposed tower location. This view would be across the nearby Gatlinburg area, which is highly developed and does not contribute to the aesthetic value of GSMNP. When viewed from the U.S. 441 Bypass, the tower would be backed by forested mountainside and would not stand out from the background. From other directions, the view of the proposed tower would be blocked by forested topographic rises where the surface elevation would be at least 45 m above the base of the tower. The trees along these rises would block the view of the tower.

The location for R-14 would be visible from the Park Vista hotel, which is located off of Cherokee Orchard Road leading from Gatlinburg up toward the proposed Relocatable Site. The tower would be visible to persons in the hotel parking area who look back toward Mount LeConte.

NEON, Inc. would minimize visibility of the tower through the use of non-reflective coatings and paints. In addition, there would be no permanent nighttime lights at R-14, so the night view of the sky would not be altered.

Any impacts to aesthetic and visual resources would be minor.

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**Figure 3.D07-1** Domain 7 Proposed Site Locations

**Figure 3.D07-2** Domain 7 Proposed Site Locations

**Figure 3.D07-3** Domain 7 Proposed Site Locations

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### 3.5.8 Domain 8 Ozarks Complex

#### 3.5.8.1 Introduction

Domain 8 encompasses much of the lower Mississippi River valley, extending from central Alabama, Mississippi, and Louisiana north to southern Missouri and also includes Arkansas and much of western Tennessee. The NEON sites proposed for Domain 8 are located in western Alabama. The topography of this region is rolling, dissected open hills, with gently sloping to strongly sloping side-slopes. The vegetative community is predominantly composed of oak-hickory-pine mixed forests with areas of cultivated croplands (Griffith et al., 2001).

The proposed sites for Domain 8 include three Core Site tower locations (C-22, C-23, and C-24, Figure 3.D08-1) and a STREON Site (S-22, Figure 3.D08-1) located within the Oakmulgee District of the Talladega National Forest (TNF). The proposed Core Site is approximately 30 km south-southeast of Tuscaloosa along the border of Hale and Bibb Counties. A Relocatable Site (R-15; Figure 3.D08-2) and an Aquatic Array (A-20; Figure 3.D08-2) would be placed at the Armistead Selden Lock in west Hale County, approximately 56 km south-southwest of Tuscaloosa. A Relocatable Site (R-16; Figure 3.D08-3) and an Aquatic Array (A-21; Figure 3.D08-3) also would be placed in the Choctaw National Wildlife Refuge (NWR) in southeast Choctaw County approximately 160 km southwest of Tuscaloosa.

#### 3.5.8.2 Resource Areas Considered But Not Addressed for Domain 8

Preliminary analysis indicated that there would be no potential to significantly impact four of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Airspace: The proposed NEON sites would be located on public land in remote areas of western Alabama that have not been deemed restricted or special use airspace by the FAA (FAA, 2009). No potential for airspace constraints would be expected in this domain.
- Environmental Justice: The proposed NEON sites would be located on public land with limited public access. The proposed NEON sites are in unpopulated areas and all potential impacts would be confined to the project area. There would be no potential to disproportionately impact minority or low-income populations.
- Protection of Children: The proposed NEON sites are in areas that are not routinely visited by children and placement of the NEON infrastructure would not attract children to these sites. All potential impacts would be confined to the immediate areas and no environmental health and safety risks to children would be created.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 8 are designated research areas that are not routinely viewed for aesthetic quality. Because of the topography and the dominance by evergreen trees, combined with the relatively low height of the towers (extending 10 m or less above the canopy), the Core Site towers would not be readily visible by users of the forest or nearby residents. Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

#### 3.5.8.3 Resource Areas Considered in Detail for Domain 8

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 8 where site-specific conditions would influence the anticipated environmental consequences.

**Geology/Seismicity**
***Affected Environment***

Domain 8 would have three associated NEON sites in west-central and south Alabama. Sites C-22, C-23, and C-24 would be within the Fall Line Hills ecoregion. Site R-15 would be in the Blackland Prairie ecoregion. Site R-16 would be in the Buhrstone/Lime Hills ecoregion. Each of these ecoregions is located within the larger Southeastern Plains Province in Alabama (Griffith et al., 2001). The underlying geology is young sedimentary rocks overlaying older harder rocks from the Piedmont. The layer of sedimentary rock is thinnest at the fall line where the Coastal Plain meets the Piedmont and becomes increasingly thicker toward the sea (New Georgia Encyclopedia, 2009).

The Southeast Coastal Plain is relatively stable from the standpoint of seismicity. Throughout the domain, the maximum % pga with a 2% probability of occurrence in 50 years ranges from 4% pga to 6% pga for both short wave motion and long wave motion, with the exception of an area along the New Madrid Fault in western Tennessee and eastern Arkansas along the Mississippi River where seismic activity is higher (USGS, 2009a; 2009b).

***Environmental Consequences***

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact the underlying geology. The seismic hazard is low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

**Soils**
***Affected Environment***

Soils within the general area of the proposed locations in TNF and at the proposed Core Site tower locations (C-22, C-23, C-24) consist mostly of Maubila-Smithdale complex. Maubila-Smithdale complex is moderately well drained soil with slopes ranging from 15 to 35 percent. The typical soil profile is a flaggy loam to 10 cm, clay to 70 cm, and sandy clay loam extending to 82 cm. Maubila-Smithdale is not susceptible to rill or sheet erosion (NRCS, 2009a; NRCS, 2009b).

Soils for the general area of the proposed STREON Site in TNF (S-22) are the same as described for the Core Site towers above, but the soil at the proposed STREON location is Bibb Iuka complex. This is a poorly drained soil with slopes ranging from 0 to 1 percent. The typical soil profile consists of sandy loam to 140 cm and loamy sand extending to 200 cm. Bibb Iuka complex is not considered susceptible to rill or sheet erosion (NRCS, 2009c; NRCS, 2009d).

The proposed location R-15 is within the Armistead Selden Lock where soils consist of silty clay loam and clay loams. The soil at the location proposed for R-15 is Sumter-Wastonia complex with slopes ranging from 1 to 3 percent. The typical soil profile is a silty clay loam to 50 cm, silty clay to 66 cm, and weathered bedrock extending to 205 cm. This soil is considered to be mildly susceptible to rill or sheet erosion (NRCS, 2009e; NRCS, 2009f).

The proposed Choctaw NWR Relocatable Site (R-16) location has soils of the Urbo-mooreville-Una complex. This is a poorly drained soil with a typical profile of silty clay to 8 cm and clay loam extending to 200 cm. This soil type is mildly susceptible to rill or sheet erosion (NRCS, 2009g; NRCS, 2009h).

The Aquatic Array at Choctaw NWR (A-21) would be placed on the Tombigbee River, and Armistead Selden Lock Aquatic Array (A-20) would be located on the Black Warrior River. There would be no potential to impact soils or sediments at these locations.

### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

During construction of the project, soils would be disturbed as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would be less than 0.01 ha at C-24 and less than 0.02 ha at R-15 and R-16. Soil disturbance would be approximately 0.04 at C-23, less than 0.03 ha at C-22, less than 0.04 ha at S-22, and less than 0.07 ha at A-21. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby water bodies.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

## Climate

### *Affected Environment*

Annual precipitation rates throughout Domain 8 are generally similar, approximately 125 to 150 cm (Ward and Ward, 2007). In the area near the TNF Core Site (C-22, C-23, C-24, and R-15) in west-central Alabama, the average total precipitation is 134.5 cm and the mean temperatures range from 12.2 to 24.3˚C (SERCC, 2009a). In the southwestern portion of Alabama near Site R-16, the average total precipitation is 142.8 cm and the mean temperatures range from 11.7 to 24.7˚C (SERCC, 2009b). Strong storms, with intense wind, hail, and lightning, may occur in association with tropical storms moving up from the Gulf of Mexico, as strong fronts move through or as isolated severe summer storms (FEMA, 2006). Lightning has the potential to create an unplanned natural fire.

### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. There would be no potential for interaction with other projects and no cumulative impacts to climate would result.

Due to the potential for extreme wind conditions from hurricanes and tornadoes, towers would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind. Site design also would incorporate appropriate grounding and power filtering to protect instrumentation from damage from electrical surges due to lightning.

## Air Quality

### *Affected Environment*

All of the proposed NEON locations in Domain 8 are in areas designated as in attainment for criteria pollutants (USEPA, 2009a).

The proposed NEON locations in the TNF are within 161 km of a Class I Wilderness Area. The Sipsey Wilderness Area is approximately 146 km north of the proposed NEON locations in the TNF (USEPA, 2009b; 2009c). The Armistead Selden Lock and Choctaw NWR sites are more than 161 km from a designated Class I Wilderness Area.

### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts on air quality. The construction area would be less than 0.01 ha and no large earth-moving equipment would be used. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions. Proposed instrumentation sites are located on private property with no surrounding development. Human health and human nuisance values would not be impacted from fugitive dust created during construction.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze and would not impact visibility at the TNF, Armistead Selden Lock, or Choctaw NWR.

### Noise

#### *Affected Environment*

The noise environments at the Core Site and the two Relocatable Sites in Domain 8 would be similar. All are located in rural areas with low populations in surrounding areas. There are no residential areas or sensitive receptors near the proposed sites. Existing noise levels at all three locations would likely be approximately 40 dBA or less (USEPA, 1974).

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would cause no impacts to residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand with as little impact as possible. No new roads would be constructed. During construction, noise levels would be elevated periodically only during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure.

Wildlife in the immediate construction area would be exposed to the elevated noise levels and would be expected to temporarily relocate from the construction area, but to resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

Noise from the atmospheric sampling equipment pumps could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at the Core Site and up to 5 years at Relocatable Sites).

Noise from the AOP would have minimal potential to impact residents. Very few houses are located near proposed NEON sites. AOP flights at 1,000 m above the canopy would be expected to have no impact on residents. AOP flights at 150 m above the canopy would be a short-term nuisance, but any impacts to residents would be negligible with flights occurring only once per year.

The potential for AOP flights to disturb wildlife is discussed below.

### Water Quality

#### *Affected Environment*

There are several low-order streams at the TNF site (Table 3.5.8.3-1). The proposed location of the three Core Site towers (C-22, C-23, C-24) and STREON Site (S-22) is between the Cahaba River (approximately 32 km to the east) and the Sipsey River (approximately 64 km to the north and west) (Ward and Ward, 2007). The Mayfield Creek watershed, proposed as the STREON Site, drains to Sandy Creek and ultimately to the Black Warrior River, none of which are 303(d) listed streams (ADEM, 2008). Aquatic Array A-20 would be located on the Black Warrior River approximately 55 river km north of the river's confluence with the Tombigbee River near Demopolis, Alabama, and is not a 303(d) listed stream (ADEM, 2008). The second Aquatic Array (A-21) would be located farther downstream on the Tombigbee River in southeast Choctaw County,

**TABLE 3.5.8.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 8, Ozarks Complex United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-22 | 26 | 0 | 0 | 0 | 0 | 0 |
| C-23 | 27 | 0 | 0 | 0 | 0 | 0 |
| C-24 | 27 | 0 | 0 | 0 | 0 | 0 |
| R-15 | 16 | 0 | 20 | 0 | ND | ND |
| R-16 | 23 | 0 | 29 | 0 | ND | ND |
| A-20 | 19 | 1 | 13 | 0 | ND | ND |
| A-21 | 24 | 1 | 29 | 1 | ND | ND |
| S-22 | 22 | 1 | 0 | 0 | 0 | 0 |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009c.

about 12 km north of Coffeeville, Alabama. The Tombigbee River is a 303(d) stream above and below the Choctaw NWR (ADEM, 2008).

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality from stormwater runoff could occur during construction. Because any impacts would be localized, there would be no potential for cumulative impacts to occur. STREON experiments could result in long-term moderate impacts to water quality in Mayfield Creek, with the potential for minor cumulative impacts in Sandy Creek.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

Elevation of $NH_4NO_3$ or $H_3PO_4$ concentrations in Mayfield Creek to 5 times ambient concentrations for a 10-year period could result in long-term impairment of water quality in this stream and lead to eutrophication within the experimental reach. Because the stream reach is in a hardwood forest area, nutrient additions in winter and early spring, prior to canopy leaf-out, would likely result in increased growth of algae and periphyton due to the direct exposure to sunlight and greater nutrient availability. Once the canopy closes and shades the stream, lack of sunlight would be expected to slow growth of algae and periphyton, which could lead to greater downstream transport of soluble nitrogen and phosphorus, which could impact downstream waters, particularly lakes and impoundments. There also could be a die-off of algal and periphyton biomass, which could lead to oxygen depletion in the stream from aerobic decomposition. Oxygen depletion could in turn result in changes to vertebrate and invertebrate communities in the immediate area (Hauer and Lamberti, 2006). Impacts would likely be long-term and moderate. No impacts would be expected from the recirculation tracer experiments.

There would be potential for transport of soluble nitrogen and phosphorus to incrementally interact with other human and natural events and produce cumulative impacts to downstream water quality, including accelerated eutrophication of ponds and lakes. Any cumulative impacts would be limited to Sandy Creek. Once the flow reaches the Black Warrior River, any increased nutrient concentrations would be assimilated into the larger river without impact. Any cumulative impacts to Sandy Creek would likely be minor because of the greater volume of water flowing in this stream compared to Mayfield Creek.

### Wetlands

#### *Affected Environment*

There are no wetlands at or near the locations proposed for the NEON Core Site in TNF (C-22, C-23, C-24) or the Armistead Selden Lock Relocatable Site (R-15) (Table 3.5.8.3-1). The proposed Relocatable Site at Choctaw NWR (R-16) contains extensive wetlands (Table 3.5.8.3-1). The refuge is a mosaic of sloughs, creeks, lakes, bottomland hardwoods, and upland pine ridges. There are non-pine upland areas interspersed among wetlands (Wildernet, 2009).

#### *Environmental Consequences*

No wetland impacts would occur at proposed NEON sites in Domain 8. There would be no interaction with other projects. Therefore, no cumulative impacts to wetlands would occur.

Because all work would be confined to uplands, no direct impacts to wetlands would occur at proposed NEON Core Site in TNF or the Armistead Selden Lock Relocatable Site. At Choctaw NWR, the tower and supporting infrastructure would be placed outside of wetlands. Site design would identify an appropriate area outside of a wetland to place the tower pad, tower, fencing, and IH.

NEON, Inc. would implement and maintain appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for indirect impacts to wetlands as a result of erosion and sedimentation from the construction sites.

### Floodplains

#### *Affected Environment*

The three proposed NEON sites in Domain 8 are in remote areas where FEMA has not designated floodplains or flood prone zones through development of FIRMs. The STREON Site (S-22) that would be near the three Core Site towers (C-22, C-23, C-24) and the two Aquatic Arrays (A-20 and A-21) would be located in or adjacent to streams and rivers, which would place them within flood prone areas. Relocatable Site R-16 would be located approximately 0.2 km from the Tombigbee River and also would be within an area that floods.

### *Environmental Consequences*

There would be negligible direct impacts to flood prone areas as a result of implementation of NEON. One Basic Tower, one STREON Site, and two Aquatic Arrays would be placed in areas prone to flooding. The minimal displacement of the proposed equipment would result in a negligible impact on flood storage, flood elevations, and flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected.

Structures built in floodplains have the potential to increase flood elevations and reduce flood storage capacity by displacing water in proportion to the size of the structure. Additionally, structures in floodplains may impede flood conveyance by increasing resistance to water movement or acting as traps for debris in floodwaters, which can create barriers to water movement.

At Choctaw NWR, the Relocatable Tower (R-16) and Aquatic Array (A-21) would be placed within the floodplain. No permanent infrastructure would be associated with this site. No increase in flood elevations would result and the change in flood storage capacity and flood conveyance would be negligible.

At the TNF and Armistead Selden Lock, only the STREON (S-22) and Aquatic Array (A-20) would be placed in a floodplain. No increase in flood elevations would result and the change in flood storage capacity and flood conveyance would be negligible.

There would be the potential for equipment to be damaged during flood events. NEON, Inc. would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts on existing water quality if they were to be lost in streams. There are no environmentally harmful components associated with this monitoring equipment. NEON, Inc. would temporarily remove equipment from flood prone areas when flooding is forecast for the area.

## Common Vegetation and Plant Communities

### *Affected Environment*

The natural vegetative community of the western Alabama NEON areas is predominantly composed of oak-hickory-pine mixed forests (Griffith et al., 2001). This region was originally dominated by longleaf and slash pine; however, fire management has resulted in a shift to loblolly pine dominated uplands and hardwoods in the lowlands (BLM, 2009a). Lowland hardwoods that dominate this region include the post oak, southern red oak, scarlet oak, chestnut oak, and blackjack (BLM, 2009b). These upland mixed forests also likely include overstory species such as the southern magnolia, pignut hickory, and sweetgum along with understory species such as flowering dogwood, hophornbeam, and American holly (FNAI, 1990).

On Choctaw NWR, natural sloughs, creeks, lakes, bottomland hardwoods, and pine ridges form a mosaic of habitat types (Wildernet, 2009).

### *Environmental Consequences*

Tree removal along utility lines would be a minor long-term impact to vegetation and plant communities. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation (less than 0.1 ha) would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate. Where overhead utility lines are extended, there could be limited removal of trees along the route. Because of the need to keep the utility lines clear of woody vegetation, these would be kept free of trees by hand removal of saplings, as necessary, until the end of the NEON project.

## Common Fauna

### *Affected Environment*

The state of Alabama has approximately 850 species of birds, reptiles, amphibians, mammals, and fish (USDA, 2009). The TNF Oakmulgee District, Armistead Selden Lock region, and Choctaw NWR generally host the same resident wildlife commonly found statewide. These species include white-tailed deer, bob white quail, gray fox, fox and gray squirrel, turkey, raccoon, and various waterfowl. Other common species found in western Alabama are the American alligator, eastern cottontail rabbit, various frogs, toads, bobcats, and snakes. (ADCNR, 2009 a-e). At least 23 species of crayfish have also been known to occur in either the Tombigbee or Black Warrior River (ADCNR, 2009f).

The Choctaw NWR was created in 1964 with the primary purpose to provide wood duck brood habitat and a protected habitat for wintering waterfowl. Artificial nesting boxes are built and placed in the NWR and up to 200 broods of wood ducks are produced each year. The number of waterfowl can exceed 10,000 in the winter months (USFWS, 2009). White-tailed deer, turkey, raccoon, eastern cottontail rabbit, and squirrel are abundant on the refuge. Wading bird numbers increase in the spring. The sloughs, creeks, and lakes support game fish and aquatic mammals such as river otter, beaver, mink, and the exotic nutria (Wildernet, 2009).

### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding is expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Towers and guy wires would pose a minimal risk to common birds and flying mammals. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Alabama Department of Conservation and Natural Resources prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because flights would be conducted after canopy leaf-out, visual stimuli would be minimal and the closed canopy could reduce airplane noise. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight.

The proposed Core Site locations (C-22, C-23, C-24) are within areas where training overflights from Maxwell Air Force Base and Columbus Air Force Base are conducted routinely. Any impacts from additional overflights at either 1,000 m or 150 m for the AOP would likely be negligible at the TNF sites.

Waterfowl or shorebirds at the Choctaw NWR would not typically be in closed canopy conditions at the time of an AOP overflight. Because these birds would be more in the open, a more pronounced response would be expected. It is likely that the birds would flush, particularly in response to 150-m flights, and move away from the aircraft to other suitable habitat. There could be a minor impact on waterfowl or shorebirds at Choctaw NWR from AOP overflights. To minimize the potential for impacts, no AOP overflights would occur when birds were nesting or when unfledged young were present at the nest.

Because impacts would be separated in space and time, no potential for interaction among proposed NEON project or between NEON projects and other projects would be expected.

### Sensitive Ecological Communities

#### *Affected Environment*

Review of existing data determined that the proposed project areas are not within any designated critical habitat area, as defined under the ESA (USFWS, 1977; USFWS, 1998;, USFWS, 2003, and USFWS, 2004). No sensitive ecological communities have been identified by the Alabama Natural Heritage Program (NHP) in the vicinity of the proposed NEON sites in TNF or Armistead Selden Lock.

The Tupelo Gum Natural Area on Choctaw NWR consists of 12.1 ha of black gum and 2 ha of bald cypress located in the Middle Swamp area. This area was set aside as a unique part of the refuge in 1976 (Wildernet, 2009).

#### *Environmental Consequences*

No sensitive habitat would be disturbed during the construction or operation of the NEON facilities. There would be no impacts to sensitive habitats. No cumulative impacts to sensitive ecological communities would result.

### Sensitive Species

Sensitive species identified as having potential to occur on or near proposed NEON sites are identified in Table Domain 8, Appendix B. This appendix includes information, including scientific names, legal status, and preferred habitats, for these species. The following discussion is limited to those species that may occur at or adjacent to proposed project locations where disturbance would occur.

#### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 8 (Table 3.5.8.3-2). However, there are known occurrences of species protected under ESA and state and USFS protected species within 5 km of all the proposed NEON locations. In addition, potentially suitable habitat for protected species is present at or adjacent to all of the proposed NEON locations (Table 3.5.8.3-2). The following sections discuss the species with potential to occur at or adjacent to proposed NEON sites in Domain 8.

### Federal Species

The southern clubshell prefers sand, gravel, and cobble substrates in shoals and runs of small rivers and large streams. Extant populations of the mussel are known from the Sipsey River drainage (USFWS, 2000). This species could occur in the stream proposed for the STREON location in TNF (S-22).

**TABLE 3.5.8.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 8, Ozarks Complex
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-22 | 4-ESA<br>2-USFS | 0 | 2-ESA<br>12-USFS | 3 | 0 | 0 |
| C-23 | 4-ESA<br>2-USFS | 0 | 2-ESA<br>12-USFS | 3 | 0 | 0 |
| C-24 | 4-ESA<br>2-USFS | 0 | 2-ESA<br>12-USFS | 3 | 0 | 0 |
| R-15 | 0-ESA | 0 | 0-ESA | 3 | 0 | 3 |
| R-16 | 0-ESA | 0 | 0-ESA | 4 | 0 | 2 |
| A-20 | 0-ESA | 0 | 0-ESA | 3 | 0 | 3 |
| A-21 | 0-ESA | 0 | 0-ESA | 4 | 0 | 4 |
| S-22 | 4-ESA<br>2-USFS | 0 | 3-ESA<br>34-USFS | 3 | 0 | 3 |

Source: Appendix B Domain 8

The Cahaba shiner may be endemic to the Cahaba River and Locust Fork of the Black Warrior River watersheds. This species prefers main channels where current is slow/moderate with clean sand and gravel substrates (Boschung and Mayden, 2004). This species could occur in the stream proposed for the STREON location in TNF.

The bald eagle was recently delisted under the ESA (USFWS, 2007), and will be monitored for at least 5 years to determine whether re-listing is warranted. The bald eagle remains protected under the Bald and Golden Eagle Protection Act and the MBTA, which are administered by USFWS. The eagle prefers habitats near large bodies of water with tall deciduous and coniferous trees or cliffs (NatureServe, 2009). The bald eagle is known to occur on Choctaw NWR and TNF and could occur at Armistead Selden Lock.

While not reported from within a 5-km radius of the proposed NEON location, the wood stork occurs on Choctaw NWR (Wildernet, 2009). This species could occur near the proposed NEON locations on Choctaw NWR (R-16, A-21).

RCWs require open pine woodlands and savannahs dominated by older, mature pines for nesting and roosting (USFWS, 2003). Longleaf pines are the preferred trees for cavity excavation because it produces the most resin for the longest period of time. The woodpecker also prefers habitats with abundant foraging areas of open mature pine overstory with little or no hardwoods and low density midstory (USFWS, 2003). This species is known to occur in the TNF and active clusters of this species are known to occur near the proposed Core Site towers in TNF (C-22, C-23, C-24) (USFS, 2004; Ragland, personal communication, 2009).

### USFS Species

The Bachman's sparrow, cocoa clubtail, treetop emerald dragonfly, Laura's clubtail, small flowered buckeye, Apalachicola wild indigo, ravine sedge, Kral's Indian paintbrush, Alabama croton, large witchalder, Alabama warbonnet, Alabama snow-wreath, Arkansas oak, bay starvine, royal catchfly, and lanceleaf trillium could occur at or adjacent to the proposed Core Sites (C-22, C-23, and C-24) and the STREON Site (S-22).

The Bachman's sparrow inhabits longleaf pine forests, woodlands, savannas, and grasslands (USFS, 2004). The cocoa clubtail inhabits sand-silt substrates within medium to large rivers with emergent vegetation, and Laura's clubtail is found in sand-mud substrates within small wooded streams with emergent vegetation (USFS, 2004). Both species may forage in forested floodplains, forest edges, or upland ridges (USFS, 2004). The treetop emerald dragonfly typically is found in seeps or bogs associated with forest openings and roadways where trickling water flows over moss (USFS, 2004).

Karl's Indian paintbrush, large witchalder, the Arkansas oak, and the royal catchfly are found in woodlands, savannas, and grassland habitats. The royal catchfly also inhabits glades, barrens, and mature oak forests. The Alabama croton inhabits glades, barrens, and basic mesic forests. The small-flowered buckeye is only found in mature mesic hardwood forests. The Apalachicola wild indigo and bay starvine are also found in mature mesic hardwood forests and in late successional riparian zones. The lanceleaf trillium can be found in late successional riparian zones and basic mesic forests. The ravine sedge is only found in late successional riparian zones, and the Alabama warbonnet and Alabama snow-wreath also inhabit late successional riparian zones along with canopy gaps, river channels, and basic mesic forests (USFS, 2004).

The rayed creekshell and Alabama heelsplitter are two mussel species potentially occurring at or adjacent to S-22. The rayed creekshell inhabits low to moderate gradient sluggish currents over mud-sand or gravel substrates within pools and riffles of small headwater streams and large rivers (USFS, 2004). The Alabama heelsplitter is found in tributary streams and small to medium sized rivers. Several species of caddisflies and crayfish could also occur at or adjacent to S-22. The caddisflies usually inhabit small tributary streams and the associated riparian zones. *Cheumatopsyche bibbensis* is found in tributaries associated with the Cahaba River, the *Hydroptila paralatosa* species occurs in streams around the Alabama fall line, and the *Hydropsyche hageni* species prefers small sandy streams with riparian zones containing rocky crevices or woody debris. The crayfish species prefers streams and rivers with sluggish currents over sandy-clay substrate (USFS, 2004).

Several fish species could occur at or adjacent to the proposed S-22 site including the Alabama shad, goldstripe darter, Alabama darter, blackwater darter, skygazer shiner, coal darter, and freckled darter. The Alabama shad resides in reservoirs, coastal estuaries, or bays and migrate into large rivers or tributaries to spawn every spring. The three darter species (goldstripe, Alabama, and blackwater) typically inhabit pool, run, or riffle habitats of small, sluggish streams. The coal and freckled darters prefer swift currents over cobble or sand substrate within the rapids of large streams and rivers. The stargazer shiner primarily inhabits shallow, moderate to swift currents over sand-gravel substrates within shoals of large streams and rivers (USFS, 2004).

The Rafinesque's big-eared bat and Southeastern myotis prefer den trees, lakeshores, late successional riparian zones, and open wetland areas (USFS, 2004). Both species could occur at or adjacent to the proposed STREON site (S-22).

The southern hickorynut, ridged mapleleaf, Southern lady's slipper, Carolina spider lily, Morse's long-horned sedge, and eared coneflower are all vegetative species potentially occurring at or adjacent to proposed STREON site (S-22). The southern hickorynut is only known to inhabit the Sipsey, Buttahatchee, and Upper Tombigbee Rivers and prefers moderate gradients and currents over sand and gravel substrates within streams and rivers (USFS, 2004). The ridged mapleleaf primarily inhabits moderate gradient slow to fast currents over sand-gravel substrates within medium sized rivers and reservoirs (USFS, 2004). Southern lady's slipper occurs in late successional riparian zone habitats (USFS, 2004). The Carolina spider lily is found in early successional riparian zones, open wetlands, and river channels (USFS, 2004). Morse's long-horned sedge inhabits sand substrates within small streams in and around the fall line transition and associated riparian zone (USFS, 2004).The eared coneflower is found in river channels and in early successional riparian zones (USFS, 2004).

#### State Species

The crystal darter, also a Regional Forester Sensitive Species, prefers raceways and swift, deep riffles of medium to large streams with a large amount of clean sand and/or gravel substrates. The darter is not known to inhabit areas with mud or clay bottoms and submerged vegetation (Boschung and Mayden, 2004). This species could occur in the stream proposed for the STREON location in TNF (S-22).

The frecklebelly madtom, also a Regional Forester Sensitive Species, inhabits swifter flowing rapids and gravel riffles of rivers and large tributaries with little siltation. The madtom is often found in conjunction with an abundance of river-weed (Boschung and Mayden, 2004). This species could occur in the stream proposed for the STREON location in TNF.

The black-knobbed sawback turtle occurs exclusively in rivers and prefers substrates of sand and clay. The turtle leaves the water only to bask and lay eggs on sandy bars (Mount, 1975). This species could occur near the Aquatic Arrays proposed for Choctaw NWR (A-21) and Armistead Selden Lock (A-20).

The Alabama map turtle inhabits medium-sized creeks to large rivers with expansive sandbars and deep pools. The turtles prefer waterways with an abundance of basking sites and the presence of mollusks, especially mussels, for food (Mount, 1975). This species could occur near the Aquatic Arrays proposed for Choctaw NWR and Armistead Selden Lock.

The alligator snapping turtle is an extremely large aquatic turtle attaining a maximum carapace length of over 60 cm and weighing in excess of 90 kg. The turtle generally inhabits deep waters of rivers, oxbows, and sloughs, but may be found in medium-sized creeks (Mount, 1975). This species could occur at Armistead Selden Lock and Choctaw NWR.

### *Environmental Consequences*

Proposed NEON construction activities would not be expected to impact sensitive aquatic species. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for indirect impacts to sensitive aquatic species from sedimentation as a result of stormwater runoff. Data collection at Aquatic Arrays also would not impact sensitive aquatic species. No cumulative impacts to sensitive species would be expected.

Implementation of STREON experiments would have the potential to impact aquatic species. Nutrient addition experiments could result in changes to in-stream vegetation, particularly algal growth, which could then impact aquatic organisms within and downstream of the experiment site. None of the sensitive aquatic species are known from the immediate area of the stream proposed for the STREON experiment. It is expected that any biotic changes as a result of STREON experiments would be limited in downstream extent and that there would be no impacts to sensitive aquatic species.

NEON, Inc. would work with property owners and site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid any such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat. Construction of proposed the Core Site in TNF would be coordinated with the USFS around the RCW nesting season.

There would be the potential to disturb sensitive terrestrial wildlife of the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat during construction. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Towers and guy wires would pose a minimal risk to bald eagle and wood stork at Choctaw NWR. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Alabama Department of Conservation and Natural Resources prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

## Cultural Resources

### *Affected Environment*

The proposed NEON locations for Domain 8 are within three areas of Alabama: a rural area along the Black Warrior-Tombigbee Waterway on the border of Hale and Greene Counties, the Talladega National Forest, and the Choctaw National Wildlife Refuge along the Tombigbee River on the border of Choctaw and Clarke Counties. The area along the Black Warrior-Tombigbee Waterway consists of generally undeveloped and rural land. The Talladega National Forest includes approximately 94,000 ha of undeveloped forest. The Choctaw National Wildlife Refuge was established to provide habitat and protected wintering areas for various waterfowl and encompasses approximately 1,700 ha of relatively undeveloped land.

## Prehistoric Context

During the past several years, more evidence is being gathered that human occupation of North and South America began earlier than the Terminal Pleistocene ca. 12,000 BP. No site is found within the Ozark Complex domain that is currently under investigation as a Pre-Clovis site. Clovis sites, which are found across the continent, are represented by a general hunter and gatherer strategy employed by small, highly mobile groups and date to approximately 12,000 years ago in Domain 8. The Archaic Period for this region dates from approximately 9,000 years ago to approximately 3,000 years ago and includes new adaptations by the early people related to the change from the cold, moist climate of the Pleistocene Age to a warmer, drier one as warm winds melted the glaciers to the north and warmed the ocean water. Modern game supplied much of the protein in the diet. Populations in Alabama adapted to a wide variety of environments and Archaic sites are found in all areas of the state (Walthall, 1980). By the end of the Archaic, people had become more sedentary and had begun specializing in the exploitation of specific high yield foods, such as hickory nuts, shellfish, and deer. The Gulf Formational Period dates from approximately 2500 B.C. until approximately 100 B.C. Fiber tempered and sand tempered pottery first appeared during this period and in general, the Gulf Formational Period is characterized by increasing sophistication in ceramic production.

The Woodland Period in Alabama dates from approximately 300 B.C to approximately A.D. 1000 and refers to the sedentary cultures of the extensive eastern United States woodlands. Technological advances that first appeared during the Woodland include the bow and arrow. Corn, beans, and squash were cultivated and hunting and gathering was still practiced. Burial mounds first appear during the Woodland Period. The Mississippian Period dates from approximately A.D. 700 to 1400. The Mississippian Period is characterized by monumental architecture, including earthen platform mounds with temples, residences, and political buildings, large, stable sedentary populations, organized chiefdoms, well developed religious ceremonies connected with agriculture and a fire-sun deity, increased warfare and territoriality, and craft specialization. Mississippian sites in Alabama include Moundville, where the largest earthen mound is about 18.3 m high (Walthall, 1980). During the subsequent Protohistoric Period, native populations shifted due to the presence of the Europeans. The Muskogean-speakers, the remnants of the Mississippian chiefdoms, merged into the Creek Confederacy. Other historic tribes similarly formed include the Choctaw, the Chickasaw, and the Cherokee (Alabama Department of Archives and History [ADAH], 2008).

### Historic Context

The first Europeans to explore present day Alabama included Alonzo Alvarez de Pineda, a Spaniard who explored Mobile Bay in the early 1500s, and Hernando de Soto, who made his way overland from Florida to the Mississippi River in the early 1500s (ADAH, 2008). Other French and Spanish explorers continued to traverse Alabama throughout the sixteenth and seventeenth centuries. In 1702, two Frenchmen, Iberville and Bienville Le Moyne, established the French Fort Louis de la Mobile along the Mobile River. Trade with the Native Americans continued throughout the 1700s. At the close of the French and Indian Wars, France ceded land east of the Mississippi River to the British and land west of the Mississippi to the Spanish. Parts of present day Alabama, including Mobile, became West Florida. During the Revolutionary War, the Spanish captured Mobile and at the close of the war, control of Florida, including West Florida, reverted to the Spanish. Between the Louisiana Purchase of 1803 and the annexation of West Florida by the U.S. 7 years later, most of Alabama fell into U.S. control. The Alabama Territory was created in 1817 and 2 years later, Alabama became the 22$^{nd}$ state to enter the Union (ADAH, 2008).

Alabama seceded from the Union in 1861, and was among the original six states to establish the Confederate States of America. Montgomery served as the capital of the Confederacy for 4 months before the capital was moved to Richmond, Virginia. Reconstruction followed the defeat of the Confederacy and Alabama was put under the control of a Union appointed military governor. The years following the Civil War were ones of rebuilding, and Birmingham became the center of southern iron and steel. The early years of the 20$^{th}$ Century saw the necessity of diversification in agriculture as the boll weevil was introduced into the state from neighboring Mississippi, causing the failure of cotton crops throughout the state. Alabama farmers began raising cattle in destroyed cotton fields and growing peanuts. Alabama figured prominently in the civil rights struggles of the 1950s with events such as the arrests of Rosa Parks and Martin Luther King Jr. and the Montgomery bus boycott. The modern era is characterized by a transition from a rural agricultural based economy to a more urban and industrialized one and today, the diverse Alabama economy includes aerospace, banking, automobile manufacturing, mineral extraction, and steel production (ADAH, 2008).

### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 8, including a 1.6-km radius study area around the proposed locations. A literature search was requested of the Alabama State Site File (ASSF) at the University of Alabama, Office of Archaeological Research. The files at the ASSF contain information on archaeological resources, historical resources, and previous studies within the state. Additionally, the Alabama State Historic Preservation Office (SHPO) was contacted regarding built historic resources. The SHPO maintains county lists of built historic resources in the state. Additionally, the following historic maps were reviewed at the University of Alabama Historical Maps website: the 1937 and 1949 *Map of Bibb County*, the 1870, 1937, 1949, and 1967 *Map of Hale County*, the 1937, 1950, and 1969 *Map of Choctaw County*, the 1937 and 1951 *Map of Clarke County,* and the 1858 *Map of Greene County.* The National Register Information System (NRIS), which contains information related to properties listed on the NRHP, was also consulted for Hale, Greene, Clarke, Bibb, and Choctaw Counties.

Resources previously documented within the vicinity of the proposed NEON locations include historic trash dumps, prehistoric artifact and lithic scatters, stone mounds, historic foundations of residences and mills, and a prehistoric habitation site (Table 3.5.8.3-3). Several unrecorded historic resources including historic residences, associated outbuildings, water control features, and historic roads are visible on the 1937 and 1949 *Map of Bibb County*, the 1870, 1937, 1949, and 1967 *Map of Hale County*, the 1937, 1950, and 1969 *Map of Choctaw County*, the 1937 and 1951 *Map of Clarke County*, and the 1858 *Map of Greene County.*

**TABLE 3.5.8.3-3**

Literature Search Results—Domain 8, Ozarks Complex
*National Ecological Observatory Network (NEON) EA*

| | | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | | |
|---|---|---|---|---|---|---|---|
| NEON Site Number | Previously Surveyed | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Number Evaluated | Number Eligible |
| C-22 | Yes | 0 | 3 | 0 | 15 | 2 | 0 |
| C-23 | Yes | 0 | 2 | 0 | 0 | 2 | 0 |
| C-24 | Yes | 0 | 2 | 0 | 0 | 2 | 0 |
| R-15 | No | 0 | 0 | 0 | 12 | 0 | n/a |
| R-16 | Yes | 0 | 5 | 0 | 7 | 3 | 0 |
| A-20 | No | 0 | 0 | 0 | 12 | 0 | n/a |
| A-21 | Yes | 0 | 5 | 0 | 7 | 3 | 0 |
| S-22 | Yes | 0 | 21 | 0 | 1 | 14 | 3 |

Source: Alabama State Site File (ASSF), National Register Information System (NRIS), the 1937 and 1949 *Map of Bibb County*, the 1870, 1937, 1949, and 1967 *Map of Hale County*, the 1937, 1950, and 1969 *Map of Choctaw County*, the 1937 and 1951 *Map of Clarke County*, and the 1858 *Map of Greene County.* n/a = not applicable.

R-15 and A-20 have been previously surveyed for cultural resources. The study areas for several of the NEON locations significantly overlap due to the proximity of individual facilities. No cultural resources are previously documented within the areas of disturbance of the NEON locations. Of the 60 resources located within the combined study areas, 19 have been determined eligible or the NRHP. The remaining sites are either not eligible or have not been evaluated for significance.

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 8 did not identify any significant known historic properties within the areas of disturbance for any of the proposed facilities.

Of the cultural resources that have been previously documented or appear on historic maps within the 1.6-km study area surrounding the NEON locations, 19 have been recommended or determined eligible for the NRHP. All of these resources are located outside of the area of disturbance and the towers would not be visible from historic properties.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 8, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

### Utilities

#### *Affected Environment*

The TNF, Armistead Selden Lock, and Choctaw NWR areas are remote locations that would need utilities extended from nearby infrastructure. Overhead power lines and telecommunications are located along major thoroughfares adjacent to the properties.

#### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed along existing roads as far as allowed or to the point nearest proposed tower locations. Within TNF, lines would be buried along existing roads as required by the Forest Plan (USFS, 2004). A portal would be placed at a point adjacent to the existing access road where access for maintenance activities would be available. From the portal, service lines would connect to the IH and then the tower. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2 would be implemented to minimize the potential for impacts. Extended overhead lines would be kept clear of trees by hand clearing saplings, as necessary, for the duration of the NEON project at a location.

### Transportation

#### *Affected Environment*

The TNF Core Site towers (C-22, C-23, C-24) would be adjacent to Forest Road 723. The proposed STREON Site in TNF (S-22) could be accessed by using Forest Road 707. The Armistead Selden Lock Relocatable Site (R-15) and Aquatic Array (A-20) could be accessed directly from Hale County Road 15 off Alabama Highway 14. The Choctaw NWR Relocatable Site (R-16) and Aquatic Array (A-21) could both be accessed directly from an NWR trail that leads from Choctaw County Road 14 north of U.S. Highway 84.

#### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

Existing roads would be used to bring in the materials for construction and improved trails would be used or created to transport materials by hand from the road to the proposed NEON location. Any new trails made for access would be signed to deter public use. Signs and gates would be used to deter unauthorized recreational vehicle use of these trails.

Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

### Human Health and Safety

#### *Affected Environment*

All of the proposed locations are located in rural areas. Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

NEON locations at TNF would be accessible to the public, mostly consisting of deer and turkey hunters. A USFS road, which is open 9 months of a year, is located near the proposed sites (Ragland, personal communication, 2009). Children would likely be supervised by adults. The proposed Aquatic Array at Armistead Selden Lock (A-20) would not create any health or safety risks. The public would have access to the area where NEON infrastructure would be placed at Choctaw NWR.

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety.

However, appropriate safety practices for working at heights, near fall hazards, near drowning hazards (Tombigbee and Black Warrior Rivers), and around electrical hazards would be implemented to minimize risk of injury.

Proposed site locations would have restricted public access. This would limit health and safety issues to the public. Towers would be secured with fencing and locked gates to deter unauthorized access.

There would be the potential for hunters, staff, or researchers riding ATVs to contact the guy wires during hunting, NEON maintenance, or data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential of an injury. Any impacts to site users would likely be negligible.

### Recreation

#### *Affected Environment*

The proposed NEON sites in TNF (C-22, C-23, C-24, S-22) would be on land used by the public for deer and turkey hunting. The Core Site at TNF would be near a Forest Development Road with public access 9 months of the year (Ragland, personal communication, 2009).

There are no recreational activities allowed near the proposed Relocatable Tower at Armistead Selden Lock (R-15). However, the location of the proposed Aquatic Array Armistead Selden Lock (A-20) is at a boat launch and hunting is allowed on the west side of the river at this location (USACE, 2009).

Recreational activities allowed in Choctaw NWR include wildlife observation, hiking, photography, sport fishing (rod and reel or pole and line only), boating, sight-seeing, and bird watching. The NWR has a boat ramp located near the Womack Hill Work Center. There also is limited permitted hunting with certain restrictions. Hunting for big game is by bow and arrow only and gun hunting for small game is permitted. No waterfowl hunting is allowed (Wildernet, 2009).

There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 8.

#### *Environmental Consequences*

Minor short-term impacts to recreation could occur at some proposed NEON locations during construction. Long-term impacts on recreation would be negligible. Because the NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would be likely.

Installation of the Aquatic Array at Armistead Selden Lock (A-20) would not disrupt boating or hunting activities. The proposed NEON, Inc. activities would not interfere with recreation near Armistead Selden Lock. The proposed Relocatable Tower (R-15) would be approximately 1.8 km from the river and would not impact aesthetics for boaters on the river.

Construction and site closure activities could disrupt recreational activities near the proposed NEON locations on Choctaw NWR (R-16, A-21). Any impacts would be short–term and persons could conduct recreational activities in other parts of the NWR. Any impacts would be negligible.

The presence of the tower and guy wires would be visible to persons using the NWR and would constitute a minor negative aesthetic impact to refuge use.

At proposed NEON locations where recreational vehicle activity could occur, guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

#### 3.5.8.4 References for Domain 8

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**Figure 3.D08-1** Domain 8 Proposed Site Locations

**Figure 3.D08-2** Domain 8 Proposed Site Locations

**Figure 3.D08-3** Domain 8 Proposed Site Locations

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### 3.5.9 Domain 9 Northern Plains

#### 3.5.9.1 Introduction

Domain 9 encompasses much of the Plains region in the northern United States. It covers portions of Minnesota, Montana, Nebraska, and Wyoming, a very small eastern portion of Iowa, the majority of South Dakota, and all of North Dakota. This Northern Plains Domain covers multiple ecosystems including; the High Plains, Middle Rockies, Northwestern Great Plains, Northwestern Glaciated Plains, Nebraska Sand Hills, North Central Hardwoods, Northern Glaciated Plains, and Lake Agassiz Plain. The Prairie Pothole Region covers the eastern half of Domain 9, is rich in plant and aquatic life, and supports globally significant populations of breeding waterfowl (Lin and Otte, 2007) (Figure 02-D09-01).

The sites selected in Domain 9 would be located in central North Dakota. The proposed infrastructure for the domain includes a Core Site (C-25, C-26, C-27) and an Aquatic Array (A-23), which would be located in the Woodworth Field Station (WFS) located approximately 60 km northwest of Jamestown, ND in Stutsman County (Figure 3.09-01). A Relocatable Site (R-17) and an Aquatic Array A-24 would be 10 km east of the Core Site on the North Dakota State University Dakota Coteau Field School (DCFS) property (Figure 3.09-02) (Lin and Otte, 2007). A Relocatable Site (R-18) would be located in the Northern Great Plains Research Laboratory (NGPRL) in northeastern Morton County on the southwest edge of Bismarck, ND (Figure 3.09-03).

#### 3.5.9.2 Resource Areas Considered But Not Addressed for Domain 9

Preliminary analysis indicated that there would be no potential to significantly impact four of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Floodplains: The proposed NEON infrastructure components on the WFS, DCFS, and NGPRL are not within floodplains. The Aquatic Arrays (A-23, A-24) would be at prairie potholes but would not be in areas prone to flooding. The nearest floodplains to any of these locations are those of the Missouri River, approximately 5 km from proposed Relocatable Tower R-18. There would be no potential to impact floodplains or flood prone areas.

- Environmental Justice: The proposed NEON sites would be located in unpopulated areas and all potential impacts would be confined to the project area. There would be no potential to disproportionately impact minority or low-income populations.

- Protection of Children: Educational activities at the WFS, DCFS, and NGPRL would not routinely put unsupervised children in contact with the proposed NEON infrastructure. No impacts to the environmental health and safety of children would be expected.

- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 9 are designated research areas that are not routinely viewed for aesthetic quality. Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

### 3.5.9.3 Resource Areas Considered in Detail for Domain 9

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 9 where site-specific conditions would influence the anticipated environmental consequences.

#### Geology/Seismology

##### *Affected Environment*

Domain 9 is entirely within the Interior Plains physiographic province. Precambrian metamorphic and igneous rocks form the foundation of the Interior Plains. The topography of WFS and the North Dakota State University (NDSU) DCFS is nearly level to gently rolling glacial till plains with areas of pothole lakes (USFS, 2009a, USGS, 2004). Glacial till is a mixture of sand, silt, clay, pebbles, and stones, unsorted by size (Lin and Otte, 2007). WFS and DCFS have surficial deposits of glacial till of varying depths underlain by Cretaceous marine sedimentary rocks. The proposed sites would be located within the Central Lowlands, which is a subprovince of the Interior Plains. The vegetative community is predominantly composed of wheatgrass-bluestem-needlegrass prairie lands (USFS, 2009a, USGS, 2004).

The topography of the NGPRL is gently rolling to rolling continental glacial till plains and rolling hills on the Missouri Plateau. The NGPRL has surficial deposits of glacial till of varying depths underlain by soft Cretaceous marine shale. The proposed NEON sites would be located within the Great Plains, which is a subprovince of the Interior Plains physiographic province (USFS, 2009b, USGS, 2004).

The Interior Plains province is stable from the standpoint of seismicity. In the areas of proposed NEON infrastructure, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 4 % pga to 8 % pga for short wave motion and 0 % pga to 4 % pga for long wave motion. The western edge of the domain has areas of higher seismicity associated with the Rocky Mountains (USGS, 2008a, 2008b).

##### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact the underlying geology. The seismic hazard is low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

#### Soils

##### *Affected Environment*

The Core Site towers (C-25, 26, 27) and Aquatic Array A-23 are located in WFS. The soils within this general area are loamy soils. The soils in the proposed area of Core Site C-25 are Hamerly-Parnell complex and Svea-Sioux loams. The Hamerly-Parnell complex is a somewhat poorly drained soil with slopes ranging from 0 to 3 percent. The typical soil profile for this soil is loam extending to 153 cm. Svea-Sioux loam is a moderately well drained soil with slopes ranging from 3 to 9 percent. The typical soil profile for this soil is loam extending to 153 cm. The soil in the proposed Core Site C-26 consists of Hamerly-Parnell complex and Sioux-Barnes loam. Sioux-Barnes loam is an excessively drained soil with slopes of 9 to 25 percent. The typical soil profile for this soil is loam to 18 cm, very gravelly loamy coarse sand to 61 cm, and very gravelly coarse sand extending to 153 cm. Soil in the areas of the proposed Core Site C-27 and Aquatic Array A-23 consists of Barnes-Svea-Buse loams. This soil is well drained and has slopes ranging from 0 to 35 percent. The typical soil profile for this type of soil is loam extending to 153 cm. Each of these soils is considered to be mildly susceptible to rill and sheet erosion (NRCS, 2009a; NRCS, 2009b; NRCS, 2009c; NRCS, 2009d; NRCS, 2009e).

The soil in the general area of Aquatic Array A-24 and Relocatable Site R-17 at the DCFS consists of variations of Barnes-Svea-Buse loams. The particular type of Barnes-Svea-Buse loam is the same as described for Aquatic Array A-23 except that this type has slopes ranging from 9 to 25 percent (NRCS, 2009f; NRCS, 2009g).

Soils within the NGPRL in the general area of the proposed Relocatable Site R-18 mostly consist of silt loams and silty clay loams. Soil at the Relocatable Site R-18 is Temvik-Wilton silt loam. This soil type is a well drained soil with slopes ranging from 0 to 3 percent. The typical soil profile for this type of soil is silt loam to 61cm and clay loam extending to 153 cm. This soil type is considered mildly susceptible to rill or sheet erosion (NRCS, 2009h; NRCS, 2009i).

#### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

At each of the proposed NEON locations in Domain 9, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would be approximately 0.09 ha at C-25, 0.12 at C-26, and 0.09 ha at C-27. Soil disturbance would be approximately 0.11 ha at R-17, 0.09 ha at R-18, 0.05 at A-25, and less than 0.02 ha at A-24. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are highly prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby waterbodies.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

### Climate

#### *Affected Environment*

The climate at the WFS, DCFS, and NGPRL is strongly seasonal, with average annual temperatures ranging from 4 to 8˚C and average annual precipitation around 51 cm, which falls primarily as winter snow. Prevailing winds are from the northwest with an average speed of 16 km/hr (Lin and Otte, 2007). This region is susceptible to tornados, freeze events including ice and hail storms with extreme temperature ranges of -51 to -84˚C, high winds exceeding 128 km/hr, and lightning storms (Starr and Kao, 2008a).

#### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. Due to the potential for extreme wind conditions from straight-line winds and tornadoes, towers would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile. Site design would incorporate appropriate grounding and power filtering to protect instrumentation from damage from electrical surges due to intense lightning.

### Air Quality

#### *Affected Environment*

The WFS and DCFS are located in rural areas. The proposed NEON locations would be within areas designated as in attainment. The NGPRL is located on the southwest edge of Bismarck. North Dakota is entirely in attainment for all criteria pollutants (USEPA, 2009a). However, the NGPRL is approximately 10 km south of the R.M. Heskett Station coal-fired power plant and 45 km southeast of the Milton R. Young coal-fired power plant (Environmental Working Group, 1999). There are three large coal-fired power plants approximately 105 km west of WFS and DCFS (Starr and Kao, 2008a).

The Theodore Roosevelt National Park in western North Dakota is the closest Federal Class I Wilderness Area to the proposed NEON locations, approximately 190 km from the NGPRL and approximately 315 km from the DCFS and WFS (USEPA, 2009b).

#### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts to air quality. The amount of ground disturbance would be less than 0.01 ha at any proposed location and no large earthmoving equipment would be used. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze or impairment of air quality at the Theodore Roosevelt National Park.

### Air Space

#### *Affected Environment*

The proposed NEON sites at WFS and DCFS have not been deemed restricted or special use airspace by the FAA (FAA, 2009a).

The proposed site for the Relocatable Tower (R-18) is located on NGPRL lands and is approximately 2 km west of the Mandan Municipal Airport. The area surrounding the municipal airport is controlled by the FAA and there is a flyway restricted area that extends to approximately 1 km southeast and northeast of the proposed tower site (Mandan Municipal Airport, 2008).

#### *Environmental Consequences*

There would be no restricted or special use airspace at WFS and DCFS; therefore, no impacts are anticipated with regard to restricted airspace at these locations.

R-18 is located approximately 2 km west of the Mandan Municipal Airport. Construction in the area surrounding an FAA-regulated airport is subject to FAA approval under CFR Title 14 Part 77.13 Airspace Obstruction Analysis. According to this regulation, any organization that intends to sponsor construction which may affect navigable airspace must notify the Administrator of the FAA and may be required to file a Notice of Proposed Construction or Alteration (Form 7460-1) with the FAA (FAA, 2009b). Implementation of NEON would comply with FAA Advisory Circular (AC) 150/5300-13, guidance on airport visual aids, and FAA AC 150/5200-33B, guidance on land uses that have the potential to attract hazardous wildlife on or near public-use airports. No impacts to airport operations would be expected.

AOP overflights at the proposed R-18 location would be coordinated with FAA to assure compatibility with air traffic.

### Noise

#### *Affected Environment*

The noise environments at WFS and DCFS would be similar. They are located in rural areas with low populations in surrounding areas and would be expected to have ambient sound levels of approximately 40 dBA or less (USEPA, 1974). The proposed NGPRL Relocatable Site is adjacent to urban development and the Mandan Municipal Airport is at the eastern edge of the R-18 study area.

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would have no impacts on residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. No new roads would be constructed. During construction, noise levels would be elevated periodically during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. The DCFS would be constructed concurrent with the installation of the NEON infrastructure and at this location the noise from construction of the DCFS would likely exceed the noise from NEON work. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to relocate from the construction area, but would likely resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

The pumps for atmospheric sampling equipment on an FIU would operate continuously. Typically, these pumps produce noise of approximately 65 dBA. NEON, Inc. would place the pumps within noise shielding to reduce the sound to less than 60 dBA at 12 m. Noise exposure to the urban area adjacent to proposed Relocatable Tower in NGPRL would be long-term and minor.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at Core Site tower locations and up to 5 years at Relocatable Sites).

There are residences near the proposed NEON locations at WFS and DCFS. Therefore, noise from AOP overflights would have no potential to impact residents at these locations. The proposed NGPRL site is near the Mandan Municipal Airport and any AOP overflights would not be distinguishable from routine air traffic by residents. Potential impacts of AOP overflights on wildlife are discussed below.

### Water Quality

#### *Affected Environment*

WFS and DCFS are located in the Prairie Pothole Region, which is characterized by depressional wetlands formed by glaciers scraping the landscape. Many of the prairie potholes are closed as basins and receive irregular inputs of water from their surroundings through rain and winter snowmelt (LandScope America, 2008 and USFS, 2009a). The Prairie Pothole Region has hydrologic outputs through evaporation and subsurface drainage (Starr and Kao, 2008b). The NEON infrastructure is located in the Pipestem watershed (USEPA, 2009c). There are no streams on the CWA Section 303(d) list of impaired waters in the vicinity of WFS and DCFS (North Dakota Department of Health (NDDOH, 2008).

There are no streams in the immediate vicinity of the proposed Relocatable Tower R-18 within the NGPRL. However, the NGPRL contains multiple intermittent streams and several wetlands that carry waters to the Missouri River. The study area is divided into two watersheds, Lower Heart and Upper Lake Oahe (USEPA, 2009d and 2009e). There are no streams on the CWA Section 303(d) list of impaired waters in the vicinity of the NGPRL (NDDOH, 2008).

#### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils.

Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

### Wetlands

#### *Affected Environment*

WFS and DCFS are located in the Prairie Pothole Region, which is characterized by depressional wetlands formed by glaciers scraping the landscape. Over 500 natural wetland basins occur on the WFS and DCFS, representing all wetland classes of the region (ephemeral, temporary, seasonal, semi-permanent, permanent, and fen) and can be groundwater recharge or groundwater discharge (Table 3.5.9.3-1). The salinities of the wetlands vary and depend on the hydrologic input. These wetlands support globally significant populations of breeding waterfowl and other wetland dependent wildlife (Lin and Otte, 2007). The proposed Core Site towers (C-25, C-26, C-27) and Relocatable Tower 17 on DCFS would be located in upland areas. The Aquatic Arrays would be located on prairie potholes near the towers.

**TABLE 3.5.1.9-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 9, Northern Plains
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-25 | 1 | 0 | 126 | 0 | 150+ | 0 |
| C-26 | 1 | 0 | 173 | 0 | 200+ | 0 |
| C-27 | 1 | 0 | 154 | 0 | 200+ | 0 |
| R-17 | 5 | 0 | 101 | 1 | ND | ND |
| R-18 | 11 | 0 | 7 | 0 | 30 | 0 |
| A-23 | 1 | 0 | 172 | 1 | 200+ | 1 |
| A-24 | 5 | 1 | 107 | 1 | ND | ND |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009a.

The NGPRL contains several emergent wetlands. Relocatable Tower 18 would be on an upland plain with no wetlands in the immediate vicinity. The nearest wetland would be approximately 0.25 km southwest of the proposed tower.

#### *Environmental Consequences*

There would be no direct impacts to wetlands from installation of NEON infrastructure. No other direct wetland impacts would occur. No indirect wetland impacts would be likely from implementation of NEON in Domain 9. No cumulative impacts to wetlands would be expected from this project.

Because all work would be confined to uplands, no direct impacts to wetlands would occur at proposed NEON Core Site towers on WFS or the proposed Relocatable Sites on the DCFS and NGPRL. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for indirect impacts to offsite wetlands as a result of erosion and sedimentation from the construction sites. No indirect impacts to offsite wetlands would be expected.

Both proposed Aquatic Arrays in Domain 9 would be placed in prairie pothole wetlands. Only sensors would be placed in wetlands and all supporting infrastructure would be placed in uplands adjacent to the wetlands. The support infrastructure would be secured to prevent winds from moving it into the wetlands. NEON, Inc. would obtain all required local, state, and federal permits regulating activities in wetlands prior to construction at this site and would comply with all permit conditions during construction activities (see Section 5.5 for a discussion of permits and approvals required).

### Common Vegetation and Plant Communities

#### *Affected Environment*

The Northern Plains Domain is home to approximately 1,600 species of plants. WFS and DCFS are located within the mixed-grass transition zone between the tall-grass species to the east and the short-grass prairie to the west. These stations are characterized by restored native prairie grassland uplands dominated by wetland basins (Lin and Otte, 2007). The natural prairie vegetation is dominated by western wheat grass, needle and thread grass, green needlegrass, and blue gramma (USFS, 2009a). The vegetation in the area of the proposed towers would range from 0.3 to 1.0 m tall (Starr and Kao, 2008a).

The NGPRL has been used as an experimental facility for over 100 years and currently conducts grassland research. It contains crop fields and grazed lands. The grazed lands include native prairie and hayfields. Relocatable Tower R-18 would be placed in grazed native prairie grassland (Philips, 2008, personal communication). The vegetation in this prairie grassland includes the dominant prairie grasses identified above and buffalo grass (USFS, 2009b).The vegetation in the area of the proposed towers is approximately 0.5 m tall (Philips, 2009, personal communication).

#### *Environmental Consequences*

There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

There would be no tree removal associated with extension of utility lines in Domain 9. All proposed NEON sites are in grassland habitats. Because of the need to keep overhead utility lines clear of woody vegetation, any encroachment of woody vegetation underneath extended transmission lines would be removed by hand, as necessary, until the end of the NEON project.

Minor clearing of vegetation would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate.

### Common Fauna

#### *Affected Environment*

The Northern Plains Domain is home to approximately 350 birds, 95 mammals, and more than 230 butterfly species (Lin and Otte, 2007). WFS and DCFS are located in the Prairie Pothole Region and the NGPRL is located within 6 km of the Missouri River. The proposed locations have many mammal, amphibian, and reptile species in common. Birds are common at each site, although bird habitats in the WFS and DCFS are different from those at the NGPRL.

Common mammals at the proposed locations may include white-tailed deer, mule deer, bobcat, white-tailed jackrabbit, white-tailed prairie dog, and black-tailed prairie dog. In addition, the pronghorn antelope could occur at the NGPRL (USFS, 2009a, 2009b). Less common mammals at the NGPRL locations could include the black-tailed jackrabbit and bighorn sheep (USFS, 2009a, 2009b).

Common amphibian species at the proposed locations could include the snapping turtle and spiny softshell turtle. In addition, the Great Plains toad could occur in the NGPRL area (USFS, 2009a, 2009b).

Common reptile species at the proposed locations could include the smooth green snake and the prairie rattlesnake (USFS, 2009a, 2009b).

WFS and DCFS are located in the Prairie Pothole Region. Wetlands in the domain are very important to nesting and migrating waterfowl. WFS is maintained as a waterfowl production area within the National Wildlife Refuge System (Lin and Otte, 2007). Common birds that inhabit prairie potholes could include gadwall, mallard, pintail, blue winged teal, other diving ducks, sandhill crane, northern harrier, Wilson's phalarope, Franklin's gull, and the marsh wren. Common birds that inhabit the prairie surrounding the potholes include Swainson's hawk, sharptailed grouse, upland sandpiper, horned lark, Sprague's pipit, lark bunting, chestnut collared longspur, Baird's sparrow, LeConte's sparrow, and the clay colored sparrow.

The NGPRL is located on the Missouri Plateau near the Missouri and Heart Rivers. In this area birds inhabit dry grassland and riparian areas. Common birds that inhabit this area could include ferruginous hawk, golden eagle, sharptailed grouse, gray partridge, mourning dove, black billed magpie, horned lark, western meadow lark, lark bunting, grasshopper sparrow, chestnut collared longspur, dabbling duck, eastern kingbird, bluejay, brown thrasher, yellow warbler, chimney swift, dickcissel, field sparrow, orchard oriole, eastern bluebird, western bluebird, and mountain bluebird.

#### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding is expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Towers and guy wires would pose a minimal risk to common birds and flying mammals. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the North Dakota Fish and Game Department prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

There would be a long-term loss of habitat at towers and IHs, though the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall, impacts to wildlife would be negligible.

AOP overflights at the NGPRL would not be distinguishable from routine air traffic at the Mandan Municipal Airport. No impacts to wildlife from AOP overflights would be expected at the proposed NGPRL site.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because the proposed WFS and DCFS sites are in open terrain with low vegetation, animals may startle at the approach of the plane and move a short distance. Any impacts would likely be negligible. The response would likely be greater for flights that are proposed at 150 m above the canopy.

Because impacts would be separated in space and time, no potential for interaction among proposed NEON projects and other projects would be expected.

### Sensitive Ecological Communities

#### *Affected Environment*

WFS and DCFS are located in the Prairie Pothole Region, which is characterized by depressional wetlands formed by glaciers scraping the landscape. Over 500 natural wetland basins occur on the WFS and DCFS. The WFS is maintained as a waterfowl production area within the National Wildlife Refuge System. These waterfowl production areas are of extreme importance and support globally significant populations of breeding waterfowl and other wetland dependent wildlife and are considered a sensitive ecological community (Lin and Otte, 2007). Though the DCFS property is not designated as a waterfowl production area, the habitat is very similar to the WFS habitat.

The North Dakota Natural Heritage Program identified two significant ecological communities (needle-and-thread/mixed grass prairie and bur oak upland woodland communities) approximately 5 km west of the proposed R-18 at the NGPRL in the Fort Abraham Lincoln State Park (FABLSP) by the Missouri River. However, there are no rare community types in the immediate vicinity of the proposed R-18 (North Dakota Parks and Recreation Department [NDPRD], 2008).

#### *Environmental Consequences*

Negligible temporary impacts to sensitive ecological communities at WFS and DCFS would result from disturbance to construct towers, fencing, and access trails. No impacts to sensitive ecological communities would occur at the NGPRL.

Sensitive waterfowl production habitat would be temporarily disturbed at WFS and DCFS. Construction, including access trails, would occur within the waterfowl production habitat. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for direct and indirect impacts to waterfowl habitat. The majority of WRS consists of waterfowl production habitat and temporary disturbance would be limited to less than 0.01 ha of this habitat at each proposed tower location. In addition, construction would be conducted outside the nesting and fledging period for waterfowl. Any impacts at WFS and DCFS would likely be negligible.

The proposed Relocatable Tower at the NGPRL would not be located in sensitive habitat. No impacts to sensitive habitats would occur at the NGPRL. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to nearby waters. No impacts to sensitive ecological communities would be expected at the NGPRL.

### Sensitive Species

#### *Affected Environment*

There are no state or federally protected species that are known to occur on the WFS, DCFS, or NGPRL near the proposed Core Site, Aquatic Arrays, or Relocatable Towers. WFS and DCFS are in the Prairie Pothole Region, which is an important waterfowl production area that supports globally significant populations of breeding waterfowl and other wetland-dependent wildlife. The majority of the bird species identified in the common fauna discussion are protected under the MBTA(USFWS, 2009).

### *Environmental Consequences*

Any impacts to sensitive species as a result of NEON implementation would likely be negligible. Limited disturbance would occur around proposed construction sites, but no population-level impacts would be expected and there would be no potential for cumulative impacts.

Proposed NEON construction activities would not be expected to impact sensitive aquatic or water-dependent species. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for indirect impacts to sensitive aquatic species from sedimentation as a result of stormwater runoff. Data collection at Aquatic Arrays also would not impact sensitive aquatic species.

NEON, Inc. would work with property site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where MBTA species are known to occur and would schedule construction to avoid times when migratory birds are nesting or rearing young. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly if required to avoid any such disturbance while retaining the scientific merit of the location.

All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat nearby during construction. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the North Dakota Fish and Game Department prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

## Cultural Resources

### *Affected Environment*

All but one of the proposed NEON locations for Domain 9 would be within the Woodworth Field Station (WFS) or the Dakota Coteau Field School (DCFS), which are on lands managed by the USFWS as a National Waterfowl Production Area (WPA). The WFS is an approximately 1,000 ha WPA dedicated to scientific research, habitat management, and waterfowl production. The WFS is located on the Missouri Coteau, a biogeographic region defined by irregular terrain created by dead-ice moraine left from glacial stagnation that followed the advances of late Wisconsin glaciers (USGS, 2009b). The land is dotted with wetlands formed in depressions, called potholes, closely spaced hills, and native prairie pastures. Relocatable Site R- is proposed 1.6 km west of the

Mandan Municipal Airport in Morton County, ND. This site would be on the Northern Great Plains Research Laboratory.

### Prehistoric Context

The Paleoindian period represents the earliest known occupation of the North American continent by hunters and gathers whose subsistence relied heavily upon now extinct big game animals. In North Dakota, this period begins at 9,500 before Christ (B.C.) and lasts until 5,500 B.C. and is defined by the presence of large lanceolate or stemmed projectile points belonging to the Clovis, Goshen, Folsom, Hell Gap-Agave Basin, Cody, Parallel Oblique Flaked, Pryor Stemmed, and Caribou Lake traditions (North Dakota State Historic Preservation Office [NDSHPO], 2003). Very little is known about the housing and lifeways of Paleoindians. The Plains Archaic period stretches from 5,500 B.C. to 400 B.C. and is divided into three periods: Early (5,500 B.C. – 2,500 B.C.); Middle (2,500 B.C. – 1,000 B.C.); and Late (1,000 B.C. – 400 B.C.). The spears and spear points of the Paleoindians are replaced with smaller points used to tip hunting spears propelled with an atlatl. The subsistence pattern basically reflects an adaptation to modern flora and fauna.

The end of the Archaic brought the introduction of mound burials and ceramic vessels, which are hallmarks of the Plains Woodland Tradition (400 B.C. – A.D. 1850). This tradition is divided into Early (400 B.C. – 100 B.C.), Middle (100 B.C. – A.D. 600), and Late (A.D. 600 – A.D. 1850) as defined by various cultural and technological changes. The atlatl is replaced by the bow and arrow at the beginning of the Late period. Throughout the Plains Woodland Tradition, there is an intensified use of native plants and grasses for food while the hunting and gathering subsistence strategy remains. Beginning as early as A.D. 1,000 the Plains Village period begins and lasts until 1850. This period is defined by the production of corn, while retaining the hunter-gatherer lifestyle. The easily stored corn made village life possible, with villages consisting of earthlodge structure. While European diseases wiped out many of the Plains Village populations around 1790, the introduction of the horse in the mid 18$^{th}$ century drastically changed the subsistence patterns, social organizations, demographics, and settlement patterns of the indigenous people.

### Historic Context

La Vérendrye was likely the first European to explore North Dakota in 1738. He noted the level of development reached by the Mandan horticultural society. Trade between the Native Americans and Europeans quickly followed due to the location of permanent villages along the Missouri River and the established trade network among the Native Americans. This gave them easy access to Hudson Bay and to the French and British traders. Much of North Dakota was included in the Louisiana Purchase in 1803, later becoming part of the Missouri Territory. Lewis and Clark spent the winter of 1804-1805 in a fort they built near present-day Washburn. The first permanent European settlement was Pembina, but was abandoned in 1823. The riverboats along the Missouri River caused the creation of ports of call at Bismarck and Fort Union in the middle of the 19$^{th}$ century. In 1861, the Dakota Territory was created, including both North and South Dakota. On November 2, 1889 North Dakota became a separate state.

### Archival Literature Search

To assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 9 within a defined study area that extended 1.6 km from each proposed location. A literature search was conducted at the NDSHPO. The files at the NDSHPO contain information on previous cultural resource inventories and known cultural resources in North Dakota and included a search of the NRHP.

None of the proposed NEON locations in Domain 9 have been previously surveyed for cultural resources, although previous studies have been conducted within 1.6 km of some of the proposed NEON locations. There are no known cultural resources within any of the proposed NEON locations, and no known cultural resources located within any of the 1.6-km study areas (Table 3.5.9.3-3).

**TABLE 3.5.9.3-3**
Literature Search Results– Domain 9, Northern Plains
*National Ecological Observatory Network (NEON) EA*

| | | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | | |
|---|---|---|---|---|---|---|---|
| **Neon Site Number** | **Previously Surveyed** | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | **Number Evaluated** | **Number Eligible** |
| C-25 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-26 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-27 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R-17 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R-18 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| A-23 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| A-24 | No | 0 | 0 | 0 | 0 | 0 | n/a |

Source: North Dakota State Historic Preservation Office

### *Environmental Consequences*

The literature review of proposed NEON locations in Domain 9 did not identify any significant known historic properties within the areas of disturbance for any of the proposed facilities. Because the towers would be only approximately 11 m in height, no adverse impacts to the viewshed of any known historic properties would be expected.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 9, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

### Utilities

#### *Affected Environment*

WFS has power line infrastructure and is supplied electricity through the local power grid. Water is supplied by a well onsite. Telecommunications service is provided by Dakota Central Telecommunications (Lin and Otte, 2007).

DCFS has power line infrastructure and is supplied electricity through the local power grid DCFS is an NDSU-affiliated field school and telecommunications service is provided through the state network (Lin and Otte, 2007).

The NGPRL has power line infrastructure and is supplied electricity through the local power grid.

#### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus with underground lines placed along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the access road where access for maintenance activities would be available. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2 would be implemented to minimize the potential for impacts. Should encroachment by woody vegetation occur, extended overhead lines would be kept clear of trees by hand clearing saplings, as necessary, for the duration of the NEON project at a location.

### Transportation

#### *Affected Environment*

WFS is most easily accessible by a gravel road leading from State Highway 36 at Woodworth, ND. The proposed Core Site towers (C-25, C-26, C-27) and A-23 would be located near the gravel road approximately 3.5 km east of Woodworth (Lin and Otte, 2007). WFS has an internal network of unimproved roads. These roads are accessible in summer conditions. Four-wheel drive vehicles would be required during winter conditions. The main gravel road from Hwy 36 is the only road plowed during winter and under extreme site conditions a snowmobile could be required for site access (Starr and Kao, 2008a).

DCFS is located 10 km east of WFS and is also accessible by dirt/gravel road leading from Hwy 36. DCFS has paved pathways. The proposed R-17 and A-24 would be located approximately 0.75 km south of Hwy 36 (Lin and Otte, 2007).

Access to the NGPRL is from Hwy 6 south of Mandan, ND. The proposed R-18 would be located approximately 1 km west of Hwy 6. The NGPRL has an internal network of unimproved roads. R-18 would be located alongside an access road.

### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and field roads. Materials would be transported by hand from the nearest road to the construction site. Unpaved roads could be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur.

Materials would be transported by hand from the road to the proposed NEON location. Improved trails would be created to move from the road to a proposed NEON location. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

## Human Health and Safety

### *Affected Environment*

The proposed Core Site towers (C-25, C-26, C-27), R-17, A-23 and A-24 would be located within WFS and DCFS property and access would be available to the public. R-18 would be located in an area within the NGPRL where agricultural research activities are ongoing and access is available to the public.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users and maintenance workers for the duration of NEON. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

Proposed site locations would have restricted public access. This would limit health and safety issues to the public. In addition, towers would be secured with fencing and locked gates to deter unauthorized access.

There would be potential for employees or researchers riding ATVs to strike guy wires during routine work or during NEON maintenance and data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

## Recreation

### *Affected Environment*

The WFS is open to the public for recreation activities including hunting, wildlife observation, wildlife photography, interpretation, and environmental education. Any other public uses must be compatible with the purposes of the Waterfowl Production Area. The DCFS will be open to public access within the bounds of the school's research and educational mandate (Lin and Otte, 2007).

The proposed R-18 site on the NGPRL, which is an agricultural research station, would have limited public access. The NGPRL is open to public access within the bounds of the research and educational objectives. The tower site is located approximately 5 km east of FABLSP. Recreational activities allowed in FABLSP include birding, biking, hiking, camping, horseback riding, picnicking, trolley rides, fishing, and historic and educational tours (NDPRD, 2009).

There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 9.

### *Environmental Consequences*

Minor short-term impacts to recreation could occur at some proposed NEON locations during construction. Long-term impacts on recreation would be negligible. Because NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would occur.

Construction activities could result in temporary use restrictions near proposed tower sites. Any impacts would be short–term and persons could conduct recreational activities in other parts of these properties. Any impacts would be negligible. To the extent practicable, NEON, Inc. would schedule construction to avoid peak recreational use times.

The presence of the tower and guy wires would be visible to recreational users at each of the proposed sites because of the lack of tall vegetation. Minor negative aesthetic impacts could occur at WFS and DCFS. No aesthetic impacts would be expected at the NGPRL due to the proximity to the Mandan Municipal Airport.

Towers would be secured with fencing and locked gates to deter unauthorized access. At proposed NEON locations where recreational vehicle activity could occur, guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

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**Figure 3.D09-1** Domain 9 Proposed Site Locations

**Figure 3.D09-2** Domain 9 Proposed Site Locations

**Figure 3.D09-3** Domain 9 Proposed Site Locations

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## 3.5.10 Domain 10 Central Plains

### 3.5.10.1 Introduction

Domain 10 is the Central Plains Domain, which is dominated by native shortgrass prairie habitat. Undisturbed drainages with adequate water in this domain typically support cottonwood riparian habitat. Shortgrass prairie habitat is a product of the continental climate, which is characterized by low precipitation, periodic water deficits, and large yearly and seasonal climatic fluctuations. Seventy percent of the annual precipitation in this domain comes from the Gulf of Mexico and falls during the warm season between April and September (Kelly et al., 2008).

The towers proposed for the Domain 10 Core Site (C-28, C-29, and C-30, Figure 3.D10-1) would be on Central Plains Experimental Range (CPER) near the Pawnee National Grasslands in northeastern Colorado on U.S. Department of Agriculture-Agriculture Research Service (USDA-ARS) land. The USDA-ARS CPER has operated an LTER site on this property since 1982. The proposed towers would be placed at elevations between 1,600 m and 1,650 m.

The proposed location of the Sterling Relocatable Site (R-19, Figure 2.10-2) is near the southeast corner of Logan County, Colorado at an elevation of approximately 1,400 m. The proposed Relocatable Site was converted to agricultural use from native shortgrass species in the past and is now tilled farmland that is considered prime farmland when irrigated.

Relocatable Site R-20 (Figure 3.D10-3) would be on a disjunct parcel that is part of Rocky Mountain National Park (RMNP) and owned by the NPS in Tahosa Valley. The property is surrounded by private land and is near the Roosevelt National Forest and the main part of RMNP. R-20 would be in an open meadow in Tahosa Valley at an elevation of approximately 2,743 m. Site R-20 would be approximately 1.2 km east northeast of Longs Peak Ranger Station and less than 0.5 km west of State Highway 7 (south of Lily Lake and the Twin Sisters Trailhead).

Aquatic Array A-25 would be located on Glacier Creek (Figure 3.D10-4) in RMNP at an elevation of approximately 2,665 m. Glacier Creek is a perennial stream that drains eastward from the Rocky Mountains and joins the Big Thompson River, which, in turn, flows into the South Platte River and through Domain 10.

### 3.5.10.2 Resource Areas Considered But Not Addressed for Domain 10

Preliminary analysis indicated that there would be no potential to significantly impact two of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Airspace: The proposed NEON sites in Domain 10 would be located in areas that have not been deemed restricted or special use airspace by the FAA (FAA, 2009). No impacts are anticipated with regard to restricted airspace.
- Recreation: The proposed NEON infrastructure locations are not routinely used for recreation, and installation and operation of NEON infrastructure at these locations would not impact nearby recreation. The Continental Divide NST passes within 10 km of the proposed Aquatic Array in RMNP (A-25), but the trail is over the crest

of the divide and the Aquatic Array would not impact the trail. There are no other NSTs or NHTs within 10 km of proposed NEON locations in Domain 10

- Environmental Justice: The proposed NEON sites would be located on federal land. All potential impacts would be confined to public lands. There would be no potential to disproportionately impact minority or low-income populations.

#### 3.5.10.3 Resource Areas Considered in Detail for Domain 10

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 10 where site-specific conditions would influence the anticipated environmental consequences.

### Geology/Seismicity

#### *Affected Environment*

The proposed NEON locations would be within the Colorado Piedmont, which encompasses most of northeastern Colorado**.** The Colorado Piedmont is underlain primarily by sedimentary rocks of Tertiary and Quaternary origin that have been overlain by wind-deposited sediments of Quaternary origin (Colorado Geological Survey, 2009a; 2009b; 2009c). The general relief of the proposed Core Site and proposed Relocatable Site R-19 is gently variable and largely controlled by weathering of the dominant bedrock in the region, which is predominantly of sedimentary origin.

Proposed Relocatable Site R-20 and proposed Aquatic Array A-25 would be in the Rocky Mountain region of Colorado, which borders Domain 10 on the west. This is an area of high topographic relief. The Rocky Mountain region comprises a complex assortment of igneous, metamorphic, and sedimentary rock formations in fairly equal proportions. Both proposed NEON sites would be in areas occupied by valley glaciers approximately 15,000 years ago.

Domain 10 is relatively stable from the standpoint of seismic risk. Across the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 2 % pga to 6 % pga for short wave motion and 8 % pga to 16 % pga for long wave motion (USGS, 2009a, 2009b). The higher ranges occur near the western edge of the domain in the area of the proposed locations of Relocatable Site R-20 and Aquatic Array A-25.

#### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact the underlying geology. The seismic hazard is low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

## Soils

### *Affected Environment*

Soils across the expanse of Domain 10 are dominated by the Mollisols, which are typical for grasslands worldwide. Other soil suborders in Domain 10 range from aridic Ustolls to more mesic typic Ustolls. Soil orders include the Aridisols in the southern part of the domain and areas of Entisols in more mesic areas and along drainages. The array of soils at the CPER site reflects the diversity in soil landscape relationships across the domain, including Olney fine sandy loam, Renohill fine sandy loam, and Renohill-Shingle fine sandy loam and clay loam. Areas of sandy soils frequently occur along dry creek beds, in stream terraces, and in patches near the top of slopes and hills.

Soils at the Relocatable Site R-19 belong to the loamy plains ecological soil group. The soil on this site is described as Rago loam, which is well-drained, extending more than 200 cm to the restrictive layer.

### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

At each of the proposed NEON locations in Domain 10, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would be approximately 0.11 ha at C-28, 0.34 ha at C-29, and 0.14 ha at C-30. Soil disturbance would be less than 0.04 ha at R-19 and less than 0.02 ha at R-12. Soil disturbance at A-25 would be less than 0.08 ha. There would be potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. Most soils that would be disturbed during construction are prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

## Climate

### *Affected Environment*

The climate within Domain 10 is characterized by low precipitation, periodic water deficits, and large interannual and interseasonal climatic fluctuations. The absence of climatological barriers to the north and south also permits large variations in temperature to occur within a season, as the prevailing wind shifts. The within-season changes are more pronounced during the winter, due to southern movements of arctic air masses. Pacific Ocean air reaches this region with little moisture due to the rain-shadow effect of the Rocky Mountains. Most precipitation is derived from the Gulf of Mexico and falls between April and September. Water deficits are common in mid-summer or later, but vary substantially across the domain.

The proposed Core Site for Domain 10 would be in an area at the drier end of the precipitation gradient and the cooler end of the temperature gradient within the domain. The cooler temperatures at CPER result in precipitation to evaporation/ transpiration ratios similar to those across the domain even though the precipitation typically is less than in much of the domain (Kelly et al., 2008). Growing season precipitation is highly variable from year to year, with much of the variation attributable to variability in the largest rainfall events (Kelly et al., 2008).

In RMNP, and the surrounding mountainous area, temperatures are often moderate at elevations below 2,865 m. At higher elevations, snow is not uncommon in July. There is a wide variation between day and night temperatures as a result of the elevation, with the difference between high and low temperatures often exceeding 20 °C. The area around Estes Park receives approximately 33.3 cm of precipitation every year, which comes as rain or snowfall throughout the year. Lower elevations east of the continental divide usually do not accumulate deep snow (RMNP, 2009).

Annual precipitation at the proposed location of Relocatable Site R-19 is 36 to 40 cm, and mean air temperature is 8˚C to 9˚C.

#### *Environmental Consequences*

Implementation of the NEON project would not impact the regional climate. There would be no potential for interaction with other projects and no cumulative impacts to climate would result.

Due to the potential for extreme wind conditions, including tornadoes, towers would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile. Site design would incorporate appropriate grounding and power filtering to protect instrumentation from lightning-caused electrical surges.

### Air Quality

#### *Affected Environment*

The Core Site (C-28, C-29, and C-30) and Relocatable Site R-19 would be in areas that are designated as in attainment for all criteria air pollutants. The southern portion of Weld County, in which the proposed Core Site is located, is designated as non-attainment for ozone due to emissions associated with industry and traffic in the Fort Collins-Greeley area. The proposed Core Site is approximately 10 km north of the part of the county designated as nonattainment (FHWA, 2009). Relocatable Site R-19-would be in Logan County, approximately 32 km east of the designated nonattainment area for the Fort Collins-Greeley area.

R-20 and A-25 would be in Larimer County, which is designated as nonattainment for ozone. In addition, this area is addressed through the Colorado Visibility and Regional Haze State Implementation Plan for the Twelve Mandatory Class I Federal Areas in Colorado (Colorado Department of Public Health and Environment Air Pollution Control Division, 2007).

### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts on air quality at each location. The construction area would be less than 0.01 ha and no large land clearing equipment would be used. Fugitive dust would increase in the immediate area during construction, but impacts would be temporary and negligible. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to reduce or eliminate fugitive dust emissions.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The proposed NEON projects would not contribute to regional haze and would not impact visibility in RMNP.

The Salvation Army Camp High Peak is adjacent to the proposed R-20 site. NEON construction could coincide with a heavy use period at Camp High Peak and future NEON sampling events also could coincide with periods of heavy use at the camp. In addition, the NPS is planning recreational improvements at the Longs Peak trailhead and at the Lily Lake area. Improved parking areas would be constructed at each location, with an anticipated 250 parking spaces at the Longs Peak trailhead and 80 parking spaces at Lily Lake. The timeframe for constructing these improvements is not certain, but they could be built during the projected 10-year operation of proposed Relocatable Site R-20. The potential for interaction among NEON-related traffic and traffic using Camp High Peak or recreational traffic heading toward or from the two proposed NPS parking areas could result in increased congestion and vehicle emissions along Highway 7. NEON, Inc. would time construction to avoid periods of heavy use at Camp High Peak. Recreational traffic to the proposed NPS parking areas would be dispersed and unlikely to cause traffic delays that would result in increased emissions from slowed or stopped vehicles. Any cumulative impacts to air quality from these events would likely be minor.

### Noise

#### *Affected Environment*

The noise environment at the Core Site is typical of that for undeveloped rural settings and would likely be approximately 40 dBA (USEPA, 1974). Relocatable Site R-19 would be expected to have a slightly higher ambient noise level during the day due to traffic on two county roads near the proposed location. The areas proposed for R-20 and A-25, in and around RMNP, are typical of undeveloped rural settings, with the proposed R-20 location having slightly higher daytime noise levels due to proximity to the public road leading from Golden to Estes Park.

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would cause no impacts to residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand with as little impact as possible. No new roads would be constructed. During construction, noise levels would be elevated periodically only during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure.

There are no residences near the proposed Core Site or the proposed location for Relocatable Site R-19 and no sensitive noise receptors are present at or near these proposed NEON locations. There would be no noise impacts to persons at these locations.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to temporarily relocate from the construction area, but would likely resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

The pumps for atmospheric sampling equipment on an FIU would operate continuously. Typically, these pumps produce noise of approximately 65 dBA. NEON, Inc. would place the pumps within noise shielding to reduce the sound to less than

60 dBA at 12 m. There are no residences or campgrounds near proposed NEON tower locations. Therefore, the noise from pumps would not affect any human receptors.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increase throughout the duration of NEON activities (30 years at the Core Site and up to 5 years at Relocatable Sites).

AOP overflights would not impact persons near any of the proposed NEON locations except at the proposed location for R-20. There are residences near the disjunct NPS property where R-20 would be placed. At this location, AOP overflights may be a short-term nuisance to residents, but any impacts would be minor. NEON, Inc. would coordinate AOP overflights at R-20 with RMNP and comply with all NPS policies and regulations on aircraft overflights. The potential for overflights to impact wildlife is discussed below.

### Water Quality

#### *Affected Environment*

Surface waters near proposed Core Site tower locations include intermittent channels of Cow Creek, Little Owl Creek, and Owl Creek. These creeks convey runoff in response to storm events or heavy snowmelts. All three streams meet their designated uses and none is listed by the State of Colorado as TMDL-limited on the CWA Section 303(d) list of impaired waters. Ponds on the Core Site are isolated stock ponds that do not connect to other water features.

Relocatable Site R-20 is near a series of small high mountain glacial lakes, as well as the headwaters of Alpine Brook and Tahosa Creek (Table 3.5.10.3-1). Due to the high elevation of Relocatable Site R-20, upstream processes that are typically associated with reduced water quality are nearly non-existent. All of the water bodies near Relocatable Site R-20 exhibit high water quality and meet designated uses as identified by the State of Colorado. Similar conditions exist at Glacier Creek, the location for Aquatic Array A-25, which also meets its designated uses and is representative of a high quality mountain stream.

Relocatable Site R-19 would be in tilled farmland in open plains. There are no streams in the immediate area, but surface flow drains into an ephemeral channel.

**TABLE 3.5.10.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 10, Central Plains United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-28 | 31 | 0 | 13 | 0 | ND | ND |
| C-29 | 20 | 0 | 4 | 0 | ND | ND |
| C-30 | 37 | 1 | 6 | 0 | ND | ND |
| R-19 | 4 | 1 | 0 | 0 | ND | ND |
| R-20 | 5 | 0 | 0 | 0 | ND | ND |
| A-25 | 23 | 1 | 29 | 0 | ND | ND |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009c.

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

## Wetlands

### *Affected Environment*

No wetlands are known to occur near the proposed NEON locations within the Core Site and there are no areas known to contain hydric soils near the proposed NEON locations. Emergent wetlands may occur downslope of proposed NEON sites associated with intermittent water channels. Ponds on the Core Site are isolated stock ponds that may contain wetland vegetation, but do not connect with other water features.

No wetlands occur at the proposed Aquatic Array location on Glacier Creek. There are wetlands upstream of the proposed Aquatic Array location and wetlands could occur in the riparian areas downstream of the proposed NEON location.

No wetlands occur at or near the proposed location for Relocatable Site R-19.

No wetlands occur at or adjacent to the proposed location of Relocatable Tower R-20. Wetlands could occur in the area around this proposed tower location, along streams, and adjacent to glacial lakes.

#### *Environmental Consequences*

No wetland impacts would occur at proposed NEON sites in Domain 10. There would be no interaction with other projects. Therefore, no cumulative impacts to wetlands would occur.

Because all work would be confined to uplands, no direct impacts to wetlands would occur at proposed NEON sites in Domain 10.

NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for indirect impacts to offsite wetlands as a result of erosion and sedimentation from the construction sites. No indirect impacts to offsite wetlands would be expected.

### Floodplains

#### *Affected Environment*

The proposed NEON locations in Domain 10 would be in undeveloped areas and FEMA has not designated floodplains or flood prone areas at these locations.

Intermittent streams and channels within the Core Site may carry high runoff volume during high precipitation events. Because of the nearly level topography, any flood events would be expected to have low velocities and little destructive force. Flood waters would be expected to pond and slowly drain to the South Platte River.

The location of the Aquatic Array at Glacier Creek would be expected to flood during peak snowmelt and possibly in response to large spring or summer thunderstorms.

There are no waters near the proposed location of Relocatable Site R-19. No flooding is anticipated at this location.

The high elevation of proposed Relocatable Site R-20 limits the potential for flooding, even during heavy precipitation, snowmelt, or rain-on-snow events Adjacent headwater streams and glaciated lakes near R-20 would likely transfer any excessive surface runoff and flow downslope of the proposed R-20 site.

#### *Environmental Consequences*

There would be negligible direct impacts to flood prone areas as a result of implementation of NEON. The Aquatic Array (A-25) would be placed in areas prone to flooding. The minimal displacement of the proposed equipment would result in a negligible impact on flood storage, flood elevations, and flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected.

The NEON infrastructure proposed for the Core Site would be placed outside of any area prone to flooding. No floodplain impacts would result at the Domain 10 Core Site.

The Aquatic Array would be placed within the floodplain of Glacier Creek. The sampling equipment would be small and would not be expected to increase flood elevations. Any change in flood storage capacity or flood conveyance from this array also would be negligible.

There is the potential for equipment to be damaged during flood events on Glacier Creek. NEON, Inc. would design and secure this equipment to minimize the potential for flood damage. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts on existing water quality if they were to be lost in streams. There are no environmentally harmful components associated with this monitoring equipment. NEON, Inc. would temporarily remove equipment from flood prone areas when flooding is forecast for the area.

The NEON infrastructure proposed for Relocatable Sites R-19 and R-20 would be outside of any area prone to flooding. No impacts to floodplains or flood prone areas would occur and there would be no impact to NEON infrastructure from flooding at either location.

### Common Vegetation and Plant Communities

#### *Affected Environment*

The Core Site is located within a 6,798-ha shortgrass prairie steppe habitat dominated by blue gramma, which lies within the Colorado Piedmont section of the Great Plains. As is typical of the Pawnee National Grasslands as a whole, the proposed Core Site is dominated by open prairie steppe species. The dominant species are blue gramma, and, to a lesser extent, buffalo grass. Other characteristic plant species of open steppe habitat are threeawn, fringed sage, gray rabbitbrush, snakeweed, ring muhly, prickly pear cactus, western wheatgrass, scurf pea, and scarlet globemallow (Hazlett, 1998).

Sandy areas typically support sand sage, small soapweed, and western sagewort (Hazlett, 1998).

The Aquatic Array (A-25) on Glacier Creek would be in an area of riparian vegetation with trees. Common vegetation types occurring at the proposed A-25 location include sedges, quaking aspen, and lodgepole pine.

Relocatable Site R-20 includes subalpine forest, riparian forest and wetlands, and tundra (GES, 2003b) with abundant variations depending upon slope and aspect. Natural runoff tends to be low to medium in general, with a low probability of landslides, debris flows, or avalanches except where steep slopes and unstable geology suggest increased landslide potential. The most sensitive habitats are riparian areas and tundra, where management and restoration are particularly challenging. Major uses are recreation and wildlife habitat, including important summer range for big game, hiking, recreation, and watershed (USFS, 1996, USFS, 1997).

Relocatable Site R-19 would be placed in tilled farmland and no native vegetation would occur at this location.

#### *Environmental Consequences*

Tree removal along utility lines would be a minor long-term impact to vegetation and plant communities. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation (less than 0.1 ha) would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate. There would be potential for noxious weed invasion on disturbed soils. However, NEON, Inc. would implement USFS-approved BMPs and vegetation establishment procedures to minimize this potential.

The only trees within proposed areas of disturbance would occur in the riparian area near the proposed Aquatic Array. To avoid removing trees, which would alter the stream environment, NEON, Inc. would use trenched or surface conduit to extend utility lines to the proposed Aquatic Array site.

### Common Fauna

#### *Affected Environment*

Because of the scarcity of suitable cover and food in most upland areas, the patchy areas of shrub vegetation associated with low-lying areas, ridge-tops, and sandy soils are often centers of activity and abundance for many mammals. Pronghorn are among the most common wildlife species seen on shortgrass steppe. Common bird species of prairie steppe habitat include horned larks and western meadowlarks.

Common wildlife species that may use habitat types occurring at the Relocatable Site R-20 and Aquatic Array A-25 are diverse and abundant. Black bear, coyote, mountain lion, bobcat, elk, moose, mule deer, and beaver are all common to habitats found in the area. Yellow-bellied marmot, golden-mantled ground squirrel, Wyoming ground squirrel, Colorado chipmunk, and chickaree, in addition to various hummingbirds, raptors and songbirds, are also abundant and active in such habitats.

Aquatic resources in and around the proposed Relocatable Site R-20 for Domain 10 and the Glacier Creek Aquatic Array include cold water biota such as salmonid fishes and macroinvertebrate assemblages. Because natural conditions in these high elevation environments can be harsh and widely variable both seasonally and annually, populations of aquatic fauna would likely be low and fluctuate with natural conditions (Ellis, 1914).

Relocatable Site 19 would be in tilled farmland and any wildlife use of this area would be incidental.

#### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed Core and Aquatic Arrays have adequate habitat surrounding the proposed locations, which could accommodate wildlife temporarily displaced during construction.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

There would be a long-term loss of habitat at towers and IHs, but the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall, impacts to common wildlife species would likely be negligible.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Colorado Division of Wildlife prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

Wildlife react to fixed-wing aircraft overflights in response to visual and auditory stimuli, with the type and magnitude of response varying among species and with the specific conditions of the overflight (Ward, 1984). Due to the lack of canopy cover, wildlife may startle at the noise of the plane and a flight response could occur. The response would likely be greater for flights that are proposed at 150 m. Because the flights would occur only once per year, any impact would be considered minor and no population-level impacts would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

### Sensitive Ecological Communities

#### *Affected Environment*

Elevation gradients in the vicinity of the proposed Relocatable Site R-20 and proposed Aquatic Array A-25 contribute to high habitat diversity. Habitat integrity is generally high except along roadways and trails. Sensitive ecological communities near the proposed Relocatable Site R-20 and Aquatic Array A-25 are defined as USFS Management Indicator Communities for the nearby Roosevelt National Forest (USFS, 2004) and include:

- Interior Forest, mostly spruce-fir forest

- Young to Mature Forest Structural Stages, including spruce-fir and lodgepole pine forest
- Openings within or adjacent to Forest, including mostly tundra but also grassland
- Riparian Areas and Wetlands
- Montane Aquatic Environments, including creeks and lakes
- Existing and Potential Old Growth Spruce-Fir Forest

No other proposed NEON locations in Domain 10 are in or adjacent to sensitive ecological communities. The Core Site is in the Pawnee National Grasslands, but the towers would be located on land leased to the ARS by the Pawnee National Grasslands for research and away from any sensitive communities. Relocatable Site R-19 would be in farmland.

#### *Environmental Consequences*

There would be no direct impacts to sensitive habitats in Domain 10 as a result of NEON. Any indirect impacts would be negligible. Neither R-20 or A-25 would be located on National Forest Land. There would be no direct impacts to the sensitive communities identified within 1.6 km of the proposed locations as a result of NEON construction or operation. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for indirect impacts to offsite sensitive communities. Any impacts would likely be negligible.

### Sensitive Species

#### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 10 (Table 3.5.10.3-2). However, there are known occurrences of species protected under ESA and state and USFS protected species within 5 km of all the proposed NEON locations, excluding proposed Relocatable Site (R-19). In addition, potentially suitable habitat for protected species is present at or adjacent to all of the proposed NEON locations, excluding Relocatable Site (R-19) (Table 3.5.10.3-2).

This discussion addresses federal and state listed species identified by the Colorado Division of Wildlife and any species on Pawnee National Grasslands identified by USFS as sensitive. No NPS species of concern that are not also included in the above categories are known to occur near proposed NEON infrastructure in or near RMNP.

### Federally Protected Species

Two federally threatened plant species (Colorado butterfly plant and Ute ladies-tressess) are known to occur in RMNP near the proposed locations of Aquatic Array 25 and Relocatable Site 20 (Table 3.5.10.3-2), but protocol surveys have not been conducted at the proposed NEON locations. Potentially suitable habitat exists for both species at or adjacent to the proposed NEON locations.

**TABLE 3.5.10.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 10, Central Plains
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-28 | 2-ESA<br>13-USFS | 0 | 2-ESA<br>13-USFS | 0 | 0 | 0 |
| C-29 | 2-ESA<br>13-USFS | 0 | 2-ESA<br>13-USFS | 0 | 0 | 0 |
| C-30 | 2-ESA<br>13-USFS | 0 | 2-ESA<br>13-USFS | 0 | 0 | 0 |
| R-19 | 0 | 0 | 0 | 0 | 0 | 0 |
| R-20 | 2-ESA | 0 | 2-ESA | 1 | 0 | 0 |
| A-25 | 1-ESA<br>5-USFS | 0 | 0-ESA<br>1-USFS | 1 | 0 | 1 |

Source: Appendix B Domain 10

Colorado butterfly plant is a biennial member of the evening primrose family. It is a wetland species typically found in low depressions or along bends in meandering stream systems, where it may occur a short distance from the stream channel at the base of low alluvial ridges on the interface between wet meadows and uplands (Fertig, 2000). Potentially suitable habitat for this species occurs near the proposed project areas for Aquatic Array Site 25 and Relocatable Site R-20.

Ute ladies-tressess is a perennial member of the orchid family. This is a wetland species that occurs along stream corridors, wet meadows, and other wetland habitats (Fertig et al., 2005). Potentially suitable habitat for this species occurs near the proposed project areas for Aquatic Array Site 25 and Relocatable Site R-20.

The black-tailed prairie dog was proposed for listing under the ESA by the USFWS on December 2, 2008 (FR, 2008). Black-tailed prairie dog burrows provide habitat for other species, including the USFS sensitive western burrowing owl, which also occurs in the area. Black-tailed prairie dogs are a food source for multiple predatory species, including several protected species that are known to occur at or adjacent to the proposed Core Site: mountain plover, swift fox, and ferruginous hawk (FR, 2008).

The mountain plover is a candidate species for listing under the ESA. The species nests in shortgrass prairie and is most common in areas with prairie dog colonies. The Pawnee National Grasslands has one of the largest remaining nesting populations of this species and the mountain plover has been observed in the vicinity of the proposed Core Site (Keller, 2008).

The yellow-billed cuckoo is a candidate species for listing under the ESA. This species has been observed nesting on Cow Creek, but not within the proposed Core Site. The portion of Cow Creek that crosses the proposed Core Site lacks riparian cottonwood and willow nesting habitat required by this species.

No additional state protected species occur in the area other than those described in the discussion of federally protected species.

### USFS Protected Species

USFS sensitive species that forage and nest or den in shortgrass prairie habitat and that are known to occur in the general area of the proposed Core Site include the swift fox and western burrowing owl (Keller, 2008). In eastern Colorado, the western burrowing owl typically nests in black-tailed prairie dog burrows. Swift fox occur throughout the prairie and the prairie dog is a primary prey species (Colorado Division of Wildlife, 2009).

Shortgrass prairie habitat is used for nesting by several other USFS designated sensitive species, including long-billed curlews, short-eared owls, McCown's longspur, and chestnut-collared longspur (Colorado Division of Wildlife, 2009). These species are known to occur in Weld County and potentially suitable nesting habitat is present at the Core Site.

The sage sparrow nests in sagebrush but uses shortgrass prairie habitat in winter and during migration (Colorado Division of Wildlife, 2009). Many raptor species forage over shortgrass prairie, including peregrine falcon and ferruginous hawk. Ferruginous hawks forage over grasslands and forage heavily in prairie dog towns (Colorado Division of Wildlife, 2009). Cassin's sparrow occurs in shortgrass prairie in areas with scattered brush, especially those with sand sage and rabbitbrush (Colorado Division of Wildlife, 2009). These species could occur at the proposed Core Site tower locations.

The lark bunting (the state bird of Colorado) is designated a USFS Management Indicator Species. It nests in grazed shortgrass prairie and could occur near the proposed Core Site. The lark bunting is known to occur on the Pawnee National Grasslands (Neudorf et al., 2006).

### *Environmental Consequences*

Minor short-term and long-term impacts to sensitive species could result from installation of NEON infrastructure. No cumulative impacts to sensitive species would be expected.

NEON, Inc. would work with property owners and site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity, and infrastructure locations would be adjusted slightly to avoid direct impacts while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species with potential to occur near that site. If surveys indicate that an impact would be likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or schedule construction to avoid sensitive life history stages.

Where there is the potential for construction to disturb sensitive species during periods when the species would be reluctant to relocate, such as nesting, construction would be scheduled for non-sensitive periods. All proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction would relocate a short distance to suitable habitat if the activity were not implemented during a critical or sensitive time. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Burrows within 10 m of proposed NEON locations in prairie habitat would be investigated for the presence of black-tailed prairie dog prior to construction. If a burrow is determined to be inactive, construction would proceed. If a burrow is active and it is not possible to shift the construction site to avoid the active burrow, NEON, Inc. would confer with the USFWS on the proper protocol prior to proceeding. Exclusion fencing would be placed around the construction area to prevent accidental entry of sensitive terrestrial wildlife into the work area.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Colorado Division of Wildlife prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

MBTA-listed birds would have the potential to be disturbed during construction and operation. Should nesting bird species protected by the MBTA occur in or adjacent to an area that would be cleared or be subject to a high level of human activity during construction, work would be delayed until after the young have fledged if the site could not be relocated.

With implementation of the measures specified above, impacts to sensitive species on the Core Site would likely be negligible.

### Cultural Resources

#### *Affected Environment*

The proposed NEON locations for Domain 10 are within three separate portions of the northern Colorado plains: near the town of Sterling, within the CPER, and within RMNP.

### Prehistoric Context

The Prehistory of Colorado is divided into four phases based largely on noticeable changes in technology and subsistence strategies through time (OAHP, 2008). The earliest phase is the Paleoindian Period, dating from 10,000 B.C. to 5,500 B.C. This period is dominated by big game hunters seeking largely extinct megafauna with distinctive spear tips of the Clovis, Folsom, and Plano traditions. Changing environmental conditions led to the Archaic Period (5,500 B.C. to A.D. 200), which is defined by a broadening subsistence strategy to include smaller game hunting and more plant and seed processing. The dart points become smaller and the basic toolkits become more diverse and include groundstone, fire pits, storage cists, and architectural features. The Late Prehistoric Period (A.D. 200 to 1600) represents a continuation of the Archaic subsistence pattern, but with the addition of the bow and arrow, ceramics, and the beginnings of limited horticulture. The introduction of the horse and the gun by Europeans greatly changed the cultures and ways of life.

#### Historic Context

Early Spanish explorers traversed sections of Colorado as early as 1541. However, Colorado remained largely unpopulated until well into the 19th Century, due in part to Native Americans, who had by then become mounted and armed (OAHP, 2008). The Arapaho and Cheyenne were eventually moved to reservations in Oklahoma. The discovery of gold in the eastern Rocky Mountains led to the establishment of Boulder in 1858. Gold also brought prospectors who needed supplies and railroads to move the ore to market. Much of the history of the front range is directly linked to gold mining and railroad development. The railroads sprang up and quickly connected many of the towns.

#### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 10, including a 1.6-km radius study area around the proposed location. A literature search of the Colorado Office of Archaeology and Historic Preservation (OAHP) was performed on December 2, 2008. The files at the OAHP contain information on surveyed cultural resources in the State of Colorado. The search included the NRHP.

None of the proposed NEON locations in Domain 10 for which information is currently available have been previously surveyed for cultural resources, although one linear survey was conducted in proximity to the proposed Core Site Tower C-30 location. This survey recorded several sites within its study area.

Resources previously documented within the vicinity of the proposed NEON locations for which information is available include lithic scatters, a homestead, a stone quarry, and isolated prehistoric finds (Table 3.5.10.3-3). The literature review documented multiple previously recorded sites within the 1.6-km study area of several of the project components. However, none of the sites are listed or have been recommended as eligible for the NRHP or any other state or local register.

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 10 did not identify any significant known historic properties within the areas of proposed disturbance for any of the proposed facilities.

**TABLE 3.5.10.3-3**
Literature Search Results—Domain 10, Central Plains
*National Ecological Observatory Network (NEON) EA*

| | | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | | |
|---|---|---|---|---|---|---|---|
| NEON Site Number | Previously Surveyed | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Number Evaluated | Number Eligible |
| C-28 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-29 | No | 0 | 1 | 0 | 0 | 0 | n/a |
| C-30 | No | 0 | 7 | 0 | 0 | 0 | n/a |
| R-19 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R-20 | Yes | 0 | 12 | 0 | 41 | 23 | 11 |
| A-25 | Yes | 0 | 8 | 0 | 26 | 20 | 4 |

Source: Colorado Office of Archaeology and Historic Preservation (OAHP), National Register Information System (NRIS). n/a = not applicable

Of the 8 historic properties that have been documented within the 1.6-km study areas of C-30 and C-29, none have been previously recommended as eligible for the NRHP and all fall outside of the proposed area of disturbance. The proposed towers would not be visible from any of the 8 historic properties.

There are 11 historic-age resources within the 1.6-km study area of R-20 that have been determined to be eligible for the NRHP. These resources are primarily associated with nearby ranger stations on NPS or USFS lands. All are well outside the area of direct impact of R-20 and no impacts to these resources would be expected.

There are 4 historic-age resources within the 1.6-km study area of A-25 that have been determined to be eligible for the NRHP. These resources are associated with the visitor center and nearby ranger stations. All are well outside the area of direct impact of A-25 and no impacts to these resources would be expected.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 10, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

## Utilities

### *Affected Environment*

The CPER station receives power and telecommunications via overhead power lines with availability of electrical hook-ups at the centrally located field office.

Utility hook-ups for the Relocatable and Aquatic Array sites would require less than 0.5 km of underground line from existing infrastructure.

### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the access road where access for maintenance activities would be available. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for impacts. Extended overhead lines would be kept clear of trees by hand clearing saplings, as necessary, for the duration of the NEON project at a location. Utility lines for the Aquatic Array in RMNP would be either buried or placed in surface conduits that would likely be unnoticed by visitors. An archeological survey would be completed prior to extending electrical power in RMNP.

## Transportation

### *Affected Environment*

Gravel roads to the CPER Headquarters through the Pawnee National Grasslands are maintained by Weld County (Keller, 2008). Some of these may close for a day or two during snowfall events. There are several two-track roads which are suitable for ATVs in the Core Site. Access is open to the public at the proposed Core Site, Aquatic Array, and Relocatable Site R-20. Proposed Relocatable Site R-20 is on Roosevelt National Forest land and accessible from SH-7, which is approximately 0.3 km from the site. Aquatic Array A-25 is less than 0.2 km from Bear Lake Road.

### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

The Pawnee National Grasslands and the USDA-ARS CPER Headquarters and associated leased land have an extensive network of roads and the proposed locations are within a short distance of field roads. No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and transported by hand from that point to the construction site. Existing trails would be utilized at RMNP. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur.

The Salvation Army Camp High Peak is adjacent to the proposed R-20 site. NEON construction could coincide with a heavy use period at Camp High Peak and future NEON sampling events also could coincide with periods of heavy use at the camp. In addition, the NPS is planning recreational improvements at the Longs Peak trailhead and at the Lily Lake area that could be implemented during the projected 10-year operation of proposed Relocatable Site R-20. The potential for interaction among NEON-related traffic and traffic using Camp High Peak or recreational traffic heading toward or from the two proposed NPS parking areas could result in increased congestion along Highway 7. NEON, Inc. would time construction to avoid periods of heavy use at Camp High Peak. Recreational traffic to the proposed NPS parking areas would be dispersed and unlikely to cause traffic delays that would result in increased emissions from slowed or stopped vehicles. Any cumulative impacts to traffic from these events would likely be minor.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

### Human Health and Safety

#### *Affected Environment*

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

There would be no routine public contact with proposed NEON structures in Domain 10. While there is public access near the proposed Core Site, typical recreational activities would not bring people in contract with NEON infrastructure. The proposed

Relocatable Site is within private property with restricted public access. Towers would be fenced and locked to deter unauthorized access.

There would be potential for staff, researchers, or recreational users riding ATVs to contact tower guy wires when in the vicinity. Guy wires would be clearly marked and flagged to reduce the potential for accidental contact and injury. Any impacts to site users would likely be negligible.

### Protection of Children

#### *Affected Environment*

The proposed NEON Core Site would be on public land with restricted public access. Relocatable Site R-19 would be on private land with restricted public access. Children would not have access to these sites and no environmental health or safety risks to children would be created at the Core Site or R-19.

Aquatic Array A-25 would be in RMNP in an area not regularly visited by guests. Additionally, the Aquatic Array would be secured and would not create any potential environmental or health risk for children in RMNP.

Relocatable Site R-20 would be near the Salvation Army camp in Tahosa Valley, and could be subject to unsupervised visits by children.

#### *Environmental Consequences*

No impacts to the environmental health and safety of children would be expected. Because the NEON locations would be spatially separated, no cumulative impacts on the health and safety of children would be likely.

Only the proposed Tahosa Valley location (R-20) would have the potential for risk to children. Potential safety issues for children relate to the temptation to try to climb the tower at Tahosa Valley at this location. Access to the tower would be restricted with secure fencing. As a result, no pathway would exist for direct exposure to an environmental health or safety risk. No impacts to the environmental health and safety of children would be expected.

### Aesthetics and Visual Resources

The Core Site at CPER and R-19 would be in areas that are not visited for their aesthetic and scenic values. Scenic value is very high in RMNP, which offers visitors many scenic views and views of wildlife. A-25 would be within RMNP near a developed area (parking lots, buildings, trailhead, etc.) west of Sprague Lake. R-20 would be situated between two southern extensions of the park and would be visible from some locations within the main part of RMNP and from surrounding properties which are occupied by single family residences, camps, and lodges.

#### *Environmental Consequences*

A-25 would not contain any infrastructure that would detract from aesthetic and visual resources of the portion of RMNP west of Sprague Lake. Any visible infrastructure would use materials to reduce visual impacts. Operation of the Aquatic Array would not result in any sound or light (night sky) impacts. Any impacts to aesthetic and visual resources would be minor.

The R-20 tower would be near other human infrastructure located along SH -7 in Tahosa Valley and would not greatly alter the visual quality of the general area. The tower would be visible to varying degrees from much of the surrounding area (Figure 3.D10-5). However, most homes in the area are approximately 60 to 75 m above the proposed tower location and would be above the top of the tower by approximately 40 to 55 m. When looking at the peaks that dominate the viewshed, Long's Peak to the west and Twin Sisters to the east, the tower would not extend into the view but would be part of the floor of the view, along with the nearby Salvation Army camp and conference center. There are trees around much of the proposed tower location that would provide visual screening to homes at lower elevations, and the exterior of the infrastructure would feature non-reflective materials and paint to further reduce visual impacts. There would be no night-time lighting at the tower and no change from the current night visual environment. Because the change in the viewshed would be minimal, any direct impacts to aesthetic and visual resources would be minor.

At present, there is a mountain pine beetle (*Dendroctonus ponderosae*) outbreak in and around RMNP. Should this outbreak extend to the proposed R-20 location, any trees that provide visual screening of the tower would likely be killed, making the tower more visible. However, the negative visual impact of the dead trees from a mountain pine beetle outbreak would be a far greater impact to the visual quality of the area than the single tower (Appendix C, page 2). Any cumulative contribution to decreased visual quality from the proposed NEON infrastructure would be minor.

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**Figure 3.D10-1** Domain 10 Proposed Site Locations

**Figure 3.D10-2** Domain 10 Proposed Site Locations

**Figure 3.D10-3** Domain 10 Proposed Site Locations

**Figure 3.D10-4** Domain 10 Proposed Site Locations

**Figure 3.D10-5** Domain 10 Rocky Mountain NP Viewshed Analysis

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### 3.5.11 Domain 11 Southern Plains

#### 3.5.11.1 Introduction

Domain 11 extends from the Osage Plains in southern Kansas and central Oklahoma through the Oaks and Prairies region in central Texas, continuing into the South Texas Brushlands and Coastal Prairies to the U.S.-mexico border. Parts of the Rolling Red Plains and Edwards Plateau regions are also included in this domain (BLM, 2009a) (Figure 2-1). The terrain of Domain 11 is characterized by low rolling topography. The primary vegetation of this area is Cross Timbers Forest, which largely consists of tallgrass prairie, oak savannah and forests, and mixed grass prairie on areas with shallow soils. The Cross Timbers represents the ecological region between the eastern deciduous forest and the central plains, and covers nearly 8 million ha in Kansas, Oklahoma, and Texas. The proposed NEON sites within the Southern Plains domain would be located at the Caddo-Lyndon B. Johnson National Grassland of Texas (LBJ) (C-32 and C-33, Figure 3.D11-1; C-31, Figure 3.D11-2; A-26; Figure 3.D11-5), the Klemme Range Research Station (KRRS), approximately 320 km northwest of the LBJ (R-21, A-27; Figure 3.D11-3), and University of Oklahoma Biological Station (UOBS), approximately 100 km northeast of the LBJ (R-22; Figure 3.D11-4), in Oklahoma. No STREON Site is proposed for Domain 11.

#### 3.5.11.2 Resource Areas Considered But Not Addressed for Domain 11

Preliminary analysis indicated that there would be no potential to significantly impact three of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Airspace: The proposed NEON sites in Domain 11 would be located in areas that have not been deemed restricted or special use airspace by the FAA (FAA, 2009). No impacts are anticipated with regard to restricted airspace.
- Protection of Children: The proposed Core Site at the LBJ would be located on federally owned land that is used by the public for recreational purposes; however, the tower locations would have restricted access by means of fences or gates. All potential impacts would be confined to the restricted areas and there would be no environmental health and safety risks to children. The proposed Relocatable Sites at UOBS and KRRS would be located on private land with limited public access. All potential impacts would be confined to the private lands and there would be no environmental health and safety risks to children.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 11 are designated research areas that are not routinely viewed for aesthetic quality or urban lands where aesthetic quality is impaired. Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

#### 3.5.11.3 Resource Areas Considered in Detail for Domain 11

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 11 where site-specific conditions would influence the anticipated environmental consequences.

## Geology/Seismicity

### *Affected Environment*

Domain 11 is located within a number of physiographic regions, including the Osage Plains, the Oaks and Prairies, the South Texas Brushlands, the Coastal Prairies, the Rolling Red Plains, and the Edwards Plateau (BLM, 2009a). The underlying geology is Cretaceous deposits consisting of limestone and sandstone (Hallgren, 2008).

The Southern Plains is relatively stable from the standpoint of seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 4% pga to 12% pga for short wave motion and 0% pga to 4% pga for long wave motion, with the exception of an area in south-central Oklahoma where seismic activity is higher. Maximum % pga in this area of Oklahoma ranges from 16 % pga to 36 % pga for short wave motion, and 6 % pga to 8 % pga for long wave motion (USGS, 2009a, 2009b).

### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact the underlying geology. The seismic hazard is low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. No long-term maintenance resources would likely be required to address seismicity in this domain.

## Soils

### *Affected Environment*

Dominant soil orders within the region are mollisols and alfisols, with underlying Cretaceous deposits alternating between sandstone and limestone (Hallgren, 2008).

Soils within the general area of the proposed locations in the LBJ consist mostly of fine sandy loams. The soil at the proposed location for Core Site C-32 consists of Keeter soil. Keeter is well drained with slopes ranging from 1 to 6 percent. The typical soil profile for this type of soil is very fine sandy loam to 18 cm, clay loam to 82 cm, and very fine sandy loam extending to 185 cm. Soil in the proposed area of Core Site C-33 consists of Weatherford-Duffau. Weatherford-Duffau is well drained and has slopes ranging from 3 to 8 percent. The typical soil profile for this soil is very fine sandy loam to 28 cm, sandy clay loam to 120 cm, and fine sandy loam extending to 200 cm. The soil in the area for proposed Core Site C-31 consists of both Keeter and Weatherford-Duffau. Both of these soils are considered susceptible to rill or sheet erosion (NRCS, 2009a; NRCS, 2009b; NRCS, 2009c, NRCS, 2009d).

Soils within the KRRS and the proposed Relocatable Site R-21 mostly consist of Cordell-Rock outcrop. This soil type is a somewhat excessively drained soil with slopes ranging from 2 to 15 percent. The typical soil profile for this type of soil is silty clay loam to 25 cm, very gravelly silty clay loam to 36 cm and bedrock below. This soil type is not considered highly susceptible to rill or sheet erosion (NRCS, 2009e; NRCS, 2009f). Soils at A-27, proposed for KRRS, consist of Cordell-Rock outcrop and St. Paul silt loam. St. Paul silt loam is a well drained soil with slopes ranging from 1 to 3 percent. The typical soil profile for this soil is silt loam to 20 cm, silty clay loam to 127 cm, and silt loam extends to 153 cm. This soil type is considered to be mildly susceptible to rill or sheet erosion (NRCS, 2009e; NRCS, 2009g).

The soil in the vicinity of the proposed Relocatable Site R-22 at the UOBS consist of Dougherty loamy fine sand, Konawa fine sandy loam, and Bastrop fine sandy loam. Dougherty loamy fine sand has a slope ranging from 0 to 3 percent. Konawa fine sandy loam has slopes ranging from 1 to 5 percent. Neither of these soils is considered to be highly susceptible to rill or sheet erosion. The soil at the proposed location of Relocatable Site R-22 consists of Bastrop fine sandy loam. Bastrop is a well drained soil with slopes ranging from 1 to 3 percent. The typical soil profile for this soil is fine sandy loam to 18 cm, and sandy clay loam extending to 200 cm. This soil is considered to be mildly susceptible to rill or sheet erosion (NRCS, 2009h; NRCS, 2009i).

The soil at the proposed location for Aquatic Array A-26 consists of Pulexis soils, which are well drained. The typical soil profile for this soil is fine sandy loam to 20 cm and very fine sandy loam extending to 180 cm. Pulexis soils are not considered highly susceptible to rill or sheet erosion (NRCS, 2009j; NRCS, 2009k).

#### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

At each of the proposed NEON locations in Domain 11, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals, towers, and instrument arrays. The total area of disturbed soils would be less than 0.01 ha at each location. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. Soils at each of the proposed Core Site tower locations (C-31, C-32, C-33) are very susceptible to erosion from water and wind. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and also for indirect impacts to surface waters from transport of eroded materials into nearby waterbodies.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

## Climate

### *Affected Environment*

The climate is consistent across all proposed NEON locations in Domain 11. Mean annual precipitation ranges from 76 cm to 95 cm, with peak rainfall occurring from April through July. Western portions of the domain are drier. The mean annual temperature is approximately 17 ˚C. Winters are mild, but short periods of extreme cold occur when northern fronts move through. The hottest summer days occur during July and August, with the maximum temperature near 45° C. Thunderstorms occur throughout the year and are the source of a large part of the precipitation. These storms can produce heavy rainfall, destructive winds, including tornadoes, and hail. Snowfall is rare (5 cm annual average) and the average length of the freeze-free period is 249 days, extending from mid-march to late November (Fizber, 2009; Hallgren, 2008; Oklahoma Agricultural Experiment Station, 2009).

### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. There would be no potential for interaction with other projects and no cumulative impacts to climate would result.

Due to the potential for extreme wind conditions from tornadoes, towers would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind. Site design also would incorporate grounding and power filtering appropriate to the area to protect instrumentation from damage from electrical surges due to lightning in the region.

## Air Quality

### *Affected Environment*

All of the proposed NEON locations are within areas designated as in attainment with NAAQS (USEPA, 2009). The LBJ is located in Wise County and is the closest proposed Domain 11 site to a non-attainment area, metropolitan Dallas-Fort Worth in Denton County, which is approximately 65 km southeast of the proposed site.

The Wichita Mountains National Wildlife Refuge (NWR), approximately 75 km south of KRRS, is the only Federal Class I Wilderness Area located within 161 km of proposed NEON locations in Domain 11 (NPS, 2009).

### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. This would have short-term, negligible impacts on air quality. The amount of disturbed ground would be less than 0.01 ha and no large earthmoving equipment would be used. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze and would not impact visibility at the Wichita Mountains NWR.

### Noise

#### *Affected Environment*

The noise environments at the LBJ and KRRS would be similar. Both are located in rural areas with very low populations in surrounding areas, with noise levels expected to be approximately 40 dBA (USEPA, 1974). UOBS is located in a sparsely populated setting adjacent to Lake Texoma, which receives a substantial amount of recreational boat traffic. Daytime noise at the proposed UOBS site (R-22) would periodically increase as boats traverse the lake in this area. There is a residential neighborhood approximately 1.2 km east of UOBS, across Lake Texoma.

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would cause no impacts to residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. No new roads would be constructed. During construction, noise levels would be elevated periodically only during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction.

Absent intervening vegetation, construction noise would be reduced to approximately 52 dBA as a result of natural attenuation from traveling the 1.2 km to the residential area (FHWA, 2007). This noise would be perceptible outside of homes, but would not interfere with outdoor conversations and would be below nuisance levels. Construction noise would not be perceptible to persons inside of houses, who would experience a further reduction of 15 to 25 dBA (USEPA, 1974). No noise impacts to nearby residences would be expected.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to temporarily relocate from the construction area, but would likely resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

The pumps for atmospheric sampling equipment on an FIU would operate continuously. Typically, these pumps produce noise of approximately 65 dBA. NEON, Inc. would place the pumps within noise shielding to reduce the sound to less than 60 dBA at 12 m. Residents in the neighborhood near the UOBS site (R-22) would be unlikely to perceive noise from operation of the pumps.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increase throughout the duration of NEON activities (30 years at the Core Site and up to 5 years at Relocatable Sites).

AOP overflights would not impact persons near KRRS. At the LBJ, persons involved in outdoor activities would be aware of the overflights, but there would be no impacts related to the noise of the aircraft. At UOBS, the nearby residence would be aware of the overflights, but there would be no impacts related to the noise of the aircraft. The potential for overflights to impact wildlife is discussed below.

### Water Quality

#### *Affected Environment*

All of the lakes and ponds within Domain 11 are man-made reservoirs and ponds. There are a number of lakes and ponds of various sizes on the LBJ (Table 3.5.11.3-1). Most lakes in this area are susceptible to eutrophication, likely caused by chemical and nutrient runoff from the streams that feed into the lakes (Kao, 2008a).

**TABLE 3.5.11.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 11, Southern Plains United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-31 | 35 | 0 | 100 | 0 | ND | ND |
| C-32 | 19 | 0 | 115 | 0 | ND | ND |
| C-33 | 29 | 1 | 66 | 0 | ND | ND |
| R-21 | 17 | 0 | 37 | 0 | ND | ND |
| R-22 | 13 | 0 | 24 | 0 | 10 | 0 |
| A-26 | 26 | 1 | 75 | 0 | ND | ND |
| A-27 | 19 | 1 | 40 | 1 | ND | ND |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009c.

There are many streams throughout the LBJ (Table 3.5.11.3-1), none of which are considered permanent, low-order streams. Many of the streams go dry during periods of severe drought, as has been the case in the last 2 years (Hallgren, 2008). None of the waters on or near the LBJ are considered impaired and all of these waters meet their designated uses (TCEQ, 2008).

The proposed Aquatic Array at the LBJ (A-26) would be located on Pringle Creek, 14 km northwest of the proposed Advanced Tower. Pringle Creek flows in a southeasterly direction for approximately 14 km, before draining into Big Sandy Creek just northwest of Alvord, Texas (TSHA, 2009). Big Sandy Creek is on the Texas CWA Section 303d list of impaired waters due to elevated concentrations of bacteria (TCEQ, 2008).

The proposed location for the Relocatable Tower at UOBS (R-22) is in an upland area at the UOBS, on the north shore of Lake Texoma. Lake Texoma is a 36,000-ha impoundment of the Red River, which forms the border of Texas and Oklahoma (Texas Department of Wildlife and Parks [TPWD], 2009a). Lake Texoma is on the Oklahoma 303d list of impaired waters for low concentrations of dissolved oxygen (ODEQ, 2004)

The Aquatic Array at KRRS (A-27) would be located at an unnamed lake in an area surrounded by a number of large reservoirs and streams (Table 3.5.11.3-1). The site is just east of the Oknoname 149031 Reservoir, the Oknoname 149019 Reservoir, and the Boggy Creek Watershed Site 21 Reservoir. The lake where the array would be located drains into the Boggy Creek Watershed Site 21 Reservoir (OHS, 2009).

The proposed location for the Relocatable Tower at KRRS (R-21) is in an upland area 0.6 km east of the proposed Aquatic Array.

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

## Wetlands

### *Affected Environment*

The LBJ contains fringe emergent wetlands along many of the lakes and ponds within its boundaries; however, there are no known wetlands at the proposed locations of Core Site Towers C-31, C-32, and C-33 (Table 3.5.11.3-1).

Freshwater emergent wetlands are present along the edge of Lake Texoma near the UOBS (Table 3.5.11.3-1). The UOBS is also surrounded by a number of small, man-made ponds. The ponds are classified as a palustrine, unconsolidated bottom, permanently flooded, and impounded wetlands.

There are no known wetlands within or near the proposed site of the Relocatable Tower (R-21) and Aquatic Array (A-27) at KRRS (Table 3.5.11.3-1). The Aquatic Array would be located on a small man-made reservoir.

### *Environmental Consequences*

No wetland impacts would occur at proposed NEON sites in Domain 11. There would be no interaction with other projects. Therefore, no cumulative impacts to wetlands would occur.

Because all work would be confined to uplands, no direct impacts to wetlands would occur at proposed NEON sites in Domain 11.

NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for indirect impacts to offsite wetlands as a result of erosion and sedimentation from the construction sites. No indirect impacts to offsite wetlands would be expected.

### Floodplains

#### *Affected Environment*

Floodplains in the LBJ are associated with various creeks and streams that flow throughout the area. The Advanced Tower proposed for the LBJ (C-31) would not be located in a designated floodplain or flood prone area, but would be near the floodplain associated with Pringle Creek. The two Basic Towers (C-32, C-33) would be located outside any nearby floodplains. The Aquatic Array (A-26) would be located in Pringle Creek within the floodplain (FEMA, 1990a).

Floodplains near the UOBS are associated with Lake Texoma. The proposed Relocatable Tower at UOBS (R-22) would be located out of the floodplain (FEMA, 1990b).

There are no available FIRMs for the KRRS area in Washita County, Oklahoma, where a Relocatable Tower (R-21) and Aquatic Array (A-27) are proposed. Aerial imagery and topographic maps indicate that floodplains or flood prone areas are unlikely at these locations.

#### *Environmental Consequences*

There would be negligible direct impacts to flood prone areas as a result of implementation of NEON. Two Aquatic Arrays would be placed in areas prone to flooding. The minimal displacement of the proposed equipment would result in a negligible impact on flood storage, flood elevations, and flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected.

At the LBJ and KRRS, only the Aquatic Arrays (A-26, A-27) would be placed within floodplains. No increase in flood elevations would result and any change in flood storage capacity or flood conveyance would be negligible.

There is the potential for equipment to be damaged during flood events. NEON, Inc. would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts on existing water quality if they were to be lost in streams. There are no environmentally harmful components associated with this monitoring equipment. NEON, Inc. would temporarily remove equipment from flood prone areas when flooding is forecast for the area.

### Common Vegetation and Plant Communities

#### *Affected Environment*

The LBJ is located within the West Cross Timbers subregion of the Cross Timbers and Prairies Ecological Region. This region represents the transition zone between the eastern deciduous forests and the central plains to the west. The vegetation in this region is generally a mix of tallgrass prairie, oak savannah, and deciduous forest (Hallgren, 2008). The vegetative communities in this area have been largely determined by the underlying Cretaceous deposits of limestone and sandstone, with forests being found on coarser textured soils overlaying sandstone, and grasses generally found on finer textured soils overlaying limestone. Prescribed burning and managed grazing practices are common and are regulated by the USFS.

Dominant tree species within forested areas of the LBJ include post oak and blackjack oak, with shin oak, Spanish oak, live oak, Texas ash, mesquite, Osage orange, and Ashe juniper also being common (TPWD, 2009b). Grasslands in the LBJ are dominated by little bluestem, big bluestem, Indian grass, and switchgrass (Hallgren, 2008).

The proposed Advanced Tower at the LBJ (C-31) would be placed in an area of 60 percent grasses and 40 percent hardwoods. Controlled burns are done in this area every 2 to 5 years to maintain a healthy diversity of grasses and to control invasive species encroachment, specifically eastern red cedar (Hallgren, 2008). The proposed location of the Basic Tower at the LBJ (C-33) would be on an upland mesa that is vegetated entirely with grasses and other herbaceous species. The Aquatic Array proposed for the LBJ (A-26) would be located on Pringle Creek, which has a narrow forested riparian zone dominated by species found throughout the LBJ.

The OUBS is also located within the Cross Timbers Ecological Region. The Relocatable Tower (R-22) would be on a previously disturbed area within the facility. The proposed site is currently vegetated with planted grasses and scattered trees and is regularly maintained.

KRRS is located in the Rolling Red Plains Resource Area of the Central Great Plains Ecological Region, an area historically defined by expansive grasslands and prairie communities. The natural vegetation is this area consists of mixed grass plains, shin oak grasslands, and mesquite grassland plains. Oak mottes are commonly found throughout the various grasslands as well. The majority of this area is now used primarily for cropland and grazing, with wheat, sorghum, alfalfa, and cotton being the major agricultural commodities. Fragmentation and overgrazing are major factors in the loss of natural communities in the region (BLM, 2009b).

The Relocatable Tower at KRRS (R-21) would be placed in an upland area dominated by grasses and herbaceous species. The primary species would be similar to those at the LBJ. The Aquatic Array at KRRS (A-27) would be located in a man-made lake and would not impact vegetation

### *Environmental Consequences*

Minor clearing of vegetation would occur during construction to prepare for tower pads, fencing, and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. These areas would be kept free of trees by hand removal of saplings, as necessary.

Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to approximately 5 years at Relocatable Sites and 30 years at the Core Site. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate. Where overhead utility lines are extended, the new lines would be located to avoid removal of trees along the route. Because of the need to keep the utility lines clear of woody vegetation, these would be kept free of trees by hand removal of saplings, as necessary, until the end of the NEON project. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines.

### Common Fauna

#### *Affected Environment*

Wildlife within the LBJ consists of a variety of species that would typically be found in tallgrass prairies, oak savannahs, and mixed hardwood forests. These mixed habitat communities are dominated by white-tailed deer, coyote, bobcat, bobwhite quail, turkey, and a variety of waterfowl and songbirds (USDA, 2009a). The abundance of lakes and ponds throughout the LBJ provides excellent feeding and nesting areas for a number of waterfowl, reptiles, fish, and insects. The LBJ is a prominent area for migratory ducks and is also located in the middle of the Central Flyway for monarch butterflies and dragonflies (Kao, 2008b).

Wildlife surrounding the UOBS would be similar to that described for the LBJ. However, due to development of the UOBS and surrounding facilities, common terrestrial species would be less likely to occur at the site. Lake Texoma provides excellent habitat for a number of year-round resident and migratory birds, including ducks, geese, ibis, heron, and cormorant. Common fish species in Lake Texoma include largemouth, smallmouth, striped, and spotted bass, white and black crappie, blue and channel catfish, and bluegill (TPWD, 2009a).

Common wildlife found throughout the grasslands and scrub habitats at the KRRS include a large diversity of terrestrial and aquatic species. This region is also a very attractive route for migratory birds due to its central location within the Central Flyway. Large mammals commonly found near the KRRS include white-tailed deer and mule deer. Common small mammals found in the area include bobcat, red fox, jackrabbit, cottontail, and prairie dog. A number of year-round bird species can be found here, including ring-necked pheasant, horned lark, bobwhite, Cooper's hawk, and prairie falcon. Summer nesters include Swainson's hawk, blue-winged teal, and ruddy duck. Snapping turtle, Great Plains toad, western hog-nosed snake, and the western garter snake are also common to this area. Channel catfish are the most common fish found in area waters (USFS, 1994).

#### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide wildlife refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding is expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Towers that would be placed in prairie habitat would be relatively short (approximately 8 m) and would not be expected to pose a risk to bird species and flying mammals.

The tower and guy wires could pose a minimal risk to sensitive bird species on the LBJ near the proposed Advanced Tower (C-31), which would have surrounding canopy trees. The Advanced Tower and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Texas Parks and Wildlife and Oklahoma Department of Wildlife Conservation prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

There would be a long-term loss of habitat at towers and IHs, though the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall, impacts to wildlife would likely be negligible.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). In Domain 11, responses would likely be greatest in grassland areas where there would be no canopy cover. Animals may startle and it is possible that a flight response would occur. The response would likely be greater for flights that are proposed at 150 m above the canopy. Because the flights would occur only once per year, any impact would be considered minor and no population-level impacts would be expected.

Flights would be conducted after canopy leaf-out, so visual stimuli would be minimal in closed canopy areas and airplane noise could be reduced. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight.

### Sensitive Ecological Communities

#### *Affected Environment*

The TPWD 2002 Land and Water Resources Conservation Plan (Plan) identified the Cross Timbers and Prairies region as a high priority for conservation efforts. In this Plan, TPWD also classified the Native Prairie and Grassland Habitats as a critical wildlife habitat on lands that cross ecoregion boundaries (TPWD, 2002). Fragments of these tallgrass prairies, dominated by big and little bluestem, switchgrass, and sideoats, are scattered throughout the LBJ, intertwined with oak savannah and hardwood forest. Conserving these native prairie remnants through preservation management is a stated goal of the LBJ.

There are no rare habitats known to occur near the UOBS or KRRS. No areas at or near proposed tower or aquatic locations in Domain 11 have been designated as critical habitat for species listed under the ESA.

### *Environmental Consequences*

Minor short-term and long-term impacts to sensitive ecological communities could result from installation of NEON infrastructure. No cumulative impacts to sensitive ecological communities would be expected.

Tallgrass prairie remnants located at the LBJ would be disturbed, but disturbance would be less than 0.01 ha. Construction, including access trails and fencing around towers, would occur within the native prairie community. However, there is a substantial amount of similar habitat throughout the LBJ and no substantial loss of this habitat would occur. Impacts to this sensitive habitat at the LBJ would be negligible.

No other sensitive habitat impacts would be expected in Domain 11.

## Sensitive Species

### *Affected Environment*

In Texas and Oklahoma, sensitive species include those with federal endangered or threatened status; species proposed for listing as federal endangered or threatened; and rare, state endangered, threatened, and species of special concern status. Sensitive species also include those species protected under the MBTA. Sensitive species identified as having potential to occur on or near the LBJ, UOBS, or KRRS are identified in Table Domain 11, Appendix B, along with their legal status and preferred habitat types. This table also provides the scientific names for the species discussed in the following sections.

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 11 (Table 3.5.11.3-2). However, there are known occurrences of federal and state protected species within 5 km of all the proposed Core Site locations and the Aquatic Array (A-26). In addition, potentially suitable habitat for protected species is present at or adjacent to the same proposed NEON locations (Table 3.5.11.3-2). The following discussion is limited to those species that may occur in or near the proposed project locations in Domain 11.

## Federally Protected Species

The federally endangered black-capped vireo occurs within scattered shrubs and open grasslands. These songbirds breed and nest from central Oklahoma across central and west Texas, and spend the winter months in western Mexico. The black-capped vireo has been in decline, largely due to overgrazing (by deer and cattle) of the low growing vegetation the species needs for nesting. Nests are commonly found in shin oak or sumac shrubs (TPWD, 2009c). This species could occur near proposed NEON sites on the LBJ (C-31, C-32, C-33, A-26).

**TABLE 3.5.11.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 11, Southern Plains
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-31 | 1-ESA | 0 | 2-ESA | 1 | 0 | 1 |
| C-32 | 1-ESA | 0 | 2-ESA | 1 | 0 | 1 |
| C-33 | 1-ESA | 0 | 2-ESA | 1 | 0 | 1 |
| R-21 | 0 | 0 | 0 | 0 | 0 | 0 |
| R-22 | 0 | 0 | 0 | 0 | 0 | 0 |
| A-26 | 1-ESA | 0 | 2-ESA | 1 | 0 | 1 |
| A-27 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: Appendix B Domain 11

The federally endangered American burying beetle could also be found near the NEON sites on the LBJ (C-31, C-32, C-33, A-26). This species occurs in oak-hickory forests, open pastures, and the forest-pasture ecotone, which is similar to the habitat at the LBJ sites (Sanchez, personal communication, 2009).

There are no documented occurrences of federally protected species near the proposed locations of NEON infrastructure at UOBS (R-22) or KRRS (R-21, A-27) (Table 3.5.11.3-2) (ONHI, 2008).

### State Sensitive Species

This section addresses state-protected species that are not also protected under the ESA.

The Texas kangaroo rat is a relatively large kangaroo rat found in north-central Texas. They can be found in shortgrasses and mesquite bushes on clay soils. The Texas kangaroo rats tend to make their burrows at the base of a mesquite shrub. They are highly nocturnal, even ceasing activity on moonlit nights. Breeding is done year-round. Texas kangaroo rats are largely threatened by the clearing of mesquite shrubs. This species could occur near proposed NEON infrastructure on the LBJ.

There are no documented occurrences of state protected species near the proposed locations of NEON infrastructure at UOBS or KRRS (ONHI, 2008).

### *Environmental Consequences*

Minor short-term and long-term impacts to sensitive species could result from installation of NEON infrastructure. No cumulative impacts to sensitive species would be expected.

NEON, Inc. would work with property owners and site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid any such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat.

There is the potential to disturb sensitive wildlife in the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

One small mammal species of concern, Texas kangaroo rat, could be inadvertently captured in small mammal traps deployed as part of an FSU at the Core Site on LBJ National Grasslands in Texas. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. An animal handling permit would be obtained from the Texas Parks and Wildlife and the Oklahoma Department of Wildlife Conservation as described in Section 5.11 and all specified conditions would be followed to ensure proper treatment and handling of captured animals. If inadvertently captured, this sensitive species would be released. Any impacts would be short-term and minor. No population level impacts would be expected.

MBTA listed birds may be disturbed during construction and operation. Should nesting bird species protected by the MBTA occur in or adjacent to an area that would be cleared or be subject to a high level of human activity during construction, work would be delayed until after the young have fledged if the site could not be relocated.

Towers that would be placed in grassland habitat would be relatively short (approximately 8 m) and would not be expected to pose a risk to sensitive bird species.

The Advanced Tower (C-31) and its guy wires on the LBJ would pose a minimal risk to sensitive bird species. This tower and its guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to sensitive bird species would be eliminated at site closure.

None of the sensitive species that may occur on the LBJ, KRRS, or UOBS would be expected to experience other than negligible impacts as a result of AOP overflights. These species would likely be aware of the aircraft, but would not likely respond to the overflight.

### Cultural Resources

#### *Affected Environment*

The proposed NEON locations for Domain 11 are in eastern Oklahoma, south-central Oklahoma, and northeastern Texas. Two proposed locations are on the Oklahoma State

University's Marvin Klemme Range Research Station in Washita County. One proposed location is in Marshall County, Oklahoma on the north shore of Lake Texoma and within the University of Oklahoma Biological Research Station. The remaining four locations are in Wise County, Texas, within the LBJ.

### Prehistoric Context

During the past several years, more evidence is being gathered that human occupation of North and South America began earlier than the Terminal Pleistocene ca. 12,000 BP. Clovis sites, which are found across the continent, are found in Oklahoma and Texas and assigned to the early part of the Paleoindian Period. This period dates from approximately 13,000 to 9,000 years ago. Aside from the large spear points thought to have been used to hunt big game, other stone tools found at Paleoindian sites include scrapers, gravers, perforators, wedges, and knives. Evidence suggests that such tools were used to spear game, cut up meat, scrape and cut hides, and split and carve bone of deer, bison, and rabbit. Caribou, elk, moose, and possibly mastodon also may have been hunted.

The Archaic Period dates from approximately 9,000 years ago to A.D. 1 and includes new adaptations by the early people related to the change from the cold, moist climate of the Pleistocene Age to a warmer, drier one as warm winds melted the glaciers to the north and warmed the ocean water. Increased use of plant resources and the hunting of smaller game became more prevalent and populations became more sedentary. Bison remained vitally important for food, leather, and other resources. Near the end of the Archaic Period, the spear was replaced with the bow and arrow.

The first millennium A.D. is known as the Woodland Period and is marked by the introduction of pottery, full adaptation of the bow and arrow, and the first evidences of plant domestication. Cemeteries are found, indicating the possibility of more territorial ownership by these still semi-sedentary hunter-gatherers.

Between A.D. 800 and 1200, most of the native populations had shifted to a more permanent settlement pattern dependent upon the cultivation of corn, beans, and squash and supplemented with bison hunting. This period saw the advance of ceramic technology and the establishment of long distance trade with evidence of obsidian coming from Idaho and Wyoming, turquoise from the Pueblo Indians of the Southwest, and raw materials coming from the East. The Prehistoric Period ended with the arrival of Coronado's expedition in 1541, but, with the notable exception of the introduction of the horse, European influence was limited until the late 1700s. Native populations became more organized and the historically known tribes can be traced to the Protohistoric Period.

### Historic Context

The first Europeans to reach Oklahoma and northern Texas were the men of Francisco Vasquez de Coronado's expedition to search for Cibola in 1541, thus beginning the Historic Period. This expedition met the Wichita Indians living as successful agriculturalists and bison hunters. This is also when the horse was introduced to the Plains Indians. Although Europeans occasionally traveled through the area, no Europeans settled in the area well into the 1800s. As mentioned above, this is where the histories of the areas diverge.

This first Euro-American to move into Wise County (then part of Cook County) was Sam Woody in 1854, who was followed by many other settlers wanting to obtain 64.7 ha of land from the state preemption grants. There was one village of 65 Delaware Indians living in the county who befriended the new settlers, but raids were carried out by a hostile group of Kichai Indians. The settlements became successful in raising sheep and cattle, and Wise County was created in 1856.

Open range cattle ranching remained popular until well into the 1880s, and eastern Wise County was crossed by the Eastern Cattle Trail to Abilene, Kansas. Decatur became a stop on the Butterfield Overland Mail route between St. Louis, Missouri and San Francisco, California. Cotton was first cultivated in 1870, and with the coming of two railroads in the 1880s and 1890, agricultural development and beef became much more profitable for the residents.

Oklahoma remained largely unsettled by Euro-Americans, even after becoming part of the United States through the Louisiana Purchase in 1803. During the 1820s, the United States government began relocating Native American tribes to Oklahoma, eventually becoming part of the Indian Territory. Oklahoma lay in the route between the cattle and ranches in Texas and the railroads in Kansas, where the cowboys would run their cattle to market. Eventually settlers decided to shorten the journey and ranch in Oklahoma's prairies instead. The U.S. government began giving land grants through a series of land runs between 1889 and 1895. Native Americans were forced to give up communal lands in exchange for individual land allotments to make way for the newcomers. The discovery of oil fueled Oklahoma's growth and led to its entry into statehood on November 16, 1907.

### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 11, including a 1.6-km radius study area around the proposed locations.

A literature search of the Oklahoma Archaeological Survey was performed on December 3, 2008. The Oklahoma Archaeological Survey serves as the central repository for records of known archaeological sites in the state. Additionally, the following historic maps were reviewed: H.H. Hardesty's 1883 *Map of Indian Territory*; George F. Cram's 1898 *Oklahoma and Indian Territories*; 1901 *Denison* 30′ USGS topographic quadrangle map; 1914 *State of Oklahoma* USDI GLO Map; and 1957 *Dill City* 7.5′ USGS topographic quadrangle map.

None of the proposed NEON locations in Oklahoma for Domain 11 have been previously surveyed for cultural resources, although two small previous studies have been conducted within a 1.6-km radius of the University of Oklahoma Biological Research Station.

A comprehensive search was conducted for previous investigations and known cultural resources using the Texas Historical Commission's Restricted Cultural Resource Information and the Texas Archaeological Sites Atlas (ATLAS) on January 14, 2009. ATLAS is particularly useful as it is a geospatial database and contains relatively recent data compiled from archaeological site records from the Texas Archaeological Research Laboratory, Archaeological Projects, Neighborhood Surveys, Historical Markers, and

Cultural Resource Management Abstracts from the Texas Historical Commission files, National Register Properties from the NPS, and Sawmills from the Texas Forestry Museum.

None of the proposed NEON locations in Texas for Domain 11 have been previously surveyed for cultural resources, although several previous studies have been conducted within the 1.6-km study area of all four proposed NEON locations in Texas.

Prehistoric resources previously documented within the vicinity of the proposed NEON locations throughout Domain 11 (both Texas and Oklahoma) include lithic and artifact scatters (Table 3.5.11.3-3). The literature and map review revealed that several historic features are in the vicinity of the proposed NEON locations, including roads, buildings, historic debris scatters, homesteads sites, and one historic cemetery, some of which have not been formally recorded. The literature review documented multiple previously recorded sites within 1.6 km of several of the project components. However, none of the sites are listed or have been recommended eligible for the NRHP or any other state or local register.

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 11 did not identify any significant known historic properties within the proposed areas of disturbance for any of the proposed facilities and there are no known NRHP eligible historic properties within the study areas. The literature search revealed the presence of a historic cemetery within the study area, but well outside the area of disturbance of C-31.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 11, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

## Utilities

### *Affected Environment*

Utilities are readily available at the LBJ, largely due to the number of private residences and amount of infrastructure that exists throughout the area. Electric power at all proposed NEON locations within the LBJ is within 1,500 m and the nearest transformer is 300 m east of the proposed Advanced Tower (C-31). Telecommunications are available at the USFS office, including a T-1 DSL line that could be used by NEON (Hallgren, 2008).

Utilities are readily available at the UOBS. The proposed Relocatable Tower at UOBS (R-22) would be powered through the power line grid system that is present at the UOBS.

**TABLE 3.5.11.3-3**
Literature Search Results—Domain 11, Southern Plains
*National Ecological Observatory Network (NEON) EA*

| NEON Site Number | Previously Surveyed | Number of Archaeological Resources Present: Within Area of Direct Impact of Proposed NEON Location | Number of Archaeological Resources Present: Within 1.6-km Study Area | Number of Historic Resources, including Architecture Present: Within Area of Direct Impact of Proposed NEON Location | Number of Historic Resources, including Architecture Present: Within 1.6-km Study Area | Number Evaluated | Number Eligible |
|---|---|---|---|---|---|---|---|
| C-31 | No | 0 | 0 | 0 | 1 | 0 | n/a |
| C-32 | No | 0 | 0 | 0 | Multiple Historic farmsteads and debris scatters | 0 | n/a |
| C-33 | No | 0 | 0 | 0 | Historic homesteads | 0 | n/a |
| R-21 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| A-26 | No | 0 | 0 | 0 | Multiple Historic farmsteads and debris scatters | 0 | n/a |
| A-27 | No | 0 | 0 | 0 | 0 | 0 | n/a |

Source: Oklahoma Archaeological Survey, Texas Historical Commission, National Register Information System (NRIS). n/a = not applicable

KRRS receives power and telecommunications from existing infrastructure.

### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the access road where access for maintenance activities would be most efficient. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for impacts. Extended overhead lines would be kept clear of trees by hand clearing saplings, as necessary, for the duration of the NEON project at a location.

## Transportation

### *Affected Environment*

The LBJ is bounded by U.S. Highway U.S.-380 on the south, and Texas State Highways TX-101 on the west, FM 1749 on the northwest, FM 455 on the northeast, and FM 51 on the southeast at Decatur, Texas. The road system on the LBJ includes state, county, and

USFS roads that provide access for public and private needs (USDA, 2008). All county roads are maintained jointly by Wise County and the USFS (Hallgren, 2008). The proposed locations of the Advanced Tower (C-31) and Basic Tower C-33 at the LBJ would abut an existing USFS road. Basic Tower C-32 would be approximately 0.6 km north of an existing road. All roads in the vicinity of the proposed stations are gravel roads and are well-maintained year-round (Starr and Wee, 2008).

Access to the UOBS is from Oklahoma State Highway OK-99 (TX-377) and Oklahoma University Road. The proposed location of the Relocatable Tower (R-22) is bounded by Taylor Road to the west, north, and east, and Oklahoma University Road to the south.

The KRRS Relocatable Tower (R-21) and Aquatic Array (A-27) sites are accessible from well-maintained roads. There is an existing dirt road that would connect the Relocatable Tower to the Aquatic Array.

### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

Existing roads and field roads on the LBJ, UOBS, and KRRS would be used to bring in the materials for construction. Improved trails may be required to bring in the materials. Materials would be brought in by hand. Improved trails made for access would be restricted from public use. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access.

No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and transported by hand from that point to the construction site. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

### Human Health and Safety

#### *Affected Environment*

NEON locations at the LBJ (C-31, C-32, C-33, A-26) would be on public property where public access to the sites would be possible. The UOBS (R-22) and KRRS proposed locations (R-21, A-27) would be on private property with restricted public access. Access would be limited to staff and researchers.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

Proposed site locations at UOBS and KRRS would be on private property with restricted access to the public. This would limit public health and safety issues. In addition, towers would be fenced and locked, reducing the risk of the unauthorized access to the tower.

Towers would be secured with fencing and locked gates to deter unauthorized access and minimize the potential for accidents by members of the public. There is the potential for staff or researchers riding ATVs to contact guy wires during routine work or during NEON maintenance or data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential of an injury. Any impacts to site users would likely be negligible.

### Environmental Justice

#### *Affected Environment*

There is the potential for limited subsistence hunting and fishing on the LBJ by nearby residents. The proposed NEON sites at the LBJ are on USFS property where hunting and fishing activities are managed by the USFS (Hallgren, 2008).

The proposed NEON sites at UOBS and KRRS are on private land with limited public access. All potential impacts at UOBS and KRRS would be confined to the private lands and there would be no potential to disproportionately impact minority or low-income populations at these locations.

### *Environmental Consequences*

The areas that would be inaccessible to the public at the proposed tower locations (C-31, C-32, C-33) at the LBJ are a negligible percentage of the available public lands in the LBJ. Subsistence hunting and fishing would not be impacted by the NEON exclusions. There is no other potential to disproportionately impact minority or low-income populations. No impacts to environmental justice would be expected.

## Recreation

### *Affected Environment*

There are a number of recreational activities within the LBJ, including hiking, camping, fishing, and hunting. All of the major waterbodies in the LBJ are enclosed by USFS land and are used primarily for recreational fishing. Cottonwood Lake is the largest lake within the LBJ, and is very popular for fishing and duck hunting, although increased aquatic and weedy vegetation has made fishing more difficult in some parts of the lake. There is a boat launch at Cottonwood Lake, but only canoes and electric motors are allowed on the lake (USDA, 2009b). Black Creek Lake is located 8 km south of Cottonwood Lake. This lake is the second largest lake in the LBJ and is also popular for fishing and hunting. Black Creek Lake is the only location at the LBJ with recreational facilities, including a picnic area, boat ramp, seven campsites, and various trails and pathways. There is also a 6.4-km hiking trail that connects Black Creek Lake to Cottonwood Lake. No water, electricity, or sewage facilities are available at the recreational area (USDA, 2009c). The 121-km LBJ Multi-Use Trail extends throughout the central LBJ and is available for horseback riding, mountain biking, and hiking (USDA, 2009d).

Basic Tower C-33 would be the closest tower to the Black Creek Recreational Area. C-33 would be located 3.5 km north of the recreational area. Basic Tower C-33 would also be the only tower in the vicinity of the LBJ Multi-Use Trail, with the trail passing 0.2 km to the south of the proposed tower.

The UOBS is located on the north shore of Lake Texoma, an extremely popular location for a variety of recreational activities, including fishing, boating, and windsurfing. Along the lake there are 26 resorts, hundreds of campgrounds, and a number of golf courses. It is considered one of the top recreation and fishing destinations in the southwestern United States (Lake Texoma, 2009).

There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 11.

### *Environmental Consequences*

Minor short-term impacts to recreation could occur at some proposed NEON locations during construction. Long-term impacts on recreation would be negligible. Because NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would be likely.

Minor impacts to recreational hikers and hunters would occur in the immediate vicinity of the three towers within the LBJ (C-31, C-32, C-33) during construction activities. During operation, the visual appearance of the tower and guy wires at Basic Tower C-33 would create minor impacts to the aesthetics of the nearby trail.

There is no public access to Lake Texoma through the UOBS. Therefore, construction of the NEON infrastructure would not impact recreation on the lake. The proposed tower (R-22) would be visible from the lake. However, the appearance of the Relocatable Tower would have negligible impacts on recreational anglers and boaters on Lake Texoma.

The proposed NEON sites at KRRS (R-21, A-27) would be on private land with limited public access. No recreational activities occur on these properties. No impacts would extend off-property, so there would be no potential to impact recreation.

At proposed NEON locations where recreational vehicle activity could occur, guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

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**Figure 3.D11-1** Domain 11 Proposed Site Locations

**Figure 3.D11-2** Domain 11 Proposed Site Locations

**Figure 3.D11-3** Domain 11 Proposed Site Locations

**Figure 3.D11-4** Domain 11 Proposed Site Locations

**Figure 3.D11-5** Domain 11 Proposed Site Locations

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### 3.5.12 Domain 12 Northern Rockies

#### 3.5.12.1 Introduction

Domain 12 is the Northern Rocky Mountains. Domain 12 encompasses western Wyoming (Yellowstone National Park [YNP] area), western Montana, and nearly all of central and northern Idaho extending to the border with Canada. The proposed Core Site for Domain 12 is on the Wyoming and Montana border within YNP and encompasses 9,592 ha. The site includes parts of YNP and Gallatin National Forest, as well as small private inholdings. The proposed Core Site infrastructure (Advanced Tower C-34 and Relocatable Towers C-35 and C-36, Figure 3.D12-1) would be along a portion of the Yellowstone Northern Range (YNR) in YNP approximately 0.8 km west of Phantom Lake. Proposed Aquatic Array A-28 (Figure 3.D12-4) also would be within the Core Site and in YNP. A-28 would be located on Blacktail Deer Creek, approximately 7 km upstream from the Yellowstone River, in the YNR.

Relocatable Site R-23 would be in Bozeman, Montana (Figure 3.D12-2). R-23 would be in an area of increasing development on the south side of the City of Bozeman. Proposed Aquatic Array A-29 (Figure 3.D12-2) would be located on Bozeman Creek, approximately 01 km northeast of R-23. Bozeman Creek, in the Upper Missouri River basin, originates in the Gallatin National Forest and flows through the City of Bozeman.

Relocatable Site R-24 would be at Loch Leven (Figure 3.D12-3), is a camping and fishing area managed by the Montana Department of Fish and Wildlife. The proposed tower location is just north of the Loch Leven Recreation Area near the Yellowstone River in central Park County.

#### 3.5.12.2 Resource Areas Considered But Not Addressed for Domain 12

Preliminary analysis indicated that there would be no potential to significantly impact three of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Sensitive Ecological Communities: There are no sensitive ecological communities within 5 km of proposed sites in YNP, Bozeman, or Loch Leven (Wyoming Natural Diversity Database, 2008; Montana Natural Heritage Program, 2008). There would be no potential to impact sensitive ecological communities.
- Environmental Justice: The proposed NEON sites would be located on unpopulated or undeveloped lands with limited access by the public. All potential impacts would be confined to the project area and there would be no potential to disproportionately impact minority or low-income populations or to negatively impact subsistence hunting or fishing.
- Airspace: There is no special use airspace at or within the vicinity of any of the proposed NEON locations in Wyoming or Montana (FAA, 2009). No potential for airspace constraints would be expected in this domain.

### 3.5.12.3 Resource Areas Considered in Detail for Domain 12

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 12 where site-specific conditions would influence the anticipated environmental consequences.

The primary potential for interaction between NEON and other past, present, and reasonably foreseeable projects in Domain 12 would occur in YNP and relate to actions that could occur simultaneously with NEON construction and result in cumulative negative impacts to traffic in the park. These projects are discussed under Recreation. Other potential cumulative impacts are discussed, as appropriate, under specific resource areas.

#### Geology/Seismology

##### *Affected Environment*

The mountainous landscape of the Northern Rockies has been influenced by glacial and volcanic activity resulting in a heterogeneous geological makeup. Metasedimentary rocks are prevalent and volcanic ash deposits are widespread (USEPA, 2009a). Due to its shallow source of magma and high volcanic activity, YNP is one of the most geologically diverse areas on Earth with 10,000 hydrothermal features and more than 300 geysers (NPS, 2009a). The Greater Yellowstone Area is the most seismically active area in the Intermountain West, with approximately 2,000 earthquakes occurring each year (NPS, 2009a). Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 12 % pga to greater than 160 % pga for short wave motion and 6 % pga to 80 % pga for long wave motion (USGS, 2009a; 2009b).

##### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact the underlying geology. Proposed YNP sites would not be located in or near geothermal features. Seismic hazards at YNP are moderate to high; however, no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. NEON, Inc. would likely be required to commit long-term maintenance resources for occasional repair of towers in the event damage from a seismic event were to occur.

#### Soils

##### *Affected Environment*

Soils at the proposed sites at YNP (C-34, 35, 36, A-28; Figure 3.D12-1) have not been categorized by the NRCS (NRCS, 2009a). Volcanic rhyolites and tuffs of the Yellowstone Caldera contain quartz and potassium feldspar that derived from nutrient-poor soils. Outside the caldera, andesitic volcanic rocks containing calcium, magnesium, and iron have weathered to produce fertile soils. Lake sediments deposited during glacial periods produced clay soils where meadow communities dominate (State Parks, 2009).

The soils at the proposed Relocatable Site in Bozeman (R-23; Figure 3.D12-2) consist of Blackmore silt loam on slopes ranging from 0 to 4 percent and Blossberg loam on slopes ranging from 0 to 2 percent (NRCS, 2009b). Both are present on stream terraces. Blackmore silt is well drained and Blossberg loam is poorly drained. Soils in the area of the proposed Aquatic Array in Bozeman (A-29; Figure 3.D12-2) consist of Straw loam on 0 to 4 percent slopes, typically found on stream terraces, Sudworth-Nesda loams on 0 to 2 percent slopes, and Bandy-Riverwash-Bonebasin complex on 0 to 2 percent slopes, typically found in floodplains (NRCS, 2009c). Bandy-Riverwash-Bonebasin complex soils are occasionally flooded and Sudworth-Nesda loams are rarely flooded. These soils are moderately susceptible to erosion.

Soils in the area of the proposed Loch Leven Relocatable Tower (R-24; Figure 3.D12-3) consist of mainly Vendome-meadowcreek complex found on 0 to 4 percent slopes, Beaverell-Attewan complex on 0 to 4 percent slopes, and Cozdome-Vendome loams on 0 to 4 percent slopes (NRCS, 2009d). The parent material of these soils is alluvium derived from igneous and metamorphic rock. These soils are low to moderately susceptible to erosion.

### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

At each of the proposed NEON locations in Domain 12, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to transfer electric power from portals. The total area of disturbed soils would be approximately 0.02 ha at Advanced Tower C-34 and would be less than 0.01 ha at each other proposed locations. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are highly prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby waterbodies.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

## Climate

### *Affected Environment*

This high mountainous region has a cold, dry continental climate with long winters and short summers. Climate in the northwest part of the domain is influenced by maritime climate conditions from the Pacific Ocean. As air travels east, the moisture is captured by each successive mountain range, resulting in a colder, drier continental climate in the southern and eastern parts of the domain (Hansen, 2007). Winds can be extreme in certain locations. Narrow valleys increase wind speeds. Ice and snow storms occur often in the winter. Lightning and electrical storms occur in the YNP area (Starr, 2008).

### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. Due to the extreme wind conditions created in narrow valleys, towers located in high wind areas would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind and storm surge. Site design would incorporate appropriate grounding and power filtering to protect instrumentation from damage from electrical surges due to lightning.

## Air Quality

### *Affected Environment*

All of the proposed NEON locations in Domain 12 are in areas designated as in attainment for criteria pollutants (USEPA, 2009b). The proposed sites would be located within 161 km of a designated Class I Wilderness Areas, with the proposed Core Site being in YNP, which is a designated Class I Wilderness Area (USEPA, 2009c; 2009d).

A maintenance area, burn pit, and gravel and earth stockpiles associated with the Frog Rock Pit area are located near the proposed Core Site in YNP.

### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts on air quality. The amount of ground disturbance would be less than 0.01 ha at any proposed location and no large earthmoving equipment would be used. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

Ongoing operations at Frog Rock Pit in YNP produce fugitive dust from production of rock for construction projects and smoke from burning to dispose of untreated scrap wood. Automobile traffic by YNP visitors produces typical combustion emissions. Frog Rock Pit activities, vehicle traffic, and NEON construction would have the potential to interact and produce temporary cumulative impacts to air quality near the proposed Core Site. NEON would time construction for off-peak visitor use periods to minimize the potential for cumulative impacts to air quality. Implementation of appropriate BMPs, as discussed in Section 2.2.2, by NEON, Inc. during construction in combination with BMPs implemented by YNP at Frog Rock Pit would likely result in any cumulative impacts to air quality being negligible.

The NEON project would not contribute to regional haze or air quality degradation and would not impact visibility at any designated Class I Wilderness Area.

### Noise

#### *Affected Environment*

All of the proposed NEON locations are in remote areas with the exception of the proposed Bozeman locations. No substantial noise would be generated at Aquatic Array A-29, and it is not further discussed. Existing noise levels at proposed NEON locations at YNP and Loch Leven would likely be approximately 40 dBA (USEPA, 1974). Baseline noise levels could be elevated during extreme wind conditions.

One proposed Relocatable Tower (R-23) is located on the southern edge of Bozeman in an agricultural field that borders the Rocky Mountain Museum to the north, the Bobcat Stadium and Martel Field complex to the west, a vacant lot to the east, and a residential area to the south. Existing background noise levels would likely be 40 dBA; however, background noise levels would be elevated, between 45 to 75 dBA, during sporting events at the adjacent sports complex and during peak commuting times, due to the proximity to South 7$^{th}$ Avenue. The nearest home to the proposed tower would be approximately 100 m away.

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would have minimal impact on residents in Bozeman. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. Construction workers would likely stay in Livingston, MT until the end of construction. No new roads would be constructed. During construction, noise levels would be elevated periodically during daytime from clearing, trenching, leveling, and other construction activities. If rocky conditions permit its use, operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. There is an unrelated project that would result in construction of Wireless Communications Facilities (WCFs) adjacent to the proposed NEON site concurrent with the installation of NEON infrastructure. It is likely that noise from construction of WCFs would exceed the noise from NEON work. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure, except that there would not be concurrent removal of WCFs.

Blast training is conducted at the Frog Rock Pit in YNP near the proposed Core Site. NEON, Inc. would coordinate with YNP to minimize the potential for cumulative noise impacts during construction and operation of NEON. Because blast training would create a single point noise source that would be much louder than any other noise in the area, any contribution of NEON to cumulative noise impact s would be negligible to minor.

Wildlife in immediate construction areas would be exposed to the elevated noise and would be expected to relocate from the construction area, but would likely resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

The pumps for atmospheric sampling equipment on an FIU would operate continuously. Typically, these pumps produce noise of approximately 65 dBA. NEON, Inc. would place the pumps within noise shielding to reduce the sound to less than 60 dBA at 12 m. Noise impacts to residents near proposed R-23 would be long-term and minor.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations except for R-23 in Bozeman. The proposed tower in Bozeman would be in a residential urban area and impacts to wildlife would be negligible.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area.

During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at Core Site tower locations and up to 5 years at Relocatable Sites).

Blast training is conducted at the Frog Rock Pit in YNP near the proposed Core Site. NEON, Inc. would coordinate with YNP to minimize the potential for blast training to interact with NEON sampling events. Animal population sampling would not be conducted during blast training events. No negative interaction between YNP blast training and NEON data collection would be expected.

The proposed NEON locations at YNP and Loch Leven are near recreational areas. Construction-related noise could cause interference with outdoor conversations and be noticeable during outdoor activities. However, NEON construction would not prevent any recreational activities. There would be a temporary, negligible impact on nearby recreational activities during construction.

During construction of R-23 in Bozeman, nearby residents could perceive nuisance noise from the operation of the trencher. Absent intervening vegetation, outdoor noise levels would be reduced to approximately 73 dBA as a result of natural attenuation from traveling 100 m (FHWA, 2007). Indoor noise levels would be further reduced by 15 to 25 dBA, resulting in indoor noise levels between 48 and 58 dBA (USEPA, 1974). This is considered a moderate noise level that could cause residents to increase the volume of televisions or radios. The Montana State University stadium is across the street from the proposed location of R-23 and residents are accustomed to occasional elevated noise levels as a result of events at the stadium. There would be negligible, temporary impact to nearby residents during construction.

There are no residences near the proposed NEON locations at YNP or Loch Leven. Therefore, noise from AOP overflights would have no potential to impact residents at these locations. NEON, Inc. would coordinate AOP overflights of the Core Site with YNP and comply with all NPS policies and regulations on aircraft overflights.

At the proposed Bozeman sites residences are lactated nearby. AOP flights at 1,000 m above the canopy would be expected to have no impact on residents or outdoor activities. AOP flights at 150 m above the canopy would be a short-term nuisance, but any impacts to residents or outdoor activities would be negligible. Potential impacts of AOP overflights on wildlife are discussed below.

## Water Quality

### *Affected Environment*

There are numerous streams and ponds in the general vicinity of proposed NEON locations in Domain 12. However, only three of the proposed sites (R-24, A-28, and A-29) have waters in the immediate proposed project area (Table 3.5.12.3-1).

**TABLE 3.5.12.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 12, Northern Rockies United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-34 | 14 | 0 | 12 | 0 | 64 | 0 |
| C-35 | 12 | 0 | 12 | 0 | 64 | 0 |
| C-36 | 13 | 0 | 13 | 0 | 67 | 0 |
| R-23 | 12 | 0 | 8 | 0 | 11 | 0 |
| R-24 | 15 | 1 | 0 | 0 | 22 | 1 |
| A-28 | 16 | 1 | 12 | 0 | 47 | 1 |
| A-29 | 12 | 1 | 9 | 0 | 9 | 0 |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009c.

The locations of the proposed towers at YNP (C-34, C-35, C-36) are in an upland area. The nearest receiving stream would be Oxbow Creek, which is approximately 0.5 km north-northeast of the proposed locations. From here, Oxbow Creek flows into the Yellowstone River approximately 4.4 km to the west-northwest. The proposed Aquatic Array at YNP (A-28) would be located on Blacktail Deer Creek on the Blacktail Deer Plateau, approximately 6.2 km upstream of the Yellowstone River.

Headwater streams of the Yellowstone River are generally pristine. Leachate from mine spoils and tailings can result in increased levels of trace elements in streams and groundwater within the Yellowstone River basin. Natural trace elements are introduced from leaching of soils with high concentrations of selenium. Geothermal areas can contribute elevated levels of arsenic to waters. Due to the presence of uranium-bearing rocks, elevated levels of radon may occur in waters (USGS, 2009d).

The proposed tower in Bozeman (R-23) would be approximately 120 m from a ditch flows through the city and into Bozeman Creek. Proposed Aquatic Array A-29 would be on Bozeman Creek within the Upper Missouri River basin. Bozeman Creek is a cold mountain stream that originates in the Gallatin National Forest and its water quality is impacted following wildfires. The combination of erosive soils and steep slopes can result in excessive sediment transport to Bozeman Creek after a wildfire. Ash also may fill the stream after wildfires (USFS, 2005). Bozeman Creek fully supports agricultural, drinking water, and industrial uses and partially supports primary contact recreation but has been assessed as not supporting aquatic life and cold water fisheries below its confluence with Limestone Creek. The section of Bozeman Creek below the confluence with Limestone Creek is on the Montana CWA Section 303(d) list of impaired waters (MDEQ, 2006a) and the proposed Aquatic Array (A-29) would be in this impaired section of Bozeman Creek.

The proposed tower at Loch Leven (R-24) would be approximately 160 m from the banks of the Yellowstone River. At this location, the Yellowstone River has not been fully assessed and has not been placed on the Montana CWA Section 303(d) list of impaired waters. However, this segment of the river is designated as partially supporting aquatic life and cold water fisheries (MDEQ, 2006b).

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

## Wetlands

### *Affected Environment*

The proposed towers at YNP (C-34, C-35, C-36) would be in upland areas. The nearest wetland to any of these towers would be approximately 0.5 km east. The proposed Aquatic Array on Blacktail Deer Creek (A-28) would be placed in a scrub-shrub wetland that floods temporarily (NWI, 2009) (Table 3.5.12.3-1).

The proposed NEON locations in Bozeman are not in wetlands. The nearest wetland is approximately 0.9 km west of the location proposed for Relocatable Tower R-23. The nearest wetland is more than 1.5 km from the proposed Aquatic Array (A-29) (NWI, 2009) (Table 3.5.12.3-1).

The proposed Loch Leven site (R-24) is approximately 170 m from the nearest wetland (NWI, 2009) (Table 3.5.12.3-1).

### *Environmental Consequences*

There would be no direct impacts to wetlands from installation of Core Site towers or the Relocatable Towers in Domain 12. There would be minor direct impacts to a wetland along Blacktail Deer Creek from construction of boardwalks to access Aquatic Array A-28. No other direct wetland impacts would occur. No indirect wetland impacts would be likely from implementation of NEON in Domain 12. No cumulative impacts to wetlands would be expected from this project.

Because all work would be confined to uplands, no direct impacts to wetlands would occur at the proposed NEON Core Site towers, the proposed Relocatable Towers, or the Aquatic Array proposed for Bozeman Creek. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for indirect impacts to offsite wetlands as a result of erosion and sedimentation from the construction sites. No indirect impacts to offsite wetlands would be expected.

A boardwalk would be constructed across the riparian wetland of Blacktail Deer Creek to access Aquatic Array A-28 for data collection and maintenance. The boardwalk would eliminate the potential for impacts to the wetland from trampling and soil compaction as a result of persons accessing the site. Any impacts would be long-term and minor, but limited to the area of the boardwalk (less than 20 $m^2$ at this site). The boardwalk would be removed at site closure. Temporary minor impacts to wetlands at Black Deer Creek would also be expected at the time of site closure. However, site closure would result in removal of the NEON boardwalk from the wetland, which would then be a long-term benefit to the wetland as the area would be returned to its pre-construction condition.

NEON, Inc. would obtain all required local, state, and federal permits regulating activities in wetlands prior to construction at this site and would comply with all permit conditions during construction activities (see Section 5.5 for a discussion of permits and approvals required).

### Floodplains

#### *Affected Environment*

Floodplain maps are not available for the proposed locations at YNP. The proposed Aquatic Array (A-28) along Blacktail Deer Creek in YNP would be in an area that is frequently flooded. The proposed towers at YNP (C-34, C-35, C-36) would not be located in a floodplain or in flood prone areas.

The proposed tower in Bozeman (R-23) is located in an area that has not been mapped for floodplains. This location is upslope from the nearest stream and would not be prone to flooding. The proposed Aquatic Array along Bozeman Creek (A-29) would be located within a floodplain (FEMA, 1988).

The proposed tower in Loch Leven (R-24) would be within the Yellowstone River floodplain (FEMA, 1987). The proposed tower location is near the edge of the floodplain.

#### *Environmental Consequences*

There would be negligible direct impacts to flood prone areas as a result of implementation of NEON. One Relocatable Tower and the Aquatic Arrays would be placed in floodplains and areas subject to flooding. The minimal displacement of the proposed equipment would result in a negligible impact on flood storage, flood elevations, and flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected.

The proposed towers at YNP (C-34, C-35, C-36) and Bozeman (R-23) would not be within floodplains or flood prone areas. No impacts to floodplains would occur at these locations and NEON infrastructure would not be at risk of damage from flooding.

The proposed Aquatic Arrays in YNP (A-28) and Bozeman (A-29) and the proposed Relocatable Tower at Loch Leven (R-24) would be in floodplains and subject to flooding. Relocatable Tower R-24 would be near the upper limit of the Yellowstone River floodplain. The minimal displacement of the proposed equipment would result in a negligible impact on flood storage, flood elevations, and flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected.

There is the potential for Aquatic Arrays and sensors on R-24 to be damaged during flood events. NEON, Inc. would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage. If sufficient advance warning of flood events is received, NEON, Inc. would temporarily remove equipment from floodplains to prevent flood damage or loss.

### Common Vegetation and Plant Communities

#### *Affected Environment*

Vegetative patterns at YNP are heavily influenced by soil characteristics and elevations. Steppe communities from 1,650 m to 2,160 m in elevation are dominated by big sagebrush, Idaho fescue, June grass, bluebunch wheat grass, and rabbit brush, typically confined to fine-textured, calcareous soils. Douglas-fir mixed with steppe communities are at elevations up to 2,300 m. Willow and aspen are prevalent in and along seeps and riparian zones. The spruce-fir-pine zone is located above 2,300 m and includes subalpine fir, Englemann spruce, lodgepole pine, limber pine, and whitebark pine. Historic fire intervals range from less than 20 years in the lower steppe communities, to 20 to 50 years in the Douglas-fir zone, and greater than 150 years in the spruce-fir-pine zone (Hansen, 2007). The proposed towers (C-34, C-35, C-36) would be in a Douglas-fir and snowberry forested community surrounded by big sagebrush, Idaho fescue, and sticky geranium moist non-forested community. The proposed Aquatic Array (A-28) would be located in a riparian zone consisting of willows and aspen, within the big sagebrush and Idaho fescue non-forested sagebrush community.

Proposed sites in Bozeman are located in urban areas. The proposed Tower R-23 site is in an agricultural field. The proposed Aquatic Array (A-29) is in the riparian zone of Bozeman Creek.

The proposed Tower R-24 site in Loch Leven is located in Paradise Valley, a nearly treeless valley of the Yellowstone River. Trees are typically confined to the banks of the Yellowstone River and riparian areas along smaller streams. Paradise Valley vegetation is dominated by grasses and forbs. Typical forbs include sticky geranium, wheatgrass, bedstraw, and yellow bean and typical grasses include fescue, Parry's oatgrass, and June grass (WWF, 2009).

#### *Environmental Consequences*

There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation would occur during construction to prepare for tower pads, fencing, and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads, fencing, and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site.

The spread of noxious weeds is a serious concern in this region. Areas disturbed through trenching or other construction activities would be stabilized and seeded with native vegetation in accord with respective land management agency BMPs. Where overhead utility lines are extended, there could be limited removal of trees along the route. Because of the need to keep the utility lines clear of vegetation, these areas would remain free of trees until the end of the NEON project. Utilities at YNP would be buried or placed in an above-ground conduit.

Minor clearing of vegetation would occur during construction to prepare for tower pads and IHs. Construction of fencing would result in a long-term negligible impact to vegetation. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate.

### Common Fauna

#### *Affected Environment*

Common mammal wildlife species at YNP include grizzly bears, black bears, gray wolves, elk, bison, moose, bighorn sheep, coyotes, and bobcats (NPS, 2009b). In the summer there are over 30,000 elk at YNP and between approximately 15,000 and 22,000 during the winter (NPS, 2009c). Gray wolves have been reintroduced to the park and are the main predators for elk. Grizzly bears are typically seen in open areas of the park, while black bears are often seen along the edges of trees in the Lamar and Hayden Valleys or amongst the trees near Mammoth and Tower (NPS, 2009d). The proposed sites at YNP are located within a Bear Management Area. Bighorn sheep are adapted to climbing steep terrain where they can avoid predators such as coyotes, eagles, and mountain lions. Mating season occurs from November to December and birth occurs between May and June (NPS, 2009e).

There have been over 300 bird species identified at YNP. Most of these birds are neotropical migrants (NPS, 2009f). Due to the cool, dry conditions of the area, there are only four species of amphibians and six species of reptiles within YNP. Amphibians include the boreal toad, chorus frog, spotted frog, and tiger salamander (NPS, 2009g). Known reptiles include the prairie rattlesnake, bull snake, valley garter snake, wandering garter snake, rubber boa, and sagebrush lizard (NPS, 2009h).

The proposed locations in Bozeman are in an urban area. Sensitive wildlife would not likely be encountered at the proposed locations (R-23, A-29).

Loch Leven is located in a nearly treeless valley along the Yellowstone River. Common wildlife known to occur in the area include white-tailed deer, pronghorn antelope, coyote, rabbit, and grouse. Westslope cutthroat trout, Yellowstone cutthroat, and fluvial arctic grayling can be found in the Yellowstone River and are common to the Montana Valley and Foothill Grasslands ecoregions (WWF, 2009).

#### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure at YNP and Loch Leven. No wildlife impacts would be expected at the urban sites in Bozeman. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding is likely.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Towers and guy wires at the relocatable sites would pose a minimal risk to common birds and flying mammals. Collisions with the tower or guy wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure. Towers in YNP would be self-supporting structures and would not have guy wires. There would be a lower risk of collision with birds and flying mammals at the YNP Core Site due to the lack of guy wires.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Montana Fish, Wildlife, and Parks and the Wyoming Game and Fish Division prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

There would be a long-term loss of habitat at towers and IHs, but the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall impacts to wildlife would be negligible.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because flights would be conducted after canopy leaf-out in YNP, visual stimuli would be minimal and the closed canopy could reduce airplane noise. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight.

Loch Leven is in a treeless area and there would be no visual screening of aircraft. It would still be expected that animals would startle at the noise of the plane but not initiate flight in response to the 1,000-m AOP overflights. Should an AOP flight occur at 150 m, animals would be expected to flee but no population-level impacts would be expected and impacts would likely remain minor.

Because impacts to fauna would be separated in space and time, no potential for interaction among proposed NEON projects or between NEON projects and other projects would be expected.

### Sensitive Species

#### *Affected Environment*

Because of the urban nature and level of development surrounding the proposed NEON sites in Bozeman, no protected species would be expected to occur at these sites (R-23, A-29). Appendix B, Table D-12 identifies the protected species known to occur within 5 km of the proposed Bozeman sites, but these species are not discussed because there is no suitable habitat at the proposed locations to support these species.

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 12 (Table 3.5.12.3-2). However, there are known occurrences of species protected under ESA and state and USFS protected species within 5 km of all the proposed NEON locations. In addition, potentially suitable habitat for protected species is present at or adjacent to all of the proposed NEON locations, excluding the Relocatable Site (R-23) and Aquatic Array (A-29) (Table 3.5.12.3-2). The following sections discuss the species with potential to occur at or adjacent to proposed NEON sites in Domain 12.

### Federally Protected Species

Four federally protected species have been documented as occurring within 5 km of the proposed YNP sites (C-34, C-35, C-36, A-28), along with one recently delisted species and one under petition to be federally protected (Table 3.5.12.3-2).

The whooping crane is a federally endangered species that rarely frequents the park. Only one whooping crane was observed at the park in 2000. This species prefers freshwater marshes, wet prairies, grain and stubble fields, and shallow lakes and lagoons. The whooping crane typically wades through standing water foraging for food. Because of the low-quality potential habitat at the proposed Aquatic Array (A-28) along Blacktail Deer Creek, it would be unlikely that this species would occur here as there is higher-quality habitat in other parts of the park (NPS, 2009i).

The gray wolf, a federally threatened species, was extirpated from YNP in the 1970s and was reintroduced into YNP in 1996 (NPS, 2009j). In 2007, there were at least 171 wolves in the park in 11 packs (NPS, 2009k). A den was located within 1 mile of the site during the winter of 2008-2009. There is no special physical habitat requirement for this species, but it does require ungulate prey on a year-round basis (Appendix B, Table D-12). Also, there is suitable habitat within 1.61 km of the proposed tower locations that could support a wolf den. This species could occur at any of the proposed sites at YNP.

**TABLE 3.5.12.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 12, Northern Rockies
*National Ecological Observatory Network (NEON) EA*

| | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-34 | 5-ESA | 0 | 3-ESA | 0 | 0 | 0 |
| C-35 | 5-ESA | 0 | 3-ESA | 0 | 0 | 0 |
| C-36 | 5-ESA | 0 | 3-ESA | 0 | 0 | 0 |
| R-23 | 2-ESA 2-USFS | 0 | 0 | 2 | 0 | 0 |
| R-24 | 4-ESA 3-USFS | 0 | 4-ESA 3-USFS | 2 | 0 | 2 |
| A-28 | 5-ESA | 0 | 3-ESA | 0 | 0 | 0 |
| A-29 | 2-ESA 2-USFS | 0 | 0 | 2 | 0 | 0 |

Source: Appendix B Domain 12

The grizzly bear is a federally threatened species in Wyoming but was delisted in the Greater Yellowstone area in 2007. However, the species remains protected within and around YNP. Conservation efforts were successful in raising the population to approximately 600 bears in 2007 (NPS, 2009l). Grizzlies prefer meadows, seeps, riparian zones, mixed shrub fields, closed and open timber, sidehill parks, snow chutes, and slabrock habitats (Appendix B, Table D12). The proposed locations at YNP are within an established Bear Management Area (NPS, 2009l).

The Canada lynx is a federally threatened species that is extremely rare in the park. There have been only two reports of the lynx within YNP since 1995, both in 1997. The park does provide suitable summer habitat, consisting of conifer forests and semi-open rocky areas, and adequate shelter, along with a variety of small mammals for food (NPS, 2009m). Also, there is suitable habitat within 1.61 km of the proposed tower locations that could support a lynx den. However, it is unlikely that this species would occur at or adjacent to the proposed sites at YNP.

American bison, a federally petitioned species to be listed, occur throughout YNP. Through successful management, the American bison population has increased to approximately 3,500. Bison are typically nomadic grazers traveling in herds and are prevalent along the high grassy plateaus in the summer (NPS, 2009n).

The American peregrine falcon was delisted from the federal threatened and endangered list in 1999. It is expected that the YNP peregrine falcon population will fully recover (NPS, 2009i). Peregrine falcons prefer open areas for foraging with suitable nesting cliffs nearby (Appendix B, Table D-12). This species would not nest near the proposed sites at YNP, but could use the area for foraging.

The gray wolf, grizzly bear, and Canada lynx are known to occur within 5 km of the proposed tower site at Loch Leven (R-24). These species were discussed above. The federally delisted bald eagle also occurs along the Yellowstone River within 5 km of proposed Relocatable Tower R-24, along with the USFS sensitive species Yellowstone cutthroat trout and the wolverine (Appendix B, Table D-12). The proposed tower would be placed near a boat ramp at Loch Leven, a park used for camping and fishing along the Yellowstone River. The habitat quality for the listed mammal species is poor at this proposed location (R-24). The Yellowstone River provides excellent habitat for the Yellowstone cutthroat trout and excellent foraging habitat for the bald eagle. The Yellowstone cutthroat trout prefers clear, cold streams, rivers, and lakes, similar to that of the Yellowstone River. The bald eagle feeds around rivers and lakes and usually nests or roosts on tall, old large diameter trees (Appendix B, Table D-12).

### USFS Protected Species

The wolverine, dwarf purple monkeyflower, and Yellowstone cutthroat trout are USFS sensitive species potentially occurring at or adjacent to proposed NEON locations in Domain 12.

The dwarf purple monkeyflower occurs in dry, open valleys and foothills (Montana Field Guide, 2009a). The species prefers gravelly or sandy slopes and could inhabit areas at or immediately surrounding proposed Relocatable Tower (R-23) and Aquatic Array (A-29).

The wolverine occurs in alpine tundra and boreal and mountain forests (Montana Field Guide, 2009b). This species could inhabit areas at or adjacent to proposed Relocatable Tower (R-24). The Yellowstone cutthroat trout prefers clear and cold streams, rivers, and lakes (Montana Field Guide, 2009c). This species could occur in the Yellowstone River adjacent to Relocatable Tower (R-24).

### State Protected Species

There were no state-listed species documented as occurring within 5 km of the proposed sites at YNP (C-34, C-35, C-36, A-29) (Appendix B, Table D-12).

There are five Tier I species and one Tier II species within 5 km of proposed Loch Leven site (R-24) (Table 3.5.12.3-2). Tier I species include the bald eagle, Yellowstone cutthroat trout, gray wolf, grizzly bear, and Canada lynx. The Tier II specie includes the wolverine (Appendix B, Table D-12). Tier I and II species are also federally listed or a USFS sensitive species and were discussed above.

### *Environmental Consequences*

Proposed NEON construction activities would not be expected to impact sensitive aquatic species. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for indirect impacts to sensitive aquatic species from sedimentation as a result of stormwater runoff. Data collection at Aquatic Arrays also would not impact sensitive aquatic species.

NEON, Inc. would work with property site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid any such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species and its required habitat.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Montana Fish, Wildlife, and Parks and the Wyoming Game and Fish Division prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

NEON, Inc. would coordinate with NPS to determine whether lynx or gray wolf have active dens near proposed construction sites. No NEON-associated construction or construction-associated activity would be conducted within 1.61 km of an active lynx or wolf den prior to August 1.

In advance of annual or seasonal data collection during the 30-year life of the project, NEON, Inc. would coordinate with NPS each year to determine whether lynx or gray wolf have active dens near proposed data collection sites. No NEON-associated human activity would be conducted within 1.61 km of an active lynx or wolf den prior to August 1 of any year.

There is the potential to disturb sensitive terrestrial wildlife of the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat nearby. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Towers and guy wires would pose a minimal risk to bald eagles at Loch Leven. Wires would be flagged to make them more visible to eagles following USFWS guidelines (USFWS, 2004). Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds would be removed at site closure.

## Cultural Resources

### *Affected Environment*

The proposed Core Site for NEON in Domain 12 would be near the border of Wyoming and Montana in the Yellowstone Northern Range and the Greater Yellowstone Ecosystem. The Advanced Tower (C-34) and two Basic Towers (C-35 and C-36) would be in YNP. An Aquatic Array (A-28) also would be placed in YNP, approximately 2.5 km west of the proposed Core Site tower locations.

Proposed Relocatable Sites would be at Bozeman, Montana (R-23), and at Loch Leven (R-24), on the Yellowstone River in Montana. The Loch Leven site would be just north of the Loch Leven Recreation Area and the Bozeman site would be approximately 1.0 km south of the Montana State University campus. An Aquatic Array (A-29) is proposed for Bozeman Creek, approximately 1.8 km northeast of the proposed location of R-23.

### Prehistoric Context

The Paleoindian period represents the earliest known occupation of the North American continent by hunters and gathers whose subsistence relied heavily upon now extinct big game animals. The Paleoindian period lasts from 10,000 B.C. until 6,000 B.C. and is defined by the presence of large lanceolate or stemmed projectile points belonging to the Clovis, Goshen, Folsom, Midland, Plainview, Hell Gap-Agave Basin, and Cody (MacDonald, 2008). Very little is known about the housing and life ways of Paleoindians. The Early Holocene period stretches from 6,000 B.C. to 3,000 B.C. and is associated with a warm and dry period which saw the extinction of *Bison antiquus* (MacDonald, 2008). Modern Bison (*Bison bison*) were present as were an essentially modern representation of game animals, including deer, elk, moose, rabbit, etc. The hunting and gathering lifestyle remains with a heavier emphasis on plant and seed processing, as evidence by roasting pits and grinding stones. Projectile points become smaller and are side or corner notched and used with an atlatl.

The Middle Holocene (3,000 B.C. – A.D. 500) encompasses what is generally referred to as the Middle Plains and Late Plains Archaic periods (MacDonald 2008). This tradition is defined by a greater diversity of projectile points, including points with bifurcated bases. There is a continuation of the hunting and gathering lifestyle with grinding tools, roasting pits, and concentrations of stone circles. The adaptation of the bow and arrow is the main technological change associated with the Late Holocene Period (A.D. 500 – A.D. 1,500). The projectile points become even smaller for use with the bow and arrow and there becomes widespread evidence of communal bison drives and jumps (MacDonald, 2008). Intermountain pottery is also used throughout the region. This tradition continues well into the time when Europeans began to enter into and settle in the area and encountered the Shoshone and the Crow Indians.

### Historic Context

While it is likely that Europeans first traveled through this area in the 18th century, the first written accounts of the area comes from Lewis and Clark as they traversed this region in 1805 and 1806. Lewis and Clark did not see what is now Yellowstone National Park; however, a fellow explorer in their party did go back and visit Yellowstone a few years later. The fur trade prompted most of the European settlement in the Northern Rocky Mountains domain during the first half of the 19th century. The discovery of gold in the west brought prospectors into the area, as well. Although, prospectors moving west first went to the main gold strikes, they soon branched out into new areas looking for their own gold veins and fortunes. The Bozeman trail lead prospectors from the Oregon Trail to the gold mines located approximately 129 km west of modern-day Bozeman in Montana. On July 7, 1864, the town of Bozeman was created by Daniel E. Rouse and William J. Beall. On March 1, 1872, President Ulysses Grant created the first national park when he set aside the 890,309-ha YNP. This was the beginning of tourism in the area, which only increased in the next decade as a completed railroad made travel to and settling of the area easier and quicker.

### Archival Literature Search

To assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON locations in Domain 12 within a defined study area that extended 1.6 km from each proposed location. A literature search was requested from the Montana State Historic Preservation Office (MSHPO) and the Wyoming Cultural Resource Information System (WYCRIS) online database was also searched. The files at both the MSHPO and WYCRIS contain information on previous cultural resource inventories and known cultural resources in their respective states. This effort also included a search of the NRHP and historic maps. Additionally, the following historic maps were reviewed: 1871 *Yellowstone National Park* (Historical Map Archive, 2001a); 1888 *Yellowstone National Park* (Historical Map Archive, 2001b); 1940 *State of Wyoming* (Historical Map Archive, 2001c); 1958 *Mammoth* (Historical Map Archive, 2001d), *Wyoming*; 1879 *Wyoming Territory Map* (WYCRIS, 1879); and the *Henderson Historic Trails Map* (WYCRIS, undated).

Several previous studies were conducted within 1.6 km of each of the proposed NEON locations but none of the specific proposed locations have been previously surveyed for cultural resources. Resources previously documented within the vicinity of the proposed NEON locations include historic residences, irrigation systems, lithic scatters, a buffalo jump, and a buffalo pound (Table 3.5.12.3-3). The literature search revealed that one previously known historic property occurs near the proposed location for A-28. This site was recorded in 1958 and has never been revisited or formally evaluated. There are no known historic properties at any of the other proposed NEON tower or infrastructure locations in Domain 12.

However, there are documented resources within 1.6 km of the proposed NEON locations in Domain 12. Other than the site at A-28, none of these resources would be within the area of disturbance. The study areas for R-23 and A-29, near the University of Montana, overlap due to their proximity. There are 45 known resources within the combined study areas of R-23 and A-29. Of these, 27 have been evaluated as eligible for

**TABLE 3.5.12.3-3**
Literature Search Results– Domain 12, Northern Rockies
*National Ecological Observatory Network (NEON) EA*

| Neon Site Number | Previously Surveyed | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | Number Evaluated | Number Eligible |
|---|---|---|---|---|---|---|---|
| | | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | | |
| C-34 | No | 0 | 1 | 0 | 3 | 4 | 4 |
| C-35 | No | 0 | 1 | 0 | 3 | 4 | 4 |
| C-36 | No | 0 | 1 | 0 | 3 | 4 | 4 |
| R-23 | No | 0 | 5 | 0 | 12 | 5 | 5 |
| R-24 | No | 0 | 2 | 0 | 2 | 0 | n/a |
| A-28 | No | 1 | 8 | 0 | 1 | 6 | 6 |
| A-29 | No | 0 | 6 | 0 | 35 | 22 | 22 |

Source: Montana State Historic Preservation Office; Wyoming Cultural Resource Information System (WYCRIS) the NRHP. One is a historic district listed on the NRHP that comprises 34 individual structures, 20 of which are contributing elements to the district. The remaining 14 structures have not been evaluated for significance.

The study areas for C-34, C-35, C-36, and A-28 also overlap due to proximity. There are 12 resources within the combined study area for these locations and 8 have been recommended eligible for the NRHP. None of the remaining sites have been evaluated for the NRHP or any other state or local register.

#### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 12 did not identify any significant known historic properties within the proposed areas of disturbance for any of the proposed locations. NEON, Inc. would be able to locate the monitoring equipment for A-28 to avoid impacting the unevaluated site near its proposed location. All of the other historic properties that have been previously documented or that appear on historic maps within 1.6 km of proposed NEON locations are outside of the area of disturbance. Towers would not be visible from any of the known historic properties.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 12, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

### Recreation

#### *Affected Environment*

YNP, a World Heritage Site, is a major tourist destination for outdoor activities ranging from biking, hiking, backpacking, and camping to fishing and horseback riding. The proposed NEON locations at YNP are situated approximately half-way between the Park Headquarters, near the north entrance, and the Roosevelt Lodge area. The proposed Advanced Tower C-34 would be within approximately 100 m of Blacktail Plateau Drive, a gravel road used for two-way bike traffic and one-way vehicle traffic. Blacktail Plateau Drive and Frog Rock Pit Road are also groomed and used for cross-country skiing during the wintertime. Proposed Basic Towers C-35 and C-36 would be approximately 175 m and 200 m, respectively, from Blacktail Plateau Drive. The entrance gate to Blacktail Plateau Drive would not be blocked (NPS, 2009o). The nearest trail is a self-guided trail approximately 2 km from the sites of the proposed towers and Aquatic Array (A-28), and on the opposite side of Highway 212 (NPS, 2009p). There are no campgrounds within 10 km of the proposed YNP sites.

Proposed NEON sites in Bozeman are not located in recreational areas. However, the proposed tower in Bozeman (R-23) would be near the Bobcat Stadium and Martel Field sports complex of Montana State University and the Museum of the Rockies.

Loch Leven is a recreational area managed by Montana Fish, Wildlife, and Parks (MFWP) that offers fishing access with a concrete boat ramp and primitive camping sites (MFWP, 2009). The proposed tower at Loch Leven (R-24) would be approximately 130 m from the parking area for the boat ramp and approximately 230 m from designated camping spots.

There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 12.

### *Environmental Consequences*

All of the proposed NEON locations in Domain 12 are in areas where public recreational activities occur. Minor short-term impacts to recreation could occur during construction. NEON infrastructure could be a nuisance to recreational users in the area, but long-term impacts on recreation would be minor. Because the NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would occur.

Construction activities could result in temporary use restrictions near proposed tower sites. Any impacts would be short–term and persons could conduct recreational activities in other parts of these properties. Any impacts would be negligible. To the extent practicable, NEON, Inc. would schedule construction to avoid peak recreational use times.

During construction and operation of NEON infrastructure at YNP, the entrance gate to Blacktail Plateau Drive would not be blocked, so there would be no impacts to recreational bicycle and car traffic on this road.

Construction activities could be a nuisance to participants in activities at the adjacent sports complex in Bozeman, Montana. However, no activities would be prevented and the nuisance would end when following construction.

The towers could be visible to persons hiking on nearby trails at YNP. The towers also could be visible to persons camping at Loch Leven. Minor negative aesthetic impacts could occur, but recreational activities would not be prevented.

Towers would be secured with fencing and locked gates to deter unauthorized access.

Black Tail Plateau Drive and Grand Loop Road receive substantial visitor traffic. YNP is planning road improvements at various locations in the park that could result in changes to traffic patterns and have the potential to interact with traffic associated with construction and operation of NEON in the park. Planned road improvement projects that could interact with NEON would occur from 2010 through 2014. Because of the uncertainty associated with projects farther out in time, it is not possible to accurately assess the potential for cumulative impacts on any work that may occur beyond 2014. Additionally, road projects completed prior to 2010 would have no potential to interact with NEON. Because NEON construction traffic and operational traffic would use the North Entrance, only road improvement projects that would extend into the Mammoth area would have the potential to interact with NEON. Within the established timeframe, only planned road repairs from Norris to Golden Gate (4.8 km south of Mammoth) would have the potential to interact with NEON. This work is planned for 2011 through 2014 and could interact with NEON construction or initial operations. NEON, Inc. would time construction to be outside of peak visitation periods to minimize the potential for interaction effects to recreational traffic. Because the road work would end 4.8 km south of Mammoth and would be unlikely to cause traffic backups that would interfere with access to Grand Loop Road in Mammoth, any interaction effects among

NEON construction or operational traffic, planned road projects, and recreational traffic in YNP would likely be negligible to minor.

### Utilities

#### *Affected Environment*

The proposed YNP Core Site towers (C-34, C-35, C-36) would be located between 100 m and 200 m of Blacktail Plateau Drive. Blacktail Plateau Drive intersects Highway 212 approximately 400 m to the west. The proposed Aquatic Array site at YNP (A-28) is approximately 100 m from an unpaved road and approximately 660 m south of Highway 212.

The proposed tower (R-23) and Aquatic Array (A-29) sites in Bozeman are located in areas where power is readily available. The proposed tower would be approximately 30 m from the edge of a paved road. The proposed Aquatic Array would be in an urban area almost adjacent to Garfield Street.

The proposed tower at Loch Leven (R-24) would be 130 m away from Loch Leven Road. Loch Leven Park has electricity.

#### *Environmental Consequences*

Extending power to the proposed NEON locations in YNP would require permitting through the NPS, and overhead transmission lines would not be allowed (Mazuu, personal communication, 2008). Utility lines would be placed in trenches along Highway 212 and Blacktail Plateau Drive. Power at the other proposed NEON locations in Domain 12 would also be extended from the grid terminus, with underground lines placed along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the existing access road where access for maintenance activities would be most efficient. Power would extend to proposed NEON sites through buried lines or lines in surface conduits. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for environmental impacts from land disturbed by trenching.

### Transportation

#### *Affected Environment*

The proposed YNP Core Site towers (C-34, C-35, C-36) would be between 100 m and 200 m from Blacktail Plateau Drive, an unpaved road that is used for two-way bike traffic and one-way vehicle traffic (NPS, 2009o). Highway 212 is approximately 400 m to the west of the site of the proposed utility portal. The proposed Aquatic Array at YNP (A-28) is approximately 100 m from an unpaved road and approximately 660 m south of Highway 212.

The proposed NEON locations in Bozeman are in urban areas. Proposed Relocatable Tower R-23 would be approximately 30 m from the edge of a paved road, and the proposed Aquatic Array (A-29) would be adjacent to Garfield Street.

Loch Leven is along East River Road, which intersects Highway 89. Loch Leven has year-round automobile access. The proposed tower (R-24) would be 130 m off of Loch Leven Road in an open field.

There would be potential for cumulative impacts to traffic as discussed under Recreation.

### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and transported by hand from that point to the construction site. Existing trails would be utilized at YNP. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur.

During construction and operation of NEON infrastructure at YNP, the entrance gate to Blacktail Plateau Drive would not be blocked, so there would be no impacts to bicycle and car traffic on this road.

Materials would be transported by hand from the road to the proposed NEON location. Improved trails would be created to move from the road to a proposed NEON location. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

## Human Health and Safety

### *Affected Environment*

All of the proposed locations are in areas easily accessible to the public. The proposed YNP sites are within the boundaries of the park, which receives heavy outdoor recreational use. The proposed sites in Bozeman would be located in urban areas near residential neighborhoods. Loch Leven is open year-round and is used for public fishing and camping.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. Construction workers would likely stay in Livingston, MT until the end of construction. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. All NEON, Inc. infrastructure and materials would be removed by NEON, Inc. upon site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

Proposed site locations would have restricted public access. This would limit health and safety issues to the public. In addition, towers would be secured with fencing and locked gates to deter unauthorized access.

There would be potential for employees or researchers riding ATVs to strike guy wires during routine work or during NEON maintenance and data gathering trips, except at YNP where the towers would be self-supporting. Guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

## Protection of Children

### *Affected Environment*

All of the proposed locations in Domain 12 are easily accessible to the public. The area surrounding the proposed sites in YNP receives heavy outdoor recreational use. The proposed sites in Bozeman would be in an urban area, near residential neighborhoods and adjacent to a sports complex. Loch Leven is used year-round for public fishing and camping.

### *Environmental Consequences*

No impacts to the environmental health and safety of children would be expected. Because NEON projects would be separated spatially, no cumulative impacts on the health and safety of children would be likely.

There could be potential safety issues for children from the temptation to try to climb the tower in Bozeman or at Loch Leven. Access to the tower would be restricted with secure fencing and locked gates. No pathway for direct exposure to an environmental health or safety risk to children would exist. No impacts to the environmental health and safety of children would be expected.

### Aesthetics and Visual Resources

#### *Affected Environment*

The Core Site and Aquatic Array A-28 would be in YNP, which offers exceptional aesthetic and visual resource values to visitors. The Relocatable Sites (R-23 and R-24) and A-29 would be in areas that are developed or in proximity to other human utilitarian features such as elevated electrical transmission lines and other visible infrastructure.

#### *Environmental Consequences*

The NPS Yellowstone Wireless EA (NPS, 2008) was used as the basis for determining visual impacts related to the proposed project. As part of the impact assessment effort, the NPS developed a visibility assessment for the three Core Site towers (C-34, C-35, C-36) that depicted the visibility of towers ranging from 16.8 m to 25.9 m with no intervening vegetation (Figure 3.D12.05). The area where the Core Site towers would be located is visible by people driving on the Grand Loop Road or along Blacktail Plateau Drive and by cross-country skiers on this road in the winter. Evergreen vegetation (pine trees) would screen most of the length of the Grand Loop Road from which the tops of the towers could be seen. Vehicles that traverse Blacktail Plateau Drive (a one-way road) would have a direct view of Advanced Tower C-34 as they make the first major turn to the east-southeast (Figure 3.D12.05). This direct view of C-34 would extend for approximately 125 m along the road before vegetation would screen the view. A second unobstructed view of C-34 would be possible from farther down the road, but only by persons looking to the back of the vehicle away from the direction of travel. The second unobstructed view would be available for approximately 60 m before C-34 would be screened by trees. The two Basic Towers would always be screened by vegetation from direct observation. Along some short stretches of Blacktail Plateau Drive the tops of the towers would be visible.

By the standards of the NPS Yellowstone Wireless EA, the impacts of the towers on visual quality would be minor to moderate. Minor impacts are defined in the NPS Yellowstone Wireless EA as follows: “Impacts to the visual quality of the landscape would be slight, but detectible, visible to a relatively small number of visitors and confined to a small portion of the surrounding area”). Moderate impacts are defined as follows: “Impacts to the visual quality of the landscape would be readily apparent and/or will affect many visitors, but would not preclude enjoyment of the adjacent views by a majority of the visitors.”). NEON would coordinate with YNP staff on final tower locations and would implement mitigation measures that would include use of non-reflective coatings on towers and other exposed surfaces to reduce visibility and no night-time lighting at the towers or the IH.

The proposed Aquatic Array would be located approximately 0.6 km south of the Grand Loop Road and would not include infrastructure that would be readily seen from the road. Thus, only negligible impacts would occur, as defined in the NPS Yellowstone Wireless EA: ("Impacts to the visual quality of the landscape are barely detectible, and/or will affect very few visitors.). The Aquatic Array in YNP would also include the same mitigation measures described for the Core Site towers.

R-23, R-24, and A-29 would have a negligible impact on aesthetic and visual resources due to the developed nature of the proposed locations. Any impacts would be minor.

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**Figure 3.D12-1** Domain 12 Proposed Site Locations

**Figure 3.D12-2** Domain 12 Proposed Site Locations

**Figure 3.D12-3** Domain 12 Proposed Site Locations

**Figure 3.D12-4** Domain 12 Proposed Site Locations

**Figure 3.D12-5** Domain 12Yellowstone NP Viewshed Analysis

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### 3.5.13 Domain 13 Southern Rockies

#### 3.5.13.1 Introduction

Domain 13 is the Southern Rocky Mountains-Colorado Plateau. This domain is characterized by large elevation and moisture gradients, both west to east and south to north.

The proposed Core Site for Domain 13 is the Niwot Ridge (NWT) LTER site. NWT is in Colorado, approximately 35 km west of Boulder. The area is high-elevation, ranging from 2,900 m to more than 4,100 m. The research area is bounded on the west by the Continental Divide. This area is closed to public motorized use and open to non-motorized use. One Advanced Tower (C-37, Figure 3.D13-1) and two Basic Towers (C-38 and C-39, Figure 3.D13-1) would be placed at the proposed Core Site, approximately 2.5 km west-southwest of Niwot Mountain. The three towers would be placed at elevations ranging from 3,350 m to 3,500 m.

Relocatable Sites proposed for Domain 13 include the Canyonlands Research Station (CRS) in Utah and the Fraser Experimental Forest (FEF) in Colorado. The FEF Relocatable Site (R-26, Figure 3.D13-2) would be located along the St. Louis Trail at an elevation of approximately 3,525 m. The area consists of habitat types similar to those associated with the NWT LTER site, including alpine tundra, tree line ecotone, oligotrophic alpine lakes, high-elevation streams, and forested areas. The CRS (R-25, Figure 3.D13-3) would be located 3.2 km north of North Six-Shooter Peak at an elevation of approximately 1,525 m. The Moab Relocatable Site is representative of high desert ecosystems of the Colorado Plateau, with limited precipitation that falls typically during the early spring and late summer months.

Two Aquatic Arrays are proposed for Domain 13. The proposed Aquatic Array in Roosevelt National Forest (A-30, Figure 3.D13-1) would be located on North Boulder Creek, a high alpine stream, just upstream of its connection to Silver Lake. A-30 would be located 1.5 km southwest of the Core Site at an elevation of approximately 3,200 m on property owned by the City of Boulder. Due to its fragile nature and importance to the city of Boulder for water supply, the area is closed to the public. The proposed Arapaho National Forest Aquatic Array would be located on Fool Creek (A-31, Figure 3.D13-2) just upstream of its connection with St. Louis Creek, at an elevation of approximately 2,950 m. The area consists of steep gradient forested habitats.

#### 3.5.13.2 Resource Areas Considered But Not Addressed for Domain 13

Preliminary analysis indicated that there would be no potential to significantly impact three of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Airspace: There is no restricted airspace in proximity to proposed Domain 13 locations. No impacts to or from restricted airspace would be expected in this domain.
- Environmental Justice: The proposed NEON sites would be located on remote lands some with limited public access. All potential impacts would be in remote areas and there would be no potential to disproportionately impact minority or low-income populations.

- Protection of Children: The proposed NEON sites would be located in remote areas some with limited public access. All potential impacts would be in remote areas and there would be no environmental health and safety risks to children.

#### 3.5.13.3 Resource Areas Considered in Detail

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 13 where site-specific conditions would influence the anticipated environmental consequences.

**Geology/Seismicity**
***Affected Environment***

In Domain 13, elevation ranges from below 1,000 m to over 4,000 m (Williams, 2008). Glacial activity resulted in the development of high rugged mountains, plateaus, alpine cirques, glacial moraines, and broad valleys. In this region there are 54 mountains exceeding 4,267 m in elevation. NWT LTER is on the eastern slope of the Continental Divide. Hogbacks, mesas, and rocky outcrops are typical where the high mountains meet the plains on the east and rugged canyons and mesas are prevalent where the mountains meet the high desert country to the west (LandScope America, 2009a). The Colorado Plateau, situated to the east of the Mohave and Sonoran Deserts and west of the Rockies, consists of extensive plains, canyons, buttes, mesas, and badlands (LandScope America, 2009b). The Grand Canyon is on the Colorado Plateau.

Domain 13 is relatively stable from the standpoint of seismic risk, except for its northwestern part. The maximum percent peak % pga with a 2 percent probability of occurrence in 50 years ranges from 12 % pga to 160 % pga for short wave motion and 4% pga to 40 % pga for long wave motion (USGS, 2009a; 2009b). The higher probability areas are near Provo and Salt Lake City in Utah.

***Environmental Consequences***

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact the underlying geology. The seismic hazard is low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

**Soils**
***Affected Environment***

Soils at the proposed Core Site consist mainly of Moran family-Lithic Cryorthents-Rubble land complex on slopes ranging from 5 to 40 percent. The soils typically occur on mountain slopes and moraines from glaciofluvial deposits derived from igneous and metamorphic rock. The soil is very stony with bedrock sometimes less than 43 cm below the soil surface (Natural Resources Conservation Service [NRCS], 2009a). Soils around the proposed North Boulder Creek Aquatic Array (A-30) consist of the Cryaquolls-

Leighcan family, till substratum complex found on slopes ranging from 0 to 15 percent and Leighcan family, till substratum, found on slopes ranging from 5 to 40 percent. Cryaquolls are deeper loamy soils found on the floodplains of North Boulder Creek. The Leighcan family typically occurs on mountain slopes and outwash plains and is extremely stony (NRCS, 2009b). Soils at the proposed Core Site are not highly prone to sheet or rill erosion.

Soils in the area of the FEF Relocatable Site (R-26) and Aquatic Array A-31 were mapped by the USFS (USFS, 1996). Soil parent material is generally derived from gneiss and schist. These soils are typically shallow and gravelly or sandy. Occasionally, small outcroppings of granitic rock occur. At high elevations, especially in the western portion, sandy soils containing large amounts of stone have developed from sandstone parent material (Popovich, 1993).

At R-25 soils range from rocky strata terraces, alluvial fans, glacial moraines, and talus slopes to eolian deposits and alluvium derived from sedimentary rock. Deep soils may occur on mountainsides, alluvial fans, valley fills, and mesas. Shallow soils and exposed sandstone cover escarpments, rims, and desert benches. Undisturbed soils typically are covered by biological crusts, a collection of cyanobacteria, algae, lichens and mosses, that stabilize soil against wind and water erosion, enhance water infiltration, and fix atmospheric nitrogen (USGS, 2006).

#### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

At each of the proposed NEON locations in Domain 13, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would be less than 0.02 ha at Basic Tower C-38 and less than 0.01 ha at each other proposed location. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby waterbodies. NEON, Inc. would reseed disturbed areas with local native species approved by the BLM and the USFS and would monitor for and control weeds until native species become well established.

After construction is complete and revegetation occurs, no soils impacts would occur during the 5-year or 30-year data collection period. The potential for similar temporary impacts to soils would occur at the close of the project during site restoration. NEON, Inc. would use similar BMPs during site closure to minimize the potential for soil impacts. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

### Climate

#### *Affected Environment*

Climate in this domain varies greatly depending upon elevation, with snow increasing and temperatures decreasing with elevation. Annual precipitation ranges from less than 2 cm in the desert areas of the Colorado Plateau to greater than 125 cm in the Rocky Mountains. Summer thunderstorms typically account for 10 to 50 percent of total annual rainfall on the Colorado Plateau (USGS, 2006). At FEF, in the Rockies, almost two-thirds of the precipitation occurs as snow from October to May (USFS FEF, 2008). The annual maximum temperatures range from 32˚C on the Colorado Plateau to -7˚C in the Rocky Mountains (Williams, 2008). In the Rockies the climate is windy, cool, and humid with long, cold winters and short, cool summers with the potential for frost year-round (USFS FEF, 2008).

#### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. There would be no potential for interaction with other projects and no cumulative impacts to climate would result.

Due to the extreme wind conditions on mountain tops, towers located along mountain ridges would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind. Site design would incorporate appropriate grounding and power filtering to protect instrumentation from damage from electrical surges due to lightning.

### Air Quality

#### *Affected Environment*

The proposed Core Site towers (C-37, C-38, C-39), and Aquatic Array (A-30) would be located in Boulder County, which is designated as in non-attainment for 8-hour ozone levels (USEPA, 2009a). The remaining sites are within attainment areas. The proposed sites are within 161 km of a designated Class I Wilderness Areas (USEPA, 2009b; 2009c).

#### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles and the primary generator at proposed Relocatable Site (R-25) during the operation of NEON infrastructure. Because emissions associated with NEON projects would be small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts on air quality. The amount of ground disturbance would be less than 0.01 ha at any proposed location and no large earthmoving equipment would be used. Appropriate

BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The 130-kW propane-powered primary generator at R-25 would operate fulltime. For propane-generators, annual NOx emissions are the largest emission by volume (9,048 kg/yr) when operated fulltime (Peak Power Tools, 2009). Total annual emissions would be less than 726 kg of any criteria pollutant. This would be a long term minor impact on local air quality.

The NEON project would not contribute to regional haze or air quality degradation and would not impact visibility at any designated Class I Wilderness Area.

### Noise

#### *Affected Environment*

All of the proposed locations are in remote areas. Existing noise levels under calm conditions at all proposed NEON locations in Domain 13 would likely be approximately 40 dBA (USEPA, 1974). Baseline noise levels could be elevated during extreme wind conditions.

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment at towers and a primary generator at R-25 would produce long-term continuous minor noise impacts. AOP overflights would cause no impacts to residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

For each proposed NEON tower site, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. Equipment would be brought in by helicopter and/or carried by hand to the remote areas and with as little impact as possible. No new roads would be constructed. During construction noise levels would be elevated periodically (only during daytime) from clearing, trenching, leveling, and other construction activities. A walk-behind trencher would be used to install utilities, if possible, but rocky conditions may prevent the usage of this type of equipment. If used, operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc. Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar temporary noise impacts would be expected at the time of site closure as infrastructure is removed.

Wildlife in the immediate area of construction would be exposed to the elevated noise levels and would be expected to temporarily relocate from the active construction area. Following construction, any displaced animals would be expected to resume normal activity and return to normal use of the areas. Any construction-related noise impacts would be temporary and minor.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

NEON, Inc. would place a 130-kW propane-powered primary generator at the proposed R-25 location. The generator would be placed inside a building to reduce environmental noise. Generators of this type produce noise of less than or equal to 74 dBA at 7 m (Peak Power Tools, 2009). Additional noise shielding including the attenuation from the building would reduce this noise to less than 60 dBA at 7 m (USEPA, 1974). This would still be above ambient noise levels. The noise from the generator and atmospheric sampling pumps would be similar in intensity and the overall noise level at R-25 would be approximately 3 dBA more than if only the generator or pumps were operating. Wildlife could be affected by the generator noise but, because the noise would be relatively constant, it is likely that some wildlife would become accustomed to it and resume use of the area. Any impacts would likely be minor.

None of the proposed NEON locations in Domain 13 have potential sensitive receptors living nearby, so there would be no impacts to offsite persons from construction and operation of NEON infrastructure.

No residences are near proposed NEON locations in Domain 13, so AOP flights would have no potential to impact persons at residences. AOP flights at 1,000 m above the canopy would be expected to have no impact on outdoor activities. AOP flights at 150 m above the canopy would be a short-term nuisance, but any impacts to outdoor activities would be negligible. The potential for AOP flights to disturb wildlife is discussed below.

#### Water Quality

##### *Affected Environment*

There are numerous streams and ponds in the general vicinity of proposed NEON locations in Domain 13. However, only the proposed Aquatic Arrays (A-30 and A-31) have waters in the immediate proposed project area (Table 3.5.13.3-1).

**TABLE 3.5.13.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 13, Southern Rockies United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-37 | 30-60 | 0 | 25 | 0 | ND | ND |
| C-38 | 25 | 0 | 18 | 0 | ND | ND |
| C-39 | 30-60 | 0 | 18 | 0 | ND | ND |
| R-25 | 17 | 0 | 0 | 0 | ND | ND |
| R-26 | 7 | 0 | 2 | 0 | ND | ND |
| A-30 | 30-60 | 1 | 19 | 0 | ND | ND |
| A-31 | 15 | 1 | 1 | 0 | ND | ND |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009c.

Quality of the surface waters in the NWT LTER where the proposed Core Site would be is influenced by discharge variations from snowmelt, to a lesser extent point and non-point sources, and in-stream processes. The proposed Core Site overlaps two adjacent watersheds, which are both gauged: Como Creek, a first-order watershed of 501 ha, and North Boulder Creek, a second-order watershed of 839 ha. Within the proposed Core Site there are seven high alpine glacial lakes, all of which drain into North Boulder Creek. Included in these are two of the Green Lakes, Lake Albion, Island Lake, Silver Lake, and two smaller unnamed lakes.

Proposed Aquatic Array A-30 would be located adjacent to the proposed Core Site and above the treeline on North Boulder Creek. The headwaters of North Boulder Creek (including Silver Lake) provide more than 40 percent of the city of Boulder's water supply (City of Boulder, 2007). The area is closed to public access and surrounding lands are in near natural conditions. These factors result in good water quality in surface waters. The North Boulder Creek watershed was mined intensively in the past for gold, silver, tungsten, and other metals. The ore deposits in the greater Boulder Creek watershed usually contain small amounts of sulfides, so runoff from old mines and tailings piles is typically not acidic or metal-rich. Metal concentrations in North Boulder Creek, such as mercury and lead, are usually low (Murphy et al., 2003). North Boulder Creek is within the "airshed" of the Denver metropolitan area and receives atmospheric deposition of air pollutants, such as nitrates and sulfates (Williams and Tonnessen, 2000). Currently, North Boulder Creek meets all designated uses as defined by the USEPA (CDPHE, 2005).

Water quality in the streams near the proposed R-26 and A-31 is influenced by the same factors as discussed for North Boulder Creek. Even though this watershed is on public lands, the influence of land use activities, such as mining, clear-cutting, and grazing, on water quality have altered the condition of this watershed. Fool Creek is a headwater tributary to St. Louis Creek. The St. Louis Creek watershed, downstream of the proposed FEF Relocatable Site and Fool Creek Aquatic Array is considered at risk (Class II). The Class II designation by USFS means: "the watershed is functional, but condition is only fair. The watershed condition may be in a downward trend, or at risk of degradation, or not yet fully recovered from past damage. Recovery is considered feasible through natural processes with added protection or with minimal capital investments" (USFS, 1997a). Water quality concerns downstream in the St. Louis Creek watershed include water diversions, erosion and sedimentation related to roads and trails (USFS, 1997a), and vehicle emissions.

Water quality in the area of the Moab Relocatable Site (R-25) is characteristic of high elevation desert systems. Highly erodible soils and seasonal precipitation regimes that are typical of high desert systems produce high flushing flows that transport large quantities of sediment into nearby streams and washes. The water quality of such systems is limited primarily by high sediment loading and to a lesser extent temperature. The Moab Relocatable Site is closest to the Indian Creek drainage, which meets its designated uses (State of New Mexico, 2008). An unnamed tributary to Indian Creek is located within the Relocatable Site area, but this stream would not be impacted by NEON infrastructure.

#### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. Equipment and materials would be brought in by helicopter and/or by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

NEON, Inc. would place a 130-kW propane-powered primary generator at the proposed R-25 location. Because the fuel would be propane, no impacts to water quality would result from a fuel release.

No other water quality impacts would result from NEON data collection.

Temporary impacts to water quality, similar to those discussed for construction, could occur at the close of the project during site restoration. NEON, Inc. would use similar BMPs during site closure to minimize the potential for water quality impacts.

### Wetlands

#### *Affected Environment*

There are no digital NWI maps or other existing data on wetlands for the proposed Core Site area, or for the Relocatable and Aquatic Arrays in Domain 13. However, high elevation wetlands may occur in these areas (Table 3.5.13.3-1). Crystalline bedrock geology of the area (Murphy, 2006), combined with depth, and topographic cross sections of the glacial lake bottoms would restrict wetlands in the area to relatively narrow fringes surrounding lakes and tributaries. Sediment deposition in lower elevation meadows may contribute to the development of wetland-meadow complexes.

Wetlands may occur within the proposed Core Site or at or near the proposed locations of A-30, A-31, and R-26. Any wetlands would likely be associated with drainage patterns of the seven high alpine glacial lakes and North Boulder Creek as described above. Wetlands that may occur in these areas include alpine moist meadows, alpine snowbed wet meadows, shallow lakes, and meadow wetlands.

No wetlands are known to occur at or adjacent to the proposed CRS Relocatable Tower (R-25) in Utah (Table 3.5.13.3-1).

#### *Environmental Consequences*

No wetland impacts would occur at proposed NEON sites in Domain 13. There would be no interaction with other projects. Therefore, no cumulative impacts to wetlands would occur.

Wetlands may occur near proposed NEON locations at the NWT LTER Core Site, the North Boulder Creek Aquatic Array, and the Fool Creek Aquatic Array. No towers associated with the sites or supporting infrastructure would be placed in wetlands. At both the North Boulder Creek and Fool Creek Aquatic Arrays, the Aquatic Arrays would be located within the stream channel and below the ordinary high water mark. No impacts to wetlands from the Aquatic Arrays are anticipated. NEON, Inc. would implement and maintain, as appropriate, BMPs as described in Section 2.2.2, to minimize the potential for direct and indirect impacts to wetlands.

No impacts to wetlands for Domain 13 sites are anticipated to occur as a result of NEON implementation or site closure.

### Floodplains

#### *Affected Environment*

FEMA overview maps for the NWT LTER Core Site area identify a series of glacial lakes and the North Boulder Creek drainage (FEMA, 2009). Typically, detailed FEMA maps are developed only for urban areas or other areas where human impacts from flooding would be expected. Due to the high elevation nature of these systems and their distance from any populated areas, no FEMA flood maps have been developed for proposed NEON areas in Domain 13. Also, no digital FEMA flood maps are available for the proposed FEF Relocatable Site, the proposed Fool Creek Aquatic Array, and the proposed Moab Relocatable Site.

Floodplains or flood prone areas would be expected to occur near the riparian corridors of both proposed Aquatic Arrays. However, no floodplains or flood prone areas would likely occur at any of the proposed tower locations.

#### *Environmental Consequences*

There would be negligible direct impacts to flood prone areas as a result of implementation of NEON. Two Aquatic Arrays would be placed in areas prone to flooding. The minimal displacement of the proposed equipment would result in a negligible impact on flood storage, flood elevations, and flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected.

At the proposed Core Site and the proposed Relocatable Sites, no towers would be placed within a floodplain or flood prone area. No changes to existing flood elevations, storage, or conveyance would result. NEON instrumentation at these sites would not need to be protected against potential flooding.

At the North Boulder Creek (A-30) and Fool Creek (A-31) proposed locations, the Aquatic Array would be placed in a floodplain or a flood prone area. However, the aquatic instrumentation is small and no increase in flood elevations would be expected, and any changes in flood storage capacity and flood conveyance would be negligible. There is the potential for Aquatic Array equipment to be damaged during flood events. The equipment would be positioned to minimize the potential to snag debris and any impacts on flood conveyance would likely be negligible.

There would be the potential for equipment to be damaged during flood events. NEON, Inc. would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts on water quality if they were to be lost in streams. There are no environmentally harmful components associated with this monitoring equipment. NEON, Inc. would temporarily remove equipment from flood prone areas when flooding is forecast for the area.

### Common Vegetation and Plant Communities

#### *Affected Environment*

Common vegetation occurring at the proposed Core Site for Domain 13, as well as the North Boulder Creek Aquatic Array includes subalpine forest, riparian forest and wetlands, and tundra (GES, 2003b) with abundant variations depending upon slope and aspect. Natural runoff tends to be low to medium in general, with a low probability of landslides, debris flows, or avalanches except where steep slopes and unstable geology suggest increased landslide potential. The most sensitive habitats are riparian areas and tundra, where management and restoration are particularly challenging. Major uses are research and wildlife habitat, including important summer range for big game, recreation, and watershed (USFS, 1996, USFS, 1997b).

At the proposed locations for R-26 and A-31, common vegetation is representative or subalpine and alpine regions of the Colorado Rocky Mountains, not unlike that at the proposed Core Site for Domain 13. Native vegetation consists of Engelmann spruce, and subalpine fir at higher elevations, on north slopes, and along streams. Lodgepole pine is the predominant tree at lower elevations and on drier upper slopes (Popovich, 1993).

Proposed Relocatable Tower R-25 would be at an elevation of approximately 1,525 m and would be within vegetation representative of most of the plant communities of the Colorado Plateau. Plant communities at the CRS include:

- Lowland, alkaline flats dominated by greasewood, salt bush, and rabbitbrush.
- Grassland steppes dominated by native bunchgrasses, such as Indian ricegrass.
- Riparian zones with willow and cottonwood.
- Upland sites covered by blackbrush and sagebrush shrub.

- Piñon-juniper woodland dominated by Piñon pine and junipers.
- Farmland dominated by crops and pasture grasses.

In the Abajo Mountains, plant communities change to mountain scrub dominated by Gambel oak and Ponderosa pine. Quaking aspen and mixed conifer forests (pine-spruce-fir) are topped by subalpine fir and spruce at the highest elevations.

### *Environmental Consequences*

Tree removal along utility lines would be a minor long-term impact to vegetation and plant communities. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation (less than 0.1 ha) would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site. Spread of noxious weeds is a serious concern in this region and areas disturbed through trenching or other construction activities would be stabilized and seeded with native vegetation as specified in BMPs consistent with the land management agency requirements. Where overhead utility lines are extended, there could be limited removal of trees along the route. Because of the need to keep the utility lines clear of woody vegetation, these would be kept free of trees by hand removal of saplings, as necessary, until the end of the NEON project.

Any noxious weed impacts would likely be negligible as a result of prompt stabilization and revegetation.

## Common Fauna

### *Affected Environment*

Common wildlife species that may use habitat types occurring at the NWT LTER Core Site and North Boulder Creek Aquatic Array area are diverse and abundant. Black bears, coyote, mountain lion, bobcat, elk, moose, mule deer, and beaver are all common to habitats found in the area. Yellow-bellied marmot, golden-mantled ground squirrel, Wyoming ground squirrel, Colorado chipmunk, and chickaree, in addition to various hummingbirds, raptors and songbirds, are also abundant and active in such habitats.

Aquatic resources in and around the proposed Core Site for Domain 13 and the North Boulder Creek Aquatic Array include cold water biota such as salmonid fishes and macroinvertebrate assemblages. Because natural conditions in these high elevation environments can be harsh and widely variable both seasonally and annually, populations of aquatic fauna would likely be low and fluctuate with natural conditions (Ellis, 1914).

The area surrounding the proposed locations for R-26 and A-31 provides a large block of excellent wildlife habitat spanning the subalpine and alpine zones (USFS, 2004a).

Wildlife species similar to those that would occur in habitats around the Core Site would be expected to occur in and around R-26 and A-31.

Aquatic resources at the proposed locations for R-26 and A-31 consist of cold water biota similar to those at the proposed Core Site. Forested habitats in and around the proposed locations for R-26 and A-31, however, would likely contribute to higher nutrient levels available to aquatic resources, allowing for an anticipated increase in species richness for this system.

The Colorado Plateau and the area around the proposed Moab Relocatable Site is a region of overlap, where animals of the hot deserts, Great Basin, Rocky Mountains, and Great Plains converge. The environmental heterogeneity in this region provides habitat for diverse invertebrate and vertebrate faunas (USGS, 2006). Common mammals in the area include mule deer, pronghorn antelope, elk, bobcat, coyote, kit fox, badger, striped skunk, bats, porcupine, and a wide variety of rabbits, hares, and rodents. Many species of raptors, hummingbirds, songbirds, as well as reptiles, and amphibians, are also found throughout the area.

No aquatic resources were identified at or near the proposed Moab Relocatable Site. No aquatic fauna would occur in the area.

#### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by helicopter and/or by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding is expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Towers and guy wires would pose a minimal risk to common birds and flying mammals. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Colorado Division of Wildlife and the Utah Division of Wildlife Resources prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

There would be a long-term loss of habitat at towers and IHs, but the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall, impacts to wildlife would be negligible.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at the Core Site and up to 5 years at Relocatable Sites). Fuel for the primary generator would be brought to the R-25 approximately every week. Refueling the generator would result in negligible increases in noise levels.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because flights would be conducted after canopy leaf-out, visual stimuli would be minimal and the closed canopy could reduce airplane noise. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight. Any impacts from overflights at either 1,000 m or 150 m for the AOP would likely be negligible.

Because impacts would be separated in space and time, no potential for interaction among proposed NEON project or between NEON projects and other projects would be expected.

### Sensitive Habitats

#### *Affected Environment*

Sensitive ecological communities in the area of the proposed NWT LTER Core Site, the proposed FEF Relocatable Site, and both Aquatic Arrays include a range of USFS Management Indicator Communities (MICs) that may support USFS Management Indicator Species (MIS) (USFS, 2004a). MICs identified for these areas include:

- Interior Forest – mostly spruce-fir forest that provides potential habitat for black bear and the golden-crowned kinglet.

- Young to Mature Forest Structural Stages – spruce-fir and lodgepole pine forest that provides potential habitat for elk, mule deer, and hairy woodpecker.
- Openings within or adjacent to Forest – mostly tundra but also grassland that provides potential habitat for elk, mule deer, and mountain bluebird.
- Riparian Areas and Wetlands – riparian forest, willow thicket, grassy marsh, and tundra bogs that provides potential habitat for Wilson's warbler.
- Montane Aquatic Environments – creeks and lakes that provide potential habitat for Colorado River cutthroat trout, brook trout, brown trout, and rainbow trout.
- Existing and Potential Old Growth Forest – spruce-fir forest that provides potential habitat for the northern three-toed woodpecker and the pygmy nuthatch.

Extreme elevation gradients have contributed to high habitat diversity throughout the area, with large blocks of interior forest and young-to-mature forest. There are expanses of tundra and generally continuous belts of riparian habitat along creeks and lakes. Habitat integrity is generally excellent except along roadways and trails. One of the largest blocks of old-growth forest on the Sulphur Ranger District occurs near the proposed FEF Relocatable Site (R-26).

In the area around the Moab Relocatable Site (R-25), biological soil crust is of primary concern. This crust is a living groundcover that forms the foundation of high desert plant life in Canyonlands and the surrounding area. This knobby, black crust is dominated by cyanobacteria, but also includes lichens, mosses, green algae, microfungi, and bacteria. Anthropogenic activity can negatively affect the presence and health of soil crusts. Compressional stresses placed on them by footprints or machinery are extremely harmful, especially when the crusts are dry and brittle (NPS, 2006).

### *Environmental Consequences*

Minor short-term and long-term impacts to sensitive habitats would result from installation of NEON infrastructure. No cumulative impacts to sensitive habitats would be expected.

Sensitive habitat could be disturbed at all locations through construction activities that may involve clearing of vegetation and ground disturbance. Interior forest habitats and tundra are likely to occur at the Core Site tower locations, as well as the FEF Relocatable Site. Riparian areas and wetlands are also likely to occur at the Aquatic Arrays.

At the Moab Relocatable Site (R-25), disturbance to biological soil crusts is anticipated. Biological crusts are poorly adapted to compressional disturbances such as those caused by domestic livestock grazing and recreational activities. Disruption of crusts results in decreased organism diversity, soil nutrients, soil stability, and soil organic matter. Direct damage to crusts usually comes in the form of trampling by humans and livestock or driving by vehicles. Full recovery of crust from disturbance is a slow process, particularly for mosses and lichens. Recovering crust thickness can take up to 50 years, and mosses and lichens can take up to 250 years to recover. Limiting the size of the disturbed area also increases the rate of recovery, provided that there is a nearby source of propagules. NEON, Inc. would strictly limit new paths and use existing disturbed ground as much as possible to limit the loss of biological soil crusts. Boardwalks would be used if particularly sensitive areas need to be crossed. Excess soils would be stored on lands that have been previously disturbed. NEON, Inc. would reseed spoil areas with local native species and would monitor for and control weeds until native species become well established.

Prior to construction activities specific site locations for all of these areas would be evaluated to determine the most appropriate placement of towers and/or monitoring equipment and thus minimize impacts to the extent practicable. BMPs would also be used to minimize the potential for impacts during construction. These BMPs are further discussed in Section 2.2.2. Impacts to sensitive habitats at the Core Site, Relocatable Sites, and Aquatic Arrays are anticipated to be minor and to range from short-term to long-term.

### Sensitive Species

#### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 13 (Table 3.5.13.3-2). However, there are known occurrences of federal, state, and USFS protected species within 5 km of all the proposed NEON locations, excluding proposed Relocatable Site (R-25). In addition, potentially suitable habitat for protected species is present at or adjacent to all of the proposed NEON locations, excluding Relocatable Site (R-25) (Table 3.5.13.3-2). The following sections discuss the species with potential to occur at or adjacent to proposed NEON sites in Domain 13.

### Federally Protected Species

The federally threatened greenback cutthroat trout occurs in North Boulder Creek and Como Creek and could occur near the proposed Aquatic Array (A-30) (Table Domain 13, Appendix B). This species is currently under consideration for delisting and can be handled only with a special permit (Williams, 2008). The trout has a small range limited to the upper reaches of the South Platte and Arkansas Rivers in Colorado and Wyoming. This species typically spawns in the spring, but spawning may occur in early summer at high-elevation sites. The greenback cutthroat trout prefers clear, swift-flowing mountain streams with cover (NatureServe, 2009).

The Canada lynx has been known to occur within a 5-km radius of the proposed NWT LTER sites and the proposed FEF tower site. The last sighting prior to recovery work in the 1990s occurred in 1973 near Vail (Colorado Division of Wildlife, 2009). This species prefers boreal and montane regions dominated by coniferous or mixed forest with dense undergrowth (NatureServe, 2009).

### USFS Protected Species

There are 5 species considered as Proposed, Endangered, Threatened, and Sensitive (PETS) by USFS that may use habitat at or adjacent to the proposed NEON locations in Domain 13 (Table 3.5.13.3-2). These five species include the wolverine, which was previously discussed, boreal owl, Colorado River cutthroat trout, burrowing owl, and ferruginous hawk (USFS, 2004a).

**TABLE 3.5.13.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 13, Southern Rockies
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-37 | 0-ESA<br>3-USFS | 0 | 0-ESA<br>2-USFS | 4 | 0 | 4 |
| C-38 | 0-ESA<br>3-USFS | 0 | 0-ESA<br>2-USFS | 4 | 0 | 4 |
| C-39 | 0-ESA<br>3-USFS | 0 | 0-ESA<br>2-USFS | 4 | 0 | 4 |
| R-25 | 0 | 0 | 0 | 0 | 0 | 0 |
| R-26 | 0-ESA<br>7-USFS | 0 | 0-ESA<br>5-USFS | 5 | 0 | 5 |
| A-30 | 1-ESA<br>5-USFS | 0 | 1-ESA<br>1-USFS | 2 | 0 | 2 |
| A-31 | 0-ESA<br>7-USFS | 0 | 0-ESA<br>5-USFS | 5 | 0 | |

Source: Appendix B Domain 13

The boreal owl prefers dense coniferous forests and mixed forests with thickets of alder, aspen, or stunted spruce (NatureServe, 2009). They are often found near open grassy areas and usually nest in cavities (NatureServe, 2009). This species could occur at or adjacent to the proposed Core Site, Relocatable Site (R-26), and Aquatic Array (A-31).

The Colorado River cutthroat trout is typically found in streams with clear, cool water and well-vegetated streambanks (NatureServe, 2009). This species may occur at or adjacent to the proposed Aquatic Array (A-31) and Relocatable Site (R-26).

The burrowing owl is found in open grasslands such as prairie, plains, and savannas (NatureServe, 2009). The species is also found on vacant lots near human populations or airports (NatureServe, 2009). This species could occur at or adjacent to proposed Relocatable Site (R-26).

The ferruginous hawk inhabits open areas such as prairies, plains, and badlands (NatureServe, 2009). The species is also found in shrub lands with sagebrush and saltbrush-greasewood (NatureServe, 2009). The hawk is also known to occur along the edge of woodlands and in the desert (NatureServe, 2009). This species could occur at or adjacent to proposed Relocatable Site (R-26).

## State Protected Species

There are four state-listed species known to occur within a 5-km radius of the proposed sites at NWT LTER. These include the Canada lynx, boreal toad, wolverine, and greenback cutthroat trout (Table Domain 13, Appendix B). Federally listed species are also on the state list of protected species. The boreal toad prefers wet habitats and can be found in marshes, wet meadows, streams, beaver ponds, glacial kettle ponds, and lakes within the subalpine forest from elevations of 2,438 m to 3,505 m (USFWS, 2009). The wolverine prefers alpine conifer forests, grasslands, chaparral, and tundra and typically burrow into the soil or inhabit fallen logs and debris (NatureServe, 2009).

There are three state-listed species and one state species of special concern that are not protected under the ESA that occur within a 5-km radius of the proposed NEON sites at FEF (Table Domain 13, Appendix B). This includes the boreal toad, wolverine, and Canada lynx, all listed as endangered. The Colorado River cutthroat trout is listed as a state species of special concern. The Colorado River cutthroat trout currently occurs in small headwater streams of the Green and upper Colorado Rivers. The trout requires cool, clear water with vegetated streambanks for cover (NatureServe, 2009).

There are no state-listed species documented occurring within a 5-km radius of the proposed Relocatable Tower at Moab (Natural Heritage New Mexico [NHNM], 2008)

### *Environmental Consequences*

Minor short-term and long-term impacts to sensitive species would result from installation of NEON infrastructure. No cumulative impacts to sensitive species would be expected.

NEON, Inc. would work with property owners and site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid any such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat.

There is the potential to disturb sensitive wildlife of the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Colorado Division of Wildlife and the Utah Division of Wildlife Resources prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

MBTA listed birds may be disturbed during construction and operation. Should nesting bird species protected by the MBTA occur in or adjacent to an area that would be cleared or be subject to a high level of human activity during construction, work would be delayed until after the young have fledged if the site could not be relocated.

The AOP would have a similar potential to impact sensitive wildlife species as that described for common fauna above. Any impacts would likely be minor.

### Cultural Resources

#### *Affected Environment*

The proposed NEON locations for Domain 13 are in two states and in very different regions and environmental settings. Most of the locations are in Colorado on the eastern edge of the Rocky Mountains. One location is in southeastern Utah at the CRS. Because these affected environments are so different, the cultural context information is discussed separately in this section.

### Prehistoric Context

#### *Colorado*

The prehistory of Colorado is divided into four phases based largely on noticeable changes in technology and subsistence strategies through time. The earliest phase is the Paleoindian Period, dating from 10,000 B.C. to 5,500 B.C. This period is dominated by big game hunters seeking largely extinct megafauna with distinctive spear tips of the Clovis, Folsom, and Plano traditions. Changing environmental conditions led to the Archaic Period (5,500 B.C. to A.D. 200), which is defined by a broadening subsistence strategy to include smaller game hunting and more plant and seed processing. The dart points become smaller and the basic toolkits become more diverse and include groundstone, fire pits, storage cists, and architectural features. The Late Prehistoric Period (A.D. 200 to 1600) represents a continuation of the Archaic subsistence pattern, but with the addition of the bow and arrow, ceramics, and the beginnings of limited horticulture. The introduction of the horse and the gun by Europeans greatly changed the cultures and ways of life.

#### *Utah*

The Paleoindian Period (10,000 to 6,000 B.C.) is defined by artifacts including Clovis and Folsom fluted lanceolate projectile points and Lake Mojave lanceolate projectile points. Reliance on big game hunting dominated the Paleoindian subsistence strategy, although there is very limited evidence of Paleoindian presence on the northern Colorado Plateau. The shift to the Archaic Period (6,000 B.C. to A.D. 100) is evidenced by a change to a broader strategy focused on hunting and gathering of resources. The projectile points became smaller and more suited for hunting smaller game, and there was an increase in the number and type of stone grinding implements used for plant and seed processing. While the Archaic Period is a long and broadly defined era, there are gradual changes in the archaeological record that allow for further temporal refinements of the period.

Significant changes in the cultural adaptations begin to occur around A.D. 100 and last through A.D. 1,300, a period known as the Formative Period. In southeastern Utah, this period is defined by the presence of the Anasazi, both the Kayenta and the Mesa Verde. The Formative Period is characterized by a shift to reliance on agriculture, sedentary villages, adoption of the bow and arrow, and presence of ceramics, including painted ceramics. Beginning at A.D. 1300 evidences of Numic speaking people appear in the region. The evidences include small, triangular arrow points, the abandonment of horticulture, and unpainted, distinctive brownware pottery. The Anasazi are believed to have abandoned the region due to increasingly dry and harsh conditions. At the time of contact with Europeans, the area was populated by Numic speaking groups including the Ute and Paiute.

### Historic Context

#### *Colorado*

Early Spanish explorers traversed sections of Colorado as early as 1541. However, Colorado remained largely unpopulated until well into the 19th Century, due in part to the hostile Native Americans, who had by then become mounted and armed. The Arapaho and Cheyenne were eventually moved to reservations in Oklahoma. The discovery of gold in the eastern Rocky Mountains led to the establishment of Boulder in 1858. Gold also brought prospectors who needed supplies and railroads to move the ore to market. Much of the history of the front range is directly linked to gold mining and railroad development. The railroads sprang up and quickly connected many of the towns.

#### *Utah*

The Historic Period opened with the first explorations of the Great Basin by Europeans. The Domingues-Escalante expedition in 1776 marks the earliest recorded entry of Europeans into Utah. The earliest Euro-American settlements came with the entry of the pioneer members of the Church of Jesus Christ of Latter Day Saints in 1847 into the Salt Lake Valley. Some early settlements were attempted by homesteaders from Colorado, but control of water and clashes with the Ute Indians left the area largely unpopulated. In 1879, an expedition of Mormons led by Silas Smith brought the first permanent settlement to San Juan County. These early settlers created colonies at Bluff and Montezuma Creek. Flooding from the San Juan River wiped out Montezuma Creek, but later settlements at Blanding and Monticello above the floodplain proved successful. Farming, ranching, and mining became the staples of the local economy, and later uranium mining sustained this area and connected it with the surrounding regions through railroads and highways.

### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 13, including a 1.6-km radius around the proposed location. A literature search of the Colorado Office of Archaeology and Historic Preservation (OAHP) was performed on December 2, 2008. The files at the OAHP contain information on surveyed cultural resources in the State of Colorado, and the search included the NRHP. On January 20, 2009 a literature review was conducted at the Utah Division of State History (UDSH). The files at UDSH contain information on all known sites and areas surveyed for cultural resources for the State of Utah.

None of the proposed NEON locations in Domain 13 have been previously surveyed for cultural resources, although several previous studies have been conducted within the 1.6-km study areas of the majority of the locations. Resources previously documented within the vicinity of the proposed NEON locations include lithic scatters, ceramic scatters, open campsites, game drive sites, and a mining camp (Table 3.5.13.3-3). The literature review revealed multiple previously recorded sites within 1.6 km of several of the NEON locations. None of the sites are listed or have been recommended eligible for the NRHP or any other state or local register.

**TABLE 3.5.13.3-3**
Literature Search Results—Domain 13, Southern Rockies
*National Ecological Observatory Network (NEON) EA*

| | | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | | |
|---|---|---|---|---|---|---|---|
| NEON Site Number | Previously Surveyed | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Number Evaluated | Number Eligible |
| C-37 | No | 1 | 9 | 0 | 0 | 0 | n/a |
| C-38 | No | 0 | 6 | 0 | 1 | 0 | n/a |
| C-39 | No | 0 | 11 | 0 | 0 | 0 | n/a |
| R-25 | No | 0 | 0 | 0 | 0 | n/a | n/a |
| R-26 | No | 0 | 0 | 0 | 0 | n/a | n/a |
| A-30 | No | 0 | 16 | 0 | 1 | 0 | n/a |
| A-31 | No | 0 | 0 | 0 | 0 | n/a | n/a |

Source: Colorado Office of Archaeology and Historic Preservation (OAHP), Utah Division of State History (UDSH), National Register Information System (NRIS). n/a = not applicable

### *Environmental Consequences*

The literature search revealed the potential presence of prehistoric resources within or near the area of disturbance of C-37. However, location data gathered from the available literature are not precise enough to determine whether this site is within the area of disturbance. In addition, this resource has not been previously formally evaluated for significance. The site in the vicinity of C-37 would need to be revisited prior to construction so that its exact location can be mapped for avoidance. It is NEON, Inc.'s intention to avoid impacts to sensitive resources through final selection of locations for NEON facilities. During the final site selection process, a site would be selected such that the proposed facility would not cause adverse effects on cultural resources. The final site selection of C-37 would completely avoid the previously documented archaeological site.

A total of 19 historic properties have been documented outside the area of disturbance, but within the 1.6-km study areas of C-37, C-38, C-39, and A-30. None of these sites have been previously recommended eligible for the NRHP and all fall outside of the proposed area of disturbance. Towers would not be visible from any of the known historic properties.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 13, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

### Recreation

#### *Affected Environment*

Recreation in and around the NWT LTER site is limited to public non-motorized use and the North Boulder Creek site (A-30) is restricted due to closure of the area to the public.

The area around the FEF Relocatable Site is popular for outdoor recreation. This area contains Byers Peak, a popular destination, and has easily accessible subalpine forest, subalpine riparian areas, and alpine tundra. The watershed proposed for the Relocatable Site is relatively roadless, which is rare in the FEF area, and has few trails, offering visitors a relatively pristine forest/tundra experience and high potential for solitude except on the most popular trails. The protection received over the years as a research area makes the FEF more attractive for recreation today (USFS, 2004b).

Summer recreational access is dominated by motorized traffic. Visitors typically drive for pleasure and enjoy the subalpine environment. At present, vehicle parking does not meet demand (GES, 2003a). Hikers tend to use the higher elevation trails in the area, with the most popular trails being Byers Peak Trail and St. Louis Lake Trail. The Fool Creek and East St. Louis Creek drainages are highly valued by a small number of mostly local hunters. Mountain biking is the most popular summer non-motorized recreational use at lower elevations. Camping is available at the Byers Creek Campground and at the nearby St. Louis Creek Campground. Snowmobiles dominate winter motorized recreation but are limited to approximately 16 km of designated roadways. All roads and trails are open to winter non-motorized recreation, which is mostly cross-country skiing and snow-shoeing, and most activity occurs at lower elevations. There also is a limited amount of dog-sledding in winter.

The area around the Moab Relocatable Site is widely recognized as a world class climbing destination. Climbing occurs in the Indian Creek area and on and around North and South Six-Shooter Peaks.

The Canyonlands National Park Needles District is located at the end of State Route 211, approximately 10 km from the proposed Moab Relocatable Tower location (Google Earth, 2009). The Needles District is used for outdoor activities such as hiking and backpacking. The Needles District has over 80 km of four-wheel drive roads, but no ATVs are allowed (National Park Service (NPS), 2009).

The Continental Divide NST passes within 10 km of the proposed Core Site area. There are no other NSTs or NHTs within 10 km of proposed NEON locations in Domain 13.

#### *Environmental Consequences*

Minor short-term impacts to recreation could occur at some proposed NEON locations during construction. Long-term impacts on recreation would be negligible. Because NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would be likely.

The proposed NEON locations at the NWT LTER site, FEF, and Moab are located in areas where outdoor public recreational activities could occur, though there are no designated areas immediately nearby. Elevated noise levels during construction at proposed NWT LTER, FEF, and Moab sites would be noticeable by any persons hiking on nearby trails. This noise would be a nuisance, but the elevated noise would cease following construction. Construction activities at proposed Moab sites would not affect access to the Canyonlands National Park Needles District. Any impacts would be negligible.

Noise from operation of the primary generator at R-25 would likely be a nuisance to nearby recreational users. However, the noise from the generator would not prevent recreational activities. Any impacts would be minor.

At proposed NEON locations where recreational vehicle activity could occur, guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

There would be no impacts to the Continental Divide NST from implementation of NEON. While the trail is within 10 km of the proposed NEON locations on Niwot Ridge, there are a series of mountain peaks that exceed 3,960 m between the trail and Niwot Ridge. Along this portion, the Continental Divide NST is in a valley on the western side of multiple elevated ridgelines and the proposed NEON locations would not be visible from the trail.

### Utilities

#### *Affected Environment*

Niwot Ridge LTER is provided electricity through Excel Energy. The proposed Advanced Tower (C-37) would be located approximately 200 m from the edge of the main access road. Proposed Basic Tower 1 (C-38) would be located approximately 300 m from the edge of the main access road. Proposed Basic Tower 2 (C-39) would be located approximately 150 m from the edge of the main access road. Transformers and power connections have been established previously at NWT LTER for similar towers (Williams, 2008). The proposed Aquatic Array at NWT LTER is less than 30 m from the main access road.

The proposed Relocatable Tower at FEF would be less than 5 m from an existing road. The proposed Aquatic Array at FEF would be approximately 120 m from the edge of an existing road.

The proposed Relocatable Tower at Moab would be approximately 70 m from the edge of a USFS road and approximately 800 m from the nearest paved road, State Route 211.

#### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed in trenches along existing roads as far as allowed or to the point nearest proposed tower locations. Powerlines in Roosevelt and Arapaho National Forests are required to be buried (USFS, 1997b). Lines that cannot be buried due to rocky ground or other issues would be placed in a surface conduit. A portal would be placed at the point nearest the existing access road where access for maintenance and generator refueling for R-25 would be available. From the portal, the buried line would extend from the edge of the existing road to connect to the proposed NEON sites. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for impacts.

NEON, Inc. would place a 100-kW propane primary generator at the proposed R-25 location. There is no existing power infrastructure at this location. Use of the primary generator would avoid use of existing utilities.

### Transportation

#### *Affected Environment*

The proposed NEON locations at NWT LTER would be accessed using USFS Roads 506.1 and 506.2. This is a dirt road appropriate for a two-wheel drive vehicle with high clearance. Access is limited to administrative use only to minimize vehicle traffic that may affect ongoing air quality monitoring. This road is maintained year-round by the Boulder County Road Department and the University of Colorado Facilities Management. A separate road, maintained by the City of Boulder, is used to access the North Boulder Creek watershed, which is the proposed location for an Aquatic Array. During winter months the roads are only accessible by snowmobiles and tracked vehicles (Williams, 2008).

In the area of the FEF Relocatable Site and Fool Creek Aquatic Array, approximately 37 km of roadways are open to summer public motorized and non-motorized recreational use (USFS, 2004a). Roads at higher elevations are of lower quality and tend to have more rills and areas of washboard surface, steeper grades, and tighter curves due to the USFS history of not maintaining upper elevation roadways to maintain baseline conditions. Most roads around the FEF Relocatable Site extend through heavily forested areas, allowing minimal views or vistas. Only Fool Creek Road extends up to the tree line, allowing views of the surrounding area.

The proposed Moab Relocatable Tower would be accessed off a dirt road from State Route 211, a paved two-lane road. State Route 211 ends at Canyonlands National Park Needles District shortly past the dirt road that would be used to access the proposed Relocatable Tower.

#### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

No new roads would be constructed. Materials would be brought as near to a proposed location as possible on existing roads and transported by hand from that point to the construction site. Unpaved roads could be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur. This would require a written plan and USFS approval. A helicopter would be used if there are no nearby roads.

Materials would be transported by hand from the road to the proposed NEON location, unless a helicopter is used. Improved trails would be created to move from the road to a proposed NEON location. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access. Trails created at the proposed FEF sites could be subject to substantial human use due to the level of human activity in the area.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

### Human Health and Safety

#### *Affected Environment*

All of the proposed locations are in remote areas. At NWT LTER, motorized access is limited to staff and researchers. Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Materials would be brought in by hand or by helicopter.

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety.

However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

The Core Site towers would be at or above 3,350 m. Workers would employ measures to prevent injury to skin and eyes from ultraviolet radiation and other appropriate measures to minimize the potential for altitude sickness and hypothermia.

Tower locations would be on land with relatively gentle to level slopes, either along ridge tops or near the base of slopes. Workers would not be exposed to hazards as a result of steep slopes or precipices at a worksite.

Proposed site locations are all in remote areas. Towers would be fenced and locked, reducing the risk of unauthorized access to the tower. This would limit public health and safety issues.

There is the potential for researchers or the public riding ATVs or snowmobiles to contact the guy wires during outdoor activities, routine work, or during NEON maintenance or data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential of an injury. Any impacts to site users would likely be negligible.

#### Aesthetics and Visual Resources

##### *Affected Environment*

The Core Site and both Relocatable Sites (R-25 and R-26) would be in areas that are extensively used for recreation and that provide aesthetic and visual resource values to visitors. In addition, R-25 would be only 10 km from Canyonlands National Park, which provides high aesthetic and visual resource values to visitors.

##### *Environmental Consequences*

The proposed NEON towers in Domain 13 would be visible to persons in the general area of the towers and would detract from the aesthetic and visual resource value near the towers. The proposed Core Site towers at NWT LTER could be visible from portions of the Peak to Peak Highway, a designated scenic highway (USFS, 1997b). NEON, Inc. would use non-reflective coating on the towers to reduce visibility and would not have night-time lighting at the towers. Any impacts to the view from the Peak to Peak Highway would likely be minor.

Due to the distance from Canyonlands National Park (approximately 3.6 km), no adverse impacts to aesthetic and visual resources at the park would be expected from R-25. The proposed tower location is on the opposite side of a ridge from Canyonlands National Park that is approximately 90 m taller than the proposed tower. This ridge would effectively prevent park visitors from seeing the tower. NEON, Inc. also would use non-reflective coating on the towers to reduce visibility and would not have night-time lighting at the towers. Any impacts would likely be negligible.

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**Figure 3.D13-1** Domain 13 Proposed Site Locations

**Figure 3.D13-2** Domain 13 Proposed Site Locations

**Figure 3.D13-3** Domain 13 Proposed Site Locations

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### 3.5.14 Domain 14 Desert Southwest

#### 3.5.14.1 Introduction

Domain 14 extends from the western side of southern California, across the southern tip of Nevada, but skipping Las Vegas, and into northwest Arizona. From northwest Arizona, the Domain 14 boundary extends southwest through the state and into southwest New Mexico, and finally into the western Mountains and Basin Region of Texas. The Mexican border comprises the entire southern boundary of Domain 14 (Figure 2-1).

The Core Site Advanced Tower (C-40, Figure 3.D14-1) and Basic Towers (C-41 and C-42, Figure 3.D14-2) would be located at Santa Rita Experimental Range (SRER) in Pima County, Arizona, approximately 35 km south of Tucson. One of the Relocatable Sites (R-27, Figure 2-D14-3) would be positioned at the Jornada Basin (JB) LTER area in the Chihuahuan Desert, Doña Ana County, New Mexico. The other Relocatable Site (R-28, Figure 3.D14-4) would be placed at the Central Arizona – Phoenix LTER (CAP LTER), on the eastern outskirts of metropolitan Phoenix in Pinal County, Arizona. The CAP LTER is a study area that focuses on the effects of urbanization on adjacent ecologies. Finally, the STREON Site (S-33, Figure 3.D14-5) would be located in Sycamore Creek, approximately 1 km upstream from Otero Canyon in Maricopa County, Arizona, in the southwest region of the Tonto National Forest.

#### 3.5.14.2 Resource Areas Considered But Not Addressed for Domain 14

Preliminary analysis indicated that there would be no potential to significantly impact six resource areas as a result of implementation of NEON in Domain 14. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Wetlands: No wetlands occur at or within 5 km of the proposed NEON construction areas in Domain 14. There is no potential for direct impacts to wetlands. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for indirect impacts to offsite wetlands as a result of soil erosion and sedimentation.
- Floodplains: No floodplains occur within or adjacent to proposed NEON locations in Domain 14.
- Sensitive Ecological Communities: All desert habitats are sensitive, but there are no site-specific sensitive ecological vegetation communities within 5 km of the any of the proposed NEON sites in Domain 14. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize impacts to the desert and to minimize the potential for indirect impacts to offsite areas as a result of soil erosion and stormwater runoff.
- Recreation: With the exception of the proposed STREON Site, all NEON infrastructure proposed for Domain 14 would be placed in areas where public recreation does not occur. The Arizona NST is within 10 km of the proposed Core Site, but is separated from the Core Site by a mountain range and there is no potential for impact. There are no other NSTs or NHTs within 10 km of proposed

NEON locations in Domain 16. Sycamore Creek is not fished for trout (USFS, 2009a). The proposed STREON infrastructure and experiments would not impact recreation in the Tonto National Forest and there would be no potential for impacts to recreation at other proposed ENON locations.

- Environmental Justice: The proposed NEON sites are located on land with limited public access. All potential impacts would be confined to these lands and there would be no potential to disproportionately impact minority or low-income populations.
- Protection of Children: The proposed NEON sites are located on land with no access by unsupervised children. All potential impacts would be confined to these lands and there would be no environmental health and safety risks to children.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 14 are designated research areas that are not routinely viewed for aesthetic quality or urban lands where aesthetic quality is impaired. Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

#### 3.5.14.3 Resource Areas Considered in Detail for Domain 14

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 14 where site-specific conditions would influence the anticipated environmental consequences.

##### Geology/Seismology

##### *Affected Environment*

All of the proposed Domain 14 NEON sites are within the physiographic region known as the Basin and Range Province (USGS, 2009a). The geology of this region formed through a process of the earth's crust stretching in an east to west direction, leading to the formation of alternating north to south mountain and valley ranges. As a result of this stretching process, also referred to as "extension," the crust layer of the Basin and Range Province is extremely thin (NationMaster.com, 2009).

Much of the Basin and Range Province is fairly unstable in terms of seismicity; however, the proposed NEON Domain 14 sites are more stable than the surrounding areas. Within the vicinity of the SRER, CAP LTER, and the proposed Sycamore Creek STREON Site, the maximum % pga acceleration with a 2 percent probability of occurrence in 50 years ranges from 24 to 28 % pga for short wave motion and 4 to 6 % pga for long wave motion (USGS, 2008a, 2008b). The JB LTER is similar, with a maximum % pga acceleration with a 2 percent probability of occurrence in 50 years ranging from 24 to 28 % pga for short wave motion and approximately 6 % pga for long wave motion (USGS, 2008a, 2008b).

##### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact subsurface geological features. The seismic hazard is negligible in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

## Soils

### *Affected Environment*

Soils within the vicinity of the proposed Advanced Tower C-40 are dominated by non-hydric Anthony soils, very gravelly variants (NRCS 2009a). All soils near the proposed tower location are upland soils and no hydric soils occur in this vicinity (NRCS 2009a; 2009b). Anthony soils formed from recent gravelly alluvium derived from granite or limestone and occur on alluvial fans. The typical soil profile is fine sandy loam to a depth of 41 cm and a very gravelly fine sandy loam to a depth of 152 cm. Soils in the vicinity of the proposed location of C-40 are not highly susceptible to sheet or rill erosion (NRCS, 2009a).

Towers C-41 and C-42 would be placed on non-hydric Comoro soil, 0 to 5 percent slopes (NRCS, 2009b; 2009c; 2009d). This soil type formed from mixed recent alluvium and occurs on floodplains. A typical soil profile of Comoro soils is a sandy loam to a depth of 91 cm and a gravelly sandy loam to a depth of 152 cm. Comoro soils are not highly susceptible to sheet or rill erosion (NRCS 2009c; 2009d).

Soils within the vicinity of the proposed Relocatable Tower R-27 are dominated by upland soils of the Onite-Pajarito soil association (NRCS 2009e; 2009f). This association is composed of 40 percent Onite and similar soils, 30 percent Pajarito and similar soils, and 15 percent Pintura and similar soils. The Onite soil occurs on basin floors and is formed from igneous derived coarse-loamy alluvium. The typical Onite soil profile consists of loamy sand or sandy loam to a depth of 152 cm. The Pajarito soil occurs on dunes on basin floors and formed from mixed coarse-loamy alluvium. The typical Pajarito soil profile is fine sandy loam to a depth of 152 cm. The Pintura soil occurs on shrub-coppice dunes on basin floors and formed from sandstone derived eolian sands. The typical Pintura soil profile consists of fine sand to a depth of 152 cm. The Onite-Pajarito association is not highly susceptible to sheet or rill erosion by water (NRCS 2009e).

### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

At each of the proposed NEON locations in Domain 14, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would be less than 0.02 ha at C-41 and C-41 and less than 0.01 ha at each other proposed location. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are highly prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and also for indirect impacts to surface waters from transport of eroded materials into nearby waterbodies.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

## Climate

### *Affected Environment*

The climate varies at the SRER. Advanced Tower C-40 would be placed at a lower elevation in the Sonoran Desert region of the SRER. Mean annual temperatures in this area range from 28°C during the day to 12.8°C at night (weather.com, 2009a). The average annual precipitation is less than 26 cm (University of Arizona [UofA], 2009a). The two Basic Towers (C-41, C-42) proposed within the SRER would be located in the higher elevation, semi-arid grassland-scrub. Mean annual temperatures in this area are similar to those of the C-40 tower location, but the annual precipitation average is nearly double that of the lower elevation at approximately 46 cm per year (UofA, 2009a; weather.com, 2009a).

The JB LTER R-27 Site would be located in the northern Chihuahuan Desert. The mean annual temperatures are 24.6°C during the day and 4°C at night (JB LTER, 2009). The average annual precipitation is approximately 23 cm, with peak rainfall occurring from July to September (JB LTER, 2009).

Mean annual temperatures at CAP LTER (R-28) are 29.2°C during the day and 13.1°C at night (weather.com, 2009b). Average annual rainfall at CAP LTER is approximately 35 cm. Peak rain events typically occur in March and August (weather.com, 2009b).

The nearest available weather data for the Sycamore Creek STREON Site came from Rio Verde, Arizona which is approximately 15 km west of the proposed site (weather.com, 2009c). The mean annual temperatures in this region are 30°C during the day and 14°C at night. The average annual rainfall is 40.3 cm, with peak rainfall occurring in March and August (weather.com, 2009c).

Weather events, such as cold fronts and monsoons, which impact the southern half of Arizona and New Mexico, typically come from the Pacific Ocean. Monsoon season occurs during July and August when the dew point rises. Thunderstorms with heavy wind, lightning, and torrential downpours are common during the monsoon season. Tornados and hurricanes are rare in this region (Arizona Paths, 2009; USACE, 2008; Western Regional Climate Center, 2009).

### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. Due to the potential for severe winds from major storms, towers would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind. Site design also would incorporate appropriate grounding and power filtering to protect instrumentation from damage from electrical surges due to intense lightning.

## Air Quality

### *Affected Environment*

SRER, JB LTER, CAP LTER, and the proposed STREON Site are all located in rural areas that are designated as in attainment for all criteria air pollutants. Nogales, Arizona, which is 43 km south of the SRER, is the closest nonattainment area to any of the proposed tower locations. The proposed STREON Site is 32 km northeast of the Phoenix nonattainment area

Out of the 12 Mandatory Class I Federal Wilderness Areas in Arizona, 4 are within 161 km of a proposed NEON site (USEPA, 2009b). The Chiricahua National Monument and Wilderness Area is 128 km east-northeast of the SRER. The Galiuro Wilderness Area is 76 km northeast of the SRER and 149 km southeast of CAP LTER. Pine Mountain Wilderness Area is within 106 km of the proposed STREON Site and CAP LTER. Saguaro Wilderness Area is 43 km northeast of the SRER and 128 km south-southeast of the CAP LTER (USEPA, 2009b).

Three of New Mexico's Mandatory Class I Federal Wilderness Areas are within 161 km of JB LTER (USEPA, 2009b). Bosque del Apache Wilderness Area is 120 km north of JB LTER and White Mountain Wilderness Area is 130 km northeast. Gila Wilderness Area is 140 km west-northwest of JB LTER.

### *Environmental Consequences*

Short-term negligible direct and indirect impacts would occur to air quality during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because the proposed NEON locations in Domain 2 are separated in space and emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts on air quality. The amount of ground disturbance would be less than 0.01 ha at any proposed location and no large earthmoving equipment would be used. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

No ground disturbance would occur at the STREON Site (S-04), so there would be no potential for air quality impacts from construction. The BEF proposed Relocatable Site (R-04) is near hiking trails and fugitive dust from trenching or clearing could be a nuisance to hikers during construction. Any impacts would end when following construction. Proposed instrumentation locations at all Domain 14 proposed sites are located in rural areas with no surrounding development. Human health and human nuisance values would not be impacted from fugitive dust created during construction.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze or air quality deterioration and would not impact visibility at Class I Wilderness Areas.

### Airspace

#### *Affected Environment*

There are restrictions on airspace over and near the SRER and the JB LTER (FAA, 2009). There are no airspace restrictions at or near the CAP LTER or the Sycamore Creek proposed STREON Site (FAA, 2009).

#### *Environmental Consequences*

Prior to annual flyovers, NEON, Inc. would provide flight details to FAA and any necessary military services that manage airspace restrictions at and near SRER and JB LTER. If pre-flight approval is not granted, no airborne observations would occur in these areas at that time.

### Noise

#### *Affected Environment*

The noise environments at SRER, JB LTER, CAP LTER, and the STREON Site would be similar. All but the CAP LTER Site are located in rural areas with low populations in surrounding areas. CAP LTER is adjacent to the eastern outskirts of metropolitan Phoenix. At present, the closest residential area is slightly over 2 km west of the proposed STREON Site. Existing noise levels at all three locations would likely be approximately 40 dBA (USEPA, 1974).

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would have no impacts on residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. No new roads would be constructed. During construction, noise levels would be elevated periodically during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to relocate from the construction area, but would likely resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at Core Site tower locations and up to 5 years at Relocatable Sites).

No residences are located near the proposed SRER, JD LTER, and STREON Sites, and there would be no potential for AOP overflights to impact residents at these locations. Noise from the AOP overflights would have a slight potential to impact residents near CAP LTER. AOP flights at 1,000 m above the canopy would be expected to have no impact on residents, who would be approximately 2 km from the site. AOP flights at 150 m above the canopy would be a short-term nuisance, but any impacts to residents would be negligible. The potential for AOP flights to disturb wildlife is discussed below.

### Water Quality

#### *Affected Environment*

All of the proposed sites may be close to dry desert washes, also referred to as "arroyos" (Table 3.5.14.3-1). A wash generally flows intermittently after major rain events (USACE, 2008; Vogt, 2003).

**TABLE 3.5.14.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 14, Desert Southwest United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-40 | 30-60 | 0 | 2 | 0 | 0 | 0 |
| C-41 | 30-60 | 1 | 4 | 0 | 0 | 0 |
| C-42 | 30-60 | 0 | 1 | 0 | 0 | 0 |
| R-27 | 0 | 0 | 0 | 0 | 0 | 0 |
| R-28 | 12 | 0 | 6 | 0 | 0 | 0 |
| S-33 | 30-60 | 0 | 0 | 0 | 0 | 0 |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009b.

The SRER is located within the Upper Santa Cruz watershed of the Santa Cruz River Basin (UofA, 2009b). Within the SRER, there are hundreds of dry desert washes that carry water in response to precipitation events and there are three in the area around the proposed Advanced Tower (C-40). Similarly, Sawmill Canyon Wash and one unnamed wash are near the proposed site for Basic Tower C-41. The proposed site for Basic Tower C-42 would be adjacent to Box Canyon Wash and another unnamed wash. There are no perennial streams within the proposed NEON Sites at SRER. None of the washes near the proposed SRER Sites are included on the Arizona CWA Section 303(d) list of impaired waters (ADEQ, 2004).

JB LTER is in the Rio Grande watershed (WRRI, 2009), but there are no surface waters within 5 km of the proposed Relocatable Site R-27.

Relocatable Site R-28 on CAP LTER would be in the Lower Salt watershed of the Salt River Basin (UofA, 2009b). Weekes Wash and a large canal connecting the Salt River and the Gila River are near the proposed site of R-28 and there are numerous small unnamed washes in this area. Weekes Wash is not included on the Arizona CWA Section 303(d) list of impaired waters (ADEQ, 2004).

Sycamore Creek, the proposed location of STREON Site S-33, is a perennial stream in the Lower Verde watershed of the Verde River Basin. It is a major tributary of the Verde River (UofA, 2009b). Because of the limited amount of rainfall in the region, snowmelt from the northern mountains is a major source of water in Sycamore Creek. Sycamore Creek is not included on the Arizona CWA Section 303(d) list of impaired waters (ADEQ, 2004).

The Salt River Project (SRP) consists of the Salt River Project Agricultural Improvement and Power District, a political subdivision of the state of Arizona, and the Salt River

Valley Water Users' Association, a private corporation. The SRP provides water and power to central Arizona, including the metropolitan Phoenix area. SRP delivers approximately 1.25 billion $m^3$ of water annually to central Arizona through a water delivery system consisting of reservoirs, wells, canals, and irrigation laterals (SRP, 2009).

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. Long-term moderate impacts to water quality in Sycamore Creek could occur. Negligible long-term impacts would occur at SRP from STREON experiments. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the area of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be used to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

Elevation of $NH_4NO_3$ or $H_3PO_4$ concentrations in Sycamore Creek to 5 times ambient concentrations for a 10-year period could result in long-term impairment of water quality in this stream and lead to eutrophication within the experimental reach. Because the stream reach is in a hardwood forest area, nutrient additions in winter and early spring, prior to canopy leaf-out, would likely result in increased growth of algae and periphyton due to the direct exposure to sunlight and greater nutrient availability. Once the canopy closes and shades the stream, lack of sunlight would be expected to slow growth of algae and periphyton, which could lead to greater downstream transport of soluble nitrogen and phosphorus, which could impact downstream waters, particularly lakes and impoundments. There also could be a die-off of algal and periphyton biomass, which could lead to oxygen depletion in the stream from aerobic decomposition. Oxygen depletion could in turn result in changes to vertebrate and invertebrate communities in the immediate area (Hauer and Lamberti, 2006). Impacts would likely be long-term and moderate. No impacts would be expected from the recirculation tracer experiments.

There would be potential for transport of soluble nitrogen and phosphorus to incrementally interact with other human and natural events and produce cumulative impacts to downstream water quality, including accelerated eutrophication of ponds and lakes. Seasonal flushing of Sycamore Creek from peak snowmelt would minimize the potential for downstream cumulative impacts. Additionally, once joining the Verde River, the increased water volume would be capable of assimilating the additional nutrients added to Sycamore Creek. Any cumulative impacts would likely be minor and upstream of the Verde River.

## Common Vegetation and Plant Communities

### *Affected Environment*

The SRER is in the eastern region of the Sonora Desert. Succulent cacti and drought-tolerant shrubs are typical of this region (Sonoran Desert Naturalist, 2009) and between 50 and 70 percent of the SRER land area is not covered by vegetation (NEON, 2008). Commonly occurring vegetation at SRER includes whitethorn acacia, devil's claw, Parry's agave, fairy duster, blue palo verde, desert spoon, Mexican tea, wild buckwheat, fishhook barrel cactus, white ratany, creeping muhly, staghorn cholla, graythorn, and multiple species of golden bush (UofA, 2009a; 2009c).

JBLTEP is located in the northern region of the Chihuahuan Desert and has a vegetative composition similar to that of SRER. Typical vegetation for this region of the Chihuahuan Desert includes whitethorn acacia, viscid acacia, lechuguilla, New Mexico agave, desert marigold, stingleaf, Christmas cactus, desert rosemallow, and desert poppy (University of Texas at El Paso [UTEP], 2009a)

Much of the CAP LTER is covered by exposed soil (CAP LTER, 2009a). Vegetation found near the proposed R-28 site at CAP LTER includes typical Sonoran Desert communities of creosote bush, triangle-leaf bursage, and brittle brush (CAP LTER, 2009a, 2009b, 2009c, 2009d). In riparian communities along perennial streams, common vegetation includes a thick cover of species such as Fremont cottonwood, Goodding's willow, Arizona sycamore, and saltcedar, an aggressive invasive species (CAP LTER, 2009e).

The proposed STREON Site (S-33) would be on Sycamore Creek, approximately 44 km north of the CAP LTER and approximately 300 m higher in elevation. S-33 would be placed in the thick riparian corridor of Sycamore Creek. Typical vegetation along the riparian corridor includes mesquites, acacias, saltcedar, foothills palo verde, Fremont cottonwood, Goodding's willow, and Arizona sycamore (UofA, 2009d). Beyond the riparian corridor, the vegetation is more typical of the desert communities described above (UofA, 2009d).

### *Environmental Consequences*

Minor clearing of vegetation would occur during construction to prepare for tower pads and IHs. Construction of fencing would result in a long-term negligible impact to vegetation. There also could be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Advanced and Basic Tower locations. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate. Where overhead utility lines are extended, there could be limited removal of large desert shrubs that could otherwise entangle transmission lines along the route. Because of the need to keep utility lines clear of obstructing vegetation, these areas would remain free of large shrubs until NEON project closure.

Vegetation removal along utility lines would be a minor impact, especially in areas where only shrubby vegetation exists. Because of the slow rate of growth typical in desert plant communities, there would be minor long-term impacts to vegetation and plant communities at tower pads, IHs, and along utility lines.

### Common Fauna

#### *Affected Environment*

Common wildlife species are similar throughout the proposed Domain 14 tower sites. Common species of birds found in these desert habitats include the cactus wren, Gila woodpecker, great-tailed grackle, cardinal, and American kestrel (UofA, 2009e, CAP LTER, 2009f). Typical desert amphibians and reptiles include the spadefoot toad, Great Plains toad, western shovel-nose snake, western blind snake, black-tailed rattlesnake, western diamondback rattlesnake, Madrean alligator lizard, and Gila monster (UofA, 2009e, UTEP, 2009a, 2009b, 2009c). Multiple species of scorpions also are common (UTEP, 2009c). Typical mammals found in these regions include the kangaroo rat, spotted skunk, white-tailed prairie dog, cactus mouse, and desert shrew (UofA, 2009e).

Common wildlife that may occur at the proposed Sycamore Creek STREON Site differ from the desert wildlife due to the greater availability of water and shade within the riparian corridor. Typical species of birds include the blue-gray gnatcatcher, Lucy's warbler, and blue grosbeak (UofA, 2009e). Common amphibians and reptiles include Couch's spadefoot toad, mountain treefrog, desert spiny lizard, many-lined skink, Sonoran mountain kingsnake, and checkered garter snake (USFS, 2009b). Mammals typically found within riparian corridors are beavers, badgers, and raccoons (UofA, 2009e).

AOP flights in Domain 14 would occur during or immediately following the typically wet periods (early March or July and August) to maximize the presence of vegetation in leaf-on condition.

#### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a small crew of up to 10 workers plus oversight personnel from NEON, Inc. during the day. No large equipment would be used during construction and materials would be brought in by hand. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding would be expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. Any impacts would likely be negligible.

Towers and guy wires would 8 to 10 m in height and would pose a minimal risk to common birds and flying mammals. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Arizona Game and Fish Department and the New Mexico Department of Game and Fish prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). In Domain 14, due to the heat and intense sunlight, animals typically would not be active during the time of AOP overflights and any response would likely be negligible.

### Sensitive Species

#### *Affected Environment*

In Arizona and New Mexico, sensitive species include those with federal endangered or threatened status; species proposed for listing as federal endangered or threatened; and species identified by the state as highly safeguarded, salvage restricted, or wildlife of special concern status (Arizona Department of Agriculture, Plant Services Division, 2009). Sensitive species also include those species protected under the MBTA.

All sensitive species identified as having potential to occur on or near the SRER, JB LTER, CAP LTER, and Sycamore Creek proposed STREON Site are identified in Table Domain 14 (Appendix B). The table also includes legal status and preferred habitat types for each species. The following discussion is limited to those species which may occur in or near the proposed project locations. No species classified as sensitive by the State of New Mexico are known to occur near the proposed NEON site on JB LTER.

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 14 (Table 3.5.14.3-2). However, there are known occurrences of species listed under ESA and state, USFS, and BLM protected species within 5 km of all the proposed NEON locations, excluding proposed Relocatable Site (R-28). In addition, potentially suitable habitat for protected species is present at or adjacent to all of the proposed NEON locations, excluding Relocatable Site (R-28) (Table 3.5.14.3-2). The following sections discuss the species with potential to occur at or adjacent to proposed NEON sites in Domain 14.

### Federally Protected Species

The proposed tower locations (C-40, C-41, C-42) on SRER would be within or near habitat suitable to support five federally protected species that are known from the area: the Pima pineapple cactus, giant spotted whiptail, Sonoran desert tortoise, lesser long-nosed bat, and cave myotis (Table 3.5.14.3-2).

**TABLE 3.5.14.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 14, Desert Southwest
*National Ecological Observatory Network (NEON) EA*

| | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-40 | 4-ESA | 0 | 2-ESA | 12 | 0 | 6 |
| C-41 | 4-ESA | 0 | 2-ESA | 12 | 0 | 6 |
| C-42 | 4-ESA | 0 | 2-ESA | 12 | 0 | 6 |
| R-27 | 0-ESA<br>1-USFS<br>1-BLM | 0 | 0-ESA<br>1-USFS<br>1-BLM | 0 | 0 | 0 |
| R-28 | 0 | 0 | 0 | 0 | 0 | 0 |
| S-33 | 4-ESA<br>1-USFS | 0 | 3-ESA<br>1-USFS | 0 | 0 | 0 |

Source: Appendix B Domain 14

The Pima pineapple cactus can reach 46 cm in height and up to 18 cm in diameter. This cactus occurs on ridges within semi-desert grasslands within Sonoran desert scrub (Roller, 1996; USFWS, 2009). The spines are clustered with one strong central spine that is hooked. The Pima pineapple cactus can grow as a single stemmed plant, a multi-headed plant, or a cluster of plants. It flowers from early July, when the summer rains begin, through August. It most commonly occurs in Pima County.

The giant spotted whiptail, also a BMP and USFS protected species, is a long slender lizard that typically occurs in dry desert washes in arid or semi-arid regions. They usually occur in dense shrubby vegetation along a wash (Stebbins, 1985). The tail of the giant spotted whiptail is longer than the body and total length can reach up to 30 cm (Arizona Sonoran Desert Museum [ASDM], 2009). They are tan, olive, or brown with lighter spots of yellow or white (ASDM, 2009).

The Sonoran desert tortoise prefers the rocky slopes and bajadras of the Sonoran desert scrub (Arizona Interagency Desert Tortoise Team [AIDTT], 2000). The cut banks of desert washes are sometimes used as shelter (AIDTT, 2000). The tortoise can live 100 years. They spend the majority of their lives in burrows (DesertUSA, 2009). Sexual maturity is usually reached between 15 and 20 years of age. Male testosterone levels peak in late summer and early fall, but breeding can occur any time that a tortoise is outside of its burrow (DesertUSA, 2009). Nests are typically dug near the opening of the burrow and incubation periods range from 90 to 120 days (DesertUSA, 2009).

The lesser long-nosed bat, also a USFS sensitive species, prefers desert grassland and shrubland up to the oak transition (Flemming, 1994). Caves and mines are the common roosting locations and they have very specific food requirements (Flemming, 1994). The bat's core diet is predominantly columnar cactus fruits and the nectar from flowers of columnar cacti and agave (Flemming, 1994). The lesser long nosed bat is medium in size compared to other bat species with a forearm measurement of 51 to 56 mm and an adult weight of approximately 20 to 25 grams (Flemming, 1994). The fur of an adult bat is grayish to reddish brown and juveniles have gray fur (Flemming, 1994). Studies suggest that females bare only one pup per year and mating seasons are likely dependent upon flowering seasons (Flemming, 1994).

The cave myotis, also a BLM sensitive species, is a large bat with an average wingspan of 28 to 33 cm and dull grayish fur (AGFD [Arizona Game and Fish Department], 2002a). The preferred foraging habitat of the cave myotis includes desert scrub of creosote, brittlebush, palo verde, and cacti and they feed on small moths, beetles, and weevils (AGFD, 2002a). Typical roosting sites include caves and mineshafts (AGFD, 2002a). Mating occurs in the fall and likely occurs again in the winter; however, ovulation does not occur until April, with gestation ranging from 45 to 55 days in Arizona when a single young is born in May or June (AGFD, 2002a).

No federally protected species are known to occur within 5 km of the Relocatable Site (R-28) proposed for CAP LTER (AGFD, 2008). Three federally protected species were identified as having the potential to occur near the proposed STREON (S-33) Site. Suitable habitat is likely present for all three species, which include the Maricopa tiger beetle, Gila topminnow, and lowland leopard frog.

The Maricopa tiger beetle, also a USFS and BLM sensitive species, is known for its large characteristic burrows, which typically occur on sandy stream banks and occasionally occur on gravels and clays along stream banks in the central highlands (AGFD, 2001). Stream substrate is important for the beetle burrow; it is usually a sand-silt mix, capable of retaining moisture (AGFD, 2001a). The beetle is aggressive toward its own species and feeds on other insects (AGFD, 2001a).

The Gila topminnow prefers shallow, warm, quiet flowing waters and the species is able to adapt to other water conditions, such as intermittent streams (Weedman, 1998). The Gila topminnow is a viviparous fish with brood sizes ranging from 1 to 21. Sexual maturity is usually reached between 2 and 11 months; and the average lifespan typically exceeds one year, with females outliving males (Weedman, 1998).

The lowland leopard frog, also a USFS sensitive species, is a small brown or green frog that lacks spots and has a light yellow color to the groin area (AGFD, 2006). This frog prefers small to medium streams and rivers, but they are capable of exploiting other aquatic habitats, including ornamental ponds (AGFD, 2006). Adults feed on arthropods and other invertebrates (AGFD, 2006). Breeding typically occurs from January to May and females lay eggs attached to submerged vegetation, usually near the surface of the water. Hatching occurs 15 to 18 days later (AGFD, 2006).

#### USFS and BLM Sensitive Species

The obsolete viceroy butterfly is a USFS sensitive species. The Western burrowing owl is a BLM sensitive species, and the sandhill goosefoot and tumamoc globeberry are both USFS and BLM sensitive species. The habitat for these species occurs at or adjacent to some of the proposed NEON locations in Domain 14.

The obsolete viceroy butterfly is typically found in riparian areas dominated by Goodding willows in desert grasslands and scrub habitats (Brock and Prchal, 2001; Tilden and Smith, 1986). The Goodding willow is the host species for the butterfly, and both species could occur at or adjacent to the proposed STREON site (S-33).

The Western burrowing owl occurs in a variety of open habitats, including well-drained grasslands, steppes, deserts, prairies, agricultural lands, vacant lots near human habitation, golf courses, and airports (AGFD, 2001b). They often inhabit habitats similar to those of burrowing mammals. This species could occur at or adjacent to proposed Relocatable Tower (R-27).

The sandhill goosefoot is a plant species typically found in sandy soils on dunes and in sand prairie blowout habitats (Spackman et al., 1997). This species could occur at or adjacent to proposed Relocatable Tower (R-27).

The tumamoc globeberry is a vine that grows in the Sonoran Desert scrub habitat in settings ranging from sandy valley bottoms to rocky bajada slopes (Reichenbacher, 1990). This species could occur at or adjacent to the proposed Core Tower locations.

#### State of Arizona Sensitive Species

There is one Arizona sensitive species that could occur at or adjacent to the proposed NEON sites in addition to the federally protected species described above. Suitable habitat for Tumamoc globeberry occurs near proposed NEON locations. The Tumamoc globeberry prefers xeric conditions along desert washes in the Sonoran desert scrub (AGFD, 2004). Potential habitat may be present in and around the proposed SRER Sites (C-40, C-41, and C-42). It is a perennial vine with roots that are 5 to 15 cm deep and slender annual stems that die back after fruiting (AGFD, 2004). Flowers appear in August and are yellow to greenish-yellow, with males out-flowering females (AGFD, 2004). The fruits, appearing in August through September are green and berry-like with dark stripes that become yellow and eventually turn red when ripe, resembling a tiny watermelon (AGFD, 2004).

#### Agency Sensitive Species

The obsolete viceroy butterfly is a USFS sensitive species that could occur near proposed NEON sites. The obsolete viceroy butterfly appears to be an obligate on Gooding willow, feeding mainly on sap and rarely visiting flowers. The species also feeds on dung piles, but eggs are only deposited on the willow (AGFD, 2002b).

The western burrowing owl and the sandhill goosefoot occur in desert sand prairie habitat, which occurs on the JB LTER (USFWS, 2003; Spackman et al., 1997). Both are classified as sensitive species by the BLM (UNM, 2008).

### *Environmental Consequences*

Proposed NEON construction activities would not be expected to impact sensitive aquatic species. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2 to minimize the potential for indirect impacts to sensitive aquatic species from sedimentation as a result of stormwater runoff. Data collection at Aquatic Arrays would not impact sensitive aquatic species.

NEON, Inc. would work with property site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid any such disturbance while retaining the scientific merit of the location.

In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat.

There is the potential to disturb sensitive terrestrial wildlife of the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat nearby during construction. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Towers and guy wires would pose a minimal risk to the two protected bat species and the burrowing owl. Towers would be relatively low, extending approximately 10 m above the desert floor. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to sensitive birds and flying mammals would be removed at site closure.

The Sonoran desert tortoise may occur on or near all of the proposed NEON locations within SRER. Burrows within 10 m of the proposed NEON site locations would be investigated for the presence of the desert tortoise prior to construction. Any burrows located would be assessed for current activity. If a burrow is determined to be inactive, construction would proceed. If a burrow is determined to be active and it is not possible to shift the construction site to avoid the burrow, NEON, Inc. would coordinate with the USFWS to relocate the desert tortoise to nearby suitable habitat away from the construction site. Where there are one or more active burrows near but not within a construction area, exclusion fencing would be placed around the construction area to prevent accidental entry of desert tortoise into the work area.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Arizona Game and Fish Department and the New Mexico Department of Game and Fish prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

The giant spotted whiptail could be inadvertently captured in small mammal traps deployed as part of an FSU. This species could be encountered at all three proposed Domain 14 Core Site towers. An animal handling permit would be obtained as described in Section 5.3 and all specified conditions would be followed to ensure proper treatment and handling of captured animals. If inadvertently captured, sensitive species would be released. Any impacts would be short-term and minor. No population level impacts would be expected.

MBTA listed birds could be disturbed during construction and operation. Should nesting bird species protected by the MBTA occur in or adjacent to an area that would be cleared or be subject to a high level of human activity during construction, work would be delayed until after the young have fledged if the site could not be relocated.

While the obsolete viceroy butterfly, western burrowing owl, and the sandhill goosefoot are not protected on the lands where NEON infrastructure would be placed, NEON, Inc. would avoid impacts to these species to the extent practicable. As a result of the measures implemented to avoid impacts to other sensitive species, no impacts to these species would be expected.

### Cultural Resources

#### *Affected Environment*

The Core Site proposed for Domain 14 would contain an Advanced Tower (C-40) and two Basic Towers (C-41 and C-42) and would be in the Santa Rita Experimental Range (SRR) in Arizona. The SRR encompasses 21,008 ha and is approximately 50 km south of the Phoenix-Tucson Megapolitan area. Relocatable Sites proposed for Domain 14 include the JB LTER in New Mexico (R-27) and the Central Arizona- Phoenix Long-Term Ecological Research (CAP LTER) Urban site(R-28). The STREON Site (S-33) proposed for Domain 14 would be on Sycamore Creek in Arizona, upstream of Ostero Canyon and west of State highway 87.

### 3.5.14.4 Prehistoric Context

The term Paleoindian refers to the seemingly contemporaneous occupation of the North American continent by big game hunters. Paleoindian sites are almost exclusively identified by large, lanceolate projectile points such as Clovis or Folsom points, followed by the stemmed points of the Western Stemmed Tradition. These points were fluted and mounted on the ends of spears for hunting megafauna. The entry of Paleoindian peoples into the Southwest, or the rest of the continent, is a matter of debate with the only consensus that Paleoindians were in North America by about 11,000 years ago. The Paleoindian Period in the Southwest dates from approximately 11,000 to 7,500 years ago. Archaic is used through much of the western U.S. to describe the time period when the adaptive strategies switched from a focus on megafauna to a more diversified strategy and a greater investment in seed and plant processing. The toolkit becomes less specialized and more varied, and generally the projectile points become smaller. Groundstone becomes much more common, as do other stone tools for a greater number of tasks. Hunting continues, but the focus is on smaller game, the same types of game available today. Cultigens are introduced to the late archaic peoples, and are no doubt used to some extent. The primary difference between the late archaic people and later agricultural people is the degree of reliance on cultivated crops, and by association, the degree of sedentism. The Archaic Period in the Southwest dates from approximately 5,500 B.C. to A.D. 200.

The Agricultural Period in the Southwest dates from A.D. 200 to A.D. 1500. The large scale adoption of, and reliance on, domesticated crops from Mexico around 200 A.D. provides one of the greatest catalysts for cultural change in prehistory. For the first time people are able to adopt a sedentary lifestyle, which ushers in a suite of cultural changes ascribed to the Hohokam or Mogollon cultures. Pottery is first found, as are serious attempts at architecture. Pottery increasingly becomes more important and elaborate, and the architectural styles evolve from simple one room structures to large, multi-roomed complexes with public or common spaces and platform mounds. In the Hohokam region, this period in the core area is generally divided into the Pioneer, Colonial, Sedentary, and Classic Periods. The historic era marks the time when the first Europeans entered into the region.

### Historic Context

The eastern part of the project area began the historic era as part of the Spanish empire. Santa Fe was settled as the capital of New Mexico in 1610 and was connected to Mexico City by the Camino Real. The first European to visit the western area was a Jesuit priest, Father Eusebio Francisco Kino in 1694. Father Kino explored the Santa Cruz Valley from 1691 to 1711 and founded a series of Jesuit missions, the most famous being San Xavier del Bac, south of Tucson. The Spanish influence became permanent with the construction of a presidio in Tucson in 1776. In 1821, southern Arizona fell under the new Republic of Mexico after winning independence from Spain in a war begun in 1810. Later, the Treaty of Guadalupe Hidalgo assured that present day Tucson would remain a part of Mexico. In 1854, Mexico sold nearly 7.7 million ha of what is now southern Arizona and New Mexico to the United States for $10 million in the Gadsden Purchase.

Southern Arizona played a brief role in the Civil War, when Union troops left Tucson for the east and the Confederate troops took over the presidio in 1862. In the same year, Union troops from Yuma took back southern Arizona. Arizona became a U.S. territory in 1863. The railroad came to southern Arizona in 1880. Several decades later, in 1912, Arizona became the 48th state in the Union. Ranching and agriculture have been and remain important to the local economy.

### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 14 within a defined study area that extended 1.6 km from each proposed NEON location. A literature search was conducted by accessing the AZSITE online database of cultural resources and projects for Arizona, maintained by the Arizona State Museum in Tucson, AZ and the New Mexico online database (NMCRIS) at the Archaeological Records Management Section (ARMS) of the New Mexico State Historic Preservation Office. The files located on AZSITE and NMCRIS contain current information on previous cultural resource inventories and known historic properties and include review of the NRHP.

Although previous studies have been conducted within 1.6 km of each of the proposed NEON locations, none of the specific NEON locations in Domain 14 have been previously surveyed for cultural resources.

Resources previously documented within the vicinity of the proposed NEON locations include prehistoric lithic scatters, ceramic scatters, rock alignments, habitation sites with canals, and historic residences (Table 3.5.14.3-3). The literature search revealed that there are 35 unique prehistoric sites and 5 unique historic sites within 1.6 km of the proposed NEON locations within the SRR. Seven historic properties are located within 1.6 km of the proposed location of C-41. None of these sites have been evaluated for the NRHP.

Eight sites are within 1.6 km of the proposed location of C-42 and none have been evaluated for listing on the NRHP or any other local listing. There are 17 historic properties documented within 1.6 km of the proposed location of R-28. Of these, 11 have been evaluated and 9 have been recommended as eligible for the NRHP. Eight historic properties occur within 1.6 km of the proposed location of S-33. Of these, three are recommended eligible for the NRHP. None of the other sites within 1.6 km of a proposed NEON location have been evaluated for the NRHP or any other local or state register.

**TABLE 3.5.14.3-3**
Literature Search Results– Domain 14, Desert Southwest
*National Ecological Observatory Network (NEON) EA*

| | | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | | |
|---|---|---|---|---|---|---|---|
| **Neon Site Number** | **Previously Surveyed** | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | **Number Evaluated** | **Number Eligible** |
| C-40 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-41 | No | 0 | 7 | 0 | 0 | 0 | n/a |
| C-42 | No | 0 | 8 | 0 | 0 | 0 | n/a |
| R-28 | No | 0 | 15 | 0 | 2 | 11 | 9 |
| S-33 | No | 0 | 5 | 0 | 3 | 3 | 3 |

Source: ASM AZSITE Database; NMSHPO NMCRIS Database.

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 14 did not identify any significant known historic properties within the proposed areas of disturbance for any of the proposed facilities. All of the historic properties that have been previously documented or appear on historic maps within 1.6 km of proposed NEON locations are outside of the proposed area of disturbance.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 14, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

## Utilities

### *Affected Environment*

The SRER Florida Canyon Headquarters receives power via overhead power lines (NEON, 2008, UofA, 2009a). Power and communication service would be extended to the proposed tower locations from the headquarters via underground trenches. The proposed R-27 Relocatable Site at JB LTER would receive power from existing power lines that would be extended underground from County Road E080. Proposed Relocatable Site R-28 would be less than 1 km southwest of the CAP LTER main facilities and approximately 200 m from North Ironwood Road. Electric power would be extended to R-28 from one of these locations, depending on whether power is available along North Ironwood Road.

The proposed STREON Site (S-33) on Sycamore Creek is approximately 1 km downstream from Whitney's Circle Bar Ranch, a 9.3-ha private ranch that offers banquet facilities for special occasions (Whitney's Circle Bar Ranch, 2009). NEON, Inc. would likely extend a power line from the infrastructure that serves Whitney's Circle Bar Ranch or from the existing lines co-located with Highway 87.

#### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the existing access road where access for maintenance activities would be available. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for impacts. Extended overhead lines would be kept clear of trees by hand clearing saplings, as necessary, for the duration of the NEON project at a location.

### Transportation

#### *Affected Environment*

SRER has an extensive system of field roads throughout the area. Each of the three proposed tower sites is within a few hundred meters of an access road. The vegetation is sparse and, where present, is shrub scrub; therefore, walking from the access roads to the proposed sites would not be difficult for construction workers or researchers.

The proposed Relocatable Site within JB LTER is accessible from Las Cruces by taking North Jornada Road for approximately 27.4 km. There is an extensive network of dirt field roads throughout JB LTER. The proposed site is approximately 100 m east of an existing dirt road. Due to the limited vegetation in the region, construction workers and researchers could easily access the site on foot from the existing road.

The proposed Relocatable Site within CAP LTER is approximately 200 m east of North Ironwood Drive, and 3.4 km south of the North Ironwood Drive and Superstition Freeway interchange. Vegetation is sparse in this area and would not impede researchers and construction workers from walking the 200 m from North Ironwood Drive.

The proposed STREON Site is approximately 400 m from a jeep trail that would be used for access. Construction workers and researchers would walk to the site through a wooded riparian area.

### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and transported by hand from that point to the construction site. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur.

Materials would be transported by hand from the road to the proposed NEON location. Improved trails would be created to move from the road to a proposed NEON location. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would be negligible.

## Human Health and Safety

### *Affected Environment*

SRER, JB LTER, and CAP LTER are private properties with access limited to employees, students, and researchers. Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. Construction workers would bring materials in by hand from the nearest access road. The Sycamore Creek STREON Site is unlikely to be accessed by the general public, but there would be safety risks to researchers and maintenance technicians.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

### *Environmental Consequences*

There would be short-term minor potential for injuries to workers during site construction and a long-term negligible risk of injury to researchers and maintenance technicians for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

For all personnel during construction or working at the site during operations, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

Proposed site locations would have no public access, which would limit health and safety issues to the public. In addition, towers would be secured with fencing and locked gates to deter unauthorized access.

There would be a potential for employees or researchers riding ATVs to strike the guy wires during routine work, NEON maintenance, or data gathering trips at the proposed tower locations. Guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

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**Figure 3.D14-1** Domain 14 Proposed Site Locations

**Figure 3.D14-2** Domain 14 Proposed Site Locations

**Figure 3.D14-3** Domain 14 Proposed Site Locations

**Figure 3.D14-4** Domain 14 Proposed Site Locations

**Figure 3.D14-5** Domain 14 Proposed Site Locations

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## 3.5.15 Domain 15 Great Basin

### 3.5.15.1 Introduction

Domain 15, the Great Basin, ranges from southern Nevada extending east into Utah and Wyoming, west to the California/Nevada border and north through southeastern Idaho, eastern Oregon, and eastern Washington to the border with Canada (Figure 2-1). It is a region of broad ecological contrasts that includes warm and cold deserts as well as high mountain ranges.

The proposed Core Site for Domain 15 would be the Onaqui-Benmore Experiment Station, 100 km southwest of Salt Lake City, in west-central Utah on lands managed by the BLM. The area around the Onaqui-Benmore Experiment Station is characteristic of the Great Basin Domain with regard to climate, landforms, vegetation, disturbance regimes, and fauna. The regional climate is controlled by the mountains that surround most of the domain and the Great Basin Domain is among the driest regions of the U.S. The climate of the Intermountain Region is arid to semiarid, with cool, moist winters and hot, dry summers. The three Core Site towers, Advanced Tower C-43, Basic Tower C-44, and Basic Tower C-45 would be located at elevations ranging from about 1,660 m to 1,780 m.

Relocatable Sites proposed for Domain 15 are in Utah and include the Red Butte Canyon Relocatable Tower (R-30) east of Salt Lake City, and a Relocatable Tower (R-29) in an urban area of Murray City, a suburb south of Salt Lake City. The Red Butte Canyon Research Natural Area (RNA) is a fully protected USFS watershed with a history of ecological, aquatic, and climatic studies. Red Butte Canyon extends from 1,600 m to 2,300 m in elevation and is characteristic of Great Basin watersheds, except that this canyon has never been used for grazing, farming, or other human activities. The site is located along Red Butte Creek, northeast of Red Butte Reservoir. The proposed Murray City, Utah Relocatable Tower (R-29) would be placed in an urban area north of the Murray Parkway Golf Course in Murray City.

The proposed Aquatic Array (A-35) for Domain 15 would be co-located with the Red Butte Canyon Relocatable Tower (R-30) along Red Butte Creek.

### 3.5.15.2 Resource Areas Considered But Not Addressed for Domain 15

Preliminary analysis indicated that there would be no potential to significantly impact two of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Environmental Justice: The proposed NEON sites would be located on unpopulated or undeveloped lands with limited access by the public. All potential impacts would be confined to the project area and there would be no potential to disproportionately impact minority or low-income populations.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 15 are designated research areas that are not routinely viewed for aesthetic quality or urban lands where aesthetic quality is impaired. The proposed tower at Red Butte Canyon would be approximately 26 m tall and would not be visible from Red Butte Garden due to the intervening hillside. Implementation of NEON would not further

reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

#### 3.5.15.3 Resource Areas Considered in Detail for Domain 15

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 15 where site-specific conditions would influence the anticipated environmental consequences.

##### Geology/Seismicity

###### *Affected Environment*

The Great Basin is located in the Intermountain Region situated between the Cascade and Sierra Nevada Mountains on the west and the Rocky Mountains on the east. The topography of the Great Basin can be described as a series of parallel, alternating basins and mountain ranges. Broad basins are located between rugged mountain ranges extending parallel from north to south (NPS, 2009). This repeating pattern was formed from the stretching of the Earth's crust, which formed large faults with mountains on the upthrown side of the fault and low valleys on the down-dropped side. Erosion of mountain ranges has covered most faults with up to 300 m of deposition and rock debris (USGS, 2009a).

The Great Basin is fairly stable from the standpoint of seismicity. Throughout the domain, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 3% pga to 40% pga for short wave motion and 6% pga to 80% pga for long wave motion, with the exception of small areas along the Nevada-California border where seismic activity is higher (USGS, 2009b, 2009c).

###### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact the underlying geology. The seismic hazard is low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

##### Soils

###### *Affected Environment*

Soils in the area of the proposed Advanced Tower C-43 are dominated by loams and gravelly loams. The Advanced Tower would be within the Wyoming big sage ecological type (NRCS, 2009a). No hydric soils were identified within the vicinity of the proposed tower location (NRCS, 2008a).

The proposed location for Advanced Tower C-43 is on Taylorsflat loam on 1 to 5 percent slopes. Taylorsflat loam is commonly found on fan remnants or lake terraces and formed by mixed alluvium and/or mixed lacustrine deposits. A typical Taylorsflat loam soil profile is loam from the surface to a depth of 152 cm. The Taylorsflat loam and most soils in the vicinity are not highly susceptible to sheet or rill erosion by water (NRCS, 2009a). Soils within the area of the proposed location of Basic Tower C-44 are similar to those at C-43, consisting mostly of loam or gravelly loam (NRCS, 2008a).

Soils in the area of the proposed Basic Tower C-45 are dominated by upland loams, gravelly loams, and rock outcrops. No hydric soils were identified within the vicinity of the proposed tower (NRCS, 2008a; NRCS, 2009b). Soils at the proposed location of Basic Tower C-45 are Borvant gravelly loam on 2 to 15 percent slopes. Borvant loam typically occurs in fan remnants and formed from alluvium derived from limestone. A typical profile is gravelly loam or very gravelly loam from 0 to 46 cm. Cemented material occurs at 46 to 64 cm and stratified very gravelly sandy loam to very gravelly loamy sand to cemented material from 64 to 152 cm (NRCS, 2009b). The Borvant gravelly loam and soils in the vicinity of Basic Tower C-45 are not considered highly susceptible to sheet or rill (NRCS, 2009b).

Soils in the area of proposed Relocatable Tower R-29 in Murray City are dominated by silt loams, sandy loams, loams, very fine sandy loams, and gravelly coarse sandy loams in the uplands and silty clay loams or silty clays in the potential wetland areas (NRCS, 2009c; 2008b). Hydric soil types in the vicinity of the proposed tower include Bramwell silty clay loam, Chipman silty clay loam, Magna silty clay, and mixed alluvial land (NRCS, 2009c; NRCS, 2008b). The proposed location of Relocatable Tower R-29 is within an area mapped as sandy borrow pit (NRCS, 2009c). Approximately half of the soils mapped in the vicinity of the proposed Relocatable Tower R-29 (approximately 70 percent of the area) are not considered highly susceptible to rill or sheet erosion by water (NRCS, 2009c).

Soils in the vicinity of the proposed Relocatable Tower R-30 and Aquatic Array A-35 at Red Butte Canyon are dominated by very rocky loamy sand, very cobbley loam, and the Harkers-Wallsburg association on steep slopes. The proposed location of R-30 and A-35 are within the Harkers-Wallsburg soil association on steep slopes. This map unit contains 55 percent Harkers and similar soils and 35 percent Wallsburg and similar soils. The association typically occurs on fanhead trenches or breaks on alluvial fans. These soils are formed by colluvium derived from limestone, sandstone, and shale and/or residuum weathered from limestone, sandstone, and shale (NRCS, 2009d). The typical Harkers soil is a loam from 0 to 36 cm and continues as a gravelly clay or a very gravelly clay/clay loam to 226 cm. Wallsburg soils are a very cobbley loam from 0 to 13 cm and continue as an extremely cobbley silt clay or silt clay loam to 43 cm. Soils in the vicinity of proposed Relocatable Tower R-30 are not considered highly susceptible to rill or sheet erosion by water (NRCS, 2009d).

### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

No significant environmental consequences to soils were identified under proposed tower or STREON locations in Domain 15. Soils would be disturbed in the immediate vicinity and along access trails at proposed NEON towers in Onaqui-Benmore. Within the vicinity of the proposed Relocatable Tower R-29 in Murray City there are potential wetland/hydric soils in swales, floodplains, and depressions. Hydric soils comprise approximately 17 percent of the soils in the area surrounding the proposed Relocatable Tower R-29. These soils would be avoided during construction in adjacent uplands.

At each of the proposed NEON locations in Domain 15, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would be less than 0.08 ha at C-43, less than 0.10 ha at C-44, less than 0.02 at C-45, and less than 0.01 ha at each other proposed location. The greater disturbance at C-43, C-44, and C-45 would result from extension of utility lines co-located with roadways. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby water bodies. Cheatgrass is an aggressive exotic grass that is the predominant understory species at the proposed Advanced Tower C-43 and Basic Tower C-45 sites in Onaqui-Benmore. It would quickly occupy all disturbed sites and efforts to control this occupation would likely be unsuccessful.

Following construction and revegetation, no soil impacts would occur during the 5-year or 30-year data collection period. The potential for similar temporary impacts to soils would occur at the close of the project during site restoration. NEON, Inc. would use similar BMPs during site closure to minimize the potential for soil impacts. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

### Climate

#### *Affected Environment*

Climate is highly driven by the surrounding mountains. Cool, moist air flows westerly from the northern Pacific. The Sierra Nevadas and the Cascades intercept the moisture and cast a rain shadow across the Intermountain Region, resulting in the Intermountain Region being designated as one of the driest regions in the U.S. The overall climate of the Intermountain Region is arid to semiarid, with cool, moist winters and hot, dry summers. In the extreme northern and western parts of the domain, nearly all precipitation occurs from fall through spring. In southern and eastern parts of the domain, equal amounts of precipitation may fall in the winter and summer. Plants use winter precipitation more effectively, as summer rains quickly evaporate due to high temperatures (Ehleringer, 2007).

### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. There would be no potential for interaction with other projects and no cumulative impacts to climate would result.

Towers located in high wind areas would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind. Site design would incorporate appropriate grounding and power filtering to protect instrumentation from damage due to electrical surges associated with lightning.

## Air Quality

### *Affected Environment*

Onaqui-Benmore (C-43, C-44, and C-45) is in Tooele County, which is designated as a nonattainment area due to sulfur dioxide levels. The two proposed Relocatable Towers (R-29 and R-30) and proposed Aquatic Array (A-35) site are in Salt Lake County, which is designated as a nonattainment area due to particulate matter and sulfur dioxide levels (USEPA, 2009a). None of the proposed NEON locations in Domain 15 are located within 161 km of a Class I Federal Area (USEPA, 2009b; 2009c).

### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. Construction activity would have short-term, negligible impacts on air quality. The construction area at any location would be less than 0.01 ha and no large earthmoving equipment would be used. BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions. Proposed instrumentation sites are located on private property with no surrounding development. Human health and human nuisance values would not be impacted from fugitive dust created during construction.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze and would not impact visibility at any of the Class I areas.

### Airspace

#### *Affected Environment*

There is no special use airspace over Salt Lake City or over Red Butte Canyon. Special use airspace has been designated over much of Tooele County, the location of the proposed Onaqui-Benmore sites (FAA, 2009). There are six continuously restricted airspaces in the area, some of which overlap, and there are three other areas that may be restricted to some degree.

Continuously restricted U.S. Air Force areas include Dugway Proving Grounds airspace designated as R-6402A, Hill Air Force Base airspaces designated as R-6404A and R-6407, and Wendover airspace designated as R-6406A. These four areas are continuously restricted airspaces from the surface to an altitude of 17,678.4 m. In addition, the Dugway Proving Grounds airspace designated as R-6402B and Wendover airspace designated as R-6406B are continuously restricted airspaces from 30.5 m above ground level to 17,678.4 m. There are two other military operation areas in Tooele County that originate from Hill Air Force Base. These areas are designated for nonhazardous military activities such as air combat maneuvers and acrobatics. The Sevier A area is used by the 388$^{th}$ Tactical Fighter Wing and the Sevier B area is used by the 6501$^{st}$ Range Squadron (FAA, 2008).

The FAA Salt Lake City Air Route Traffic Control Center is the controlling agency for these restricted airspaces (FAA, 2008). The controlling agency may authorize transit through or flight within a restricted area in accordance with a joint-use letter issued under §73.15 (FAA, 2008).

There is a designated national security area in Tooele County associated with the U.S. Army Desert Chemical Depot. Flight is restricted from the surface to 2,439.4 m over this area. Cooperative voluntary avoidance of flying in these areas is requested. FAA Headquarters may temporarily prohibit flight in a designated national security area when a greater level of security is needed (FAA, 2008).

#### *Environmental Consequences*

Coordination with the FAA, U.S. Air Force, and U.S. Army may be necessary prior to conducting AOP overflights, depending on the flight plan for a particular flight. Coordination would ensure there are no impacts to airspace over Domain 15.

## Noise

### *Affected Environment*

Existing noise levels at the proposed Onaqui-Benmore (C-43, C-44, and C-45) and Red Butte Canyon (R-30 and A-35) locations would likely be approximately 40 dBA or less (USEPA, 1974), as both are located in rural areas. However, noise levels at the proposed Red Butte Canyon locations could be slightly elevated at certain times due to proximity to the University of Utah and Salt Lake City. Baseline noise levels at the proposed tower (R-29) location in Murray City would likely range from 45 to 60 dBA due to the urban surroundings. The proposed Relocatable Tower (R-29) in Murray City would be near a residential area, with the nearest residence approximately 60 m to the south.

### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would cause no impacts to residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. Equipment and materials would be brought in by hand with as little impact as possible. No new roads would be constructed. During construction noise levels would be elevated periodically during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc. Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure.

The residential area south of the proposed Relocatable Tower (R-29) in Murray City could be impacted by noise from construction. Noise levels at and inside nearby homes could be elevated during construction. Absent intervening vegetation, the sound of the walk-behind trencher would be reduced to 76 dBA as a result of natural attenuation from traveling approximately 60 m to nearby homes (FHWA, 2007). The vegetation around the proposed tower (R-29) would be expected to further reduce the sound level by 8 dBA (Ward, 1984) and persons inside of houses would experience a further reduction of 15 – 25 dBA (USEPA, 1974). Indoor noise levels during construction would be between 43 and 53 dBA, which is comparable to being inside with a television or radio operating. The noise may be noticeable, but it would not interfere with indoor activities. The outdoor noise during construction could be as high as 68 dBA, which would be above background levels and could interfere with outdoor conversations. However, construction would only occur on weekdays during normal working hours.

There would be a temporary, minor noise impact to nearby residents during construction of the proposed Relocatable Tower (R-29) in Murray City.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to temporarily relocate from the construction area, but be expected to resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

The pumps for atmospheric sampling equipment on an FIU would operate continuously. Typically, these pumps produce noise of approximately 65 dBA. NEON, Inc. would place the pumps within noise shielding to reduce the sound to less than 60 dBA at 12 m. This would likely result in long-term minor impacts to residents in the neighborhood near the proposed tower in Murray City.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations excluding Murray City. The proposed tower in Murray City would be in a residential area and impacts to wildlife would be negligible.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at the Core Site and up to 5 years at Relocatable Sites).

Noise from the AOP would have potential to impact residents near the proposed Murray City Relocatable Site R-29. No sensitive noise receptors live near the proposed Core Site or the Red Butte Canyon Relocatable Site. AOP flights at 1,000 m above the canopy would be expected to have no impact on residents. AOP flights at 150 m above the canopy would be a short-term nuisance, but any impacts to residents would be negligible. The potential for AOP flights to disturb wildlife is discussed below.

### Water Quality

#### *Affected Environment*

There are no perennial surface waters in the vicinity of the proposed Onaqui-Benmore Towers (C-43, C-44, and C-45) or at the proposed Murray City Relocatable Site R-29, although there is an intermittent drainage near the proposed location of C-44 (Table 3.5.15.3-1).

Red Butte Creek, which would be the location of the proposed Aquatic Array (A-35) and is near the proposed location of R-30, has an average flow of 0.12 cubic meters per second ($m^3sec^{-1}$), with mean flows ranging from 0.06 $m^3sec^{-1}$ (September to January) to 0.34 $m^3sec^{-1}$ in May (Sakai, 2008a). The channel is incised but stable, with a cobble/bedrock bed. Water quality in Red Butte Creek meets Utah water quality standards for its designated uses. The water in Red Butte Creek is strongly buffered from weathering of carbonate minerals. Concentrations of inorganic nitrogen species in stream water tend to be lower than those observed in nearby precipitation, indicative of the pristine condition of the basin (USGS, 2000).

**TABLE 3.5.15.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 15, Great Basin United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-43 | 13 | 0 | 1 | 0 | 0 | 0 |
| C-44 | 21 | 1 | 0 | 0 | 0 | 0 |
| C-45 | 20 | 0 | 0 | 0 | 0 | 0 |
| R-29 | 7 | 0 | 22 | 0 | 0 | 0 |
| R-30 | 30 | 1 | 3 | 0 | 0 | 0 |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009d.

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

The proposed Core Site locations (C-43, C-44, and C-45) and the Murray City Relocatable Site R-29 study areas would not contain surface waters and no direct impacts to water quality would occur. Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

At the proposed Red Butte Canyon Relocatable Site (R-30) and Aquatic Array (A-35), there would be no direct impacts to water quality, though but indirect impacts could occur from runoff associated with precipitation. Such runoff would have the potential to transport sediment into Red Butte Creek, resulting in elevated turbidity and potentially adding nutrients or minerals to the system. Any suspended materials would be expected to settle in Red Butte Reservoir, a few hundred meters downstream of the proposed NEON sites. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for impacts to water quality associated with construction activities that could promote erosion and sedimentation of exposed soils. Any impacts would be temporary and minor.

### Wetlands

#### *Affected Environment*

There are no NWI mapped wetlands or perennial or intermittent waters present at the proposed Onaqui-Benmore sites (C-43, C-44, and C-45) or at the Murray City Relocatable Site (R-29) (Table 3.5.15.3-1). There are hydric soils in the general area of the proposed Relocatable Site in Murray City. However, the tower would be located in an urban area and would not be placed in a wetland. Red Butte Creek includes waters of the U. S. and associated riparian wetlands. Forested and scrub-shrub wetlands occur along Red Butte Creek and on one of its tributaries near the proposed NEON locations (R-30 and A-35), but upstream of the proposed NEON locations (Table 3.5.15.3-1). Intermittent drainages to Red Butte Creek may support other small wetland areas.

#### *Environmental Consequences*

No wetland impacts would occur at proposed NEON sites in Domain 15. There would be no interaction with other projects. Therefore, no cumulative impacts to wetlands would occur.

No impacts to wetlands are anticipated as a result of NEON implementation or site closure in Domain 15. Wetlands occur in the vicinity of the proposed Relocatable (R-30) and Aquatic Array (A-35) Sites in Red Butte Canyon. No towers or supporting infrastructure would be placed in wetlands. Sensors for the Aquatic Array (A-35) would be located within the channel of Red Butte Creek, but no impacts to the stream or its riparian vegetation would be expected. No impacts to wetlands are anticipated. NEON, Inc. would implement and maintain appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for direct and indirect impacts to wetlands.

### Floodplains

#### *Affected Environment*

There are no FEMA mapped floodplains at any of the proposed sites in Domain 15. No floodplains or flood prone areas occur at the proposed Onaqui-Benmore Core Site (C-43, C-44, and C-45) or at the proposed Murray City location (R-29). A very narrow floodplain occurs along Red Butte Creek where A-35 and R-30 would be located. The infrastructure associated with R-30 would be outside of the flood prone area, while A-25 infrastructure would be placed in an area subject to flooding.

#### *Environmental Consequences*

There would be no impacts on floodplains or flood prone areas within Domain 15. No indirect or cumulative impacts to flood prone areas would be expected.

There is the potential for equipment to be damaged during flood events. NEON, Inc. would design infrastructure for A-35 to withstand expected flood levels and thus minimize the potential for damage. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts on existing water quality if they were to be lost in streams. There are no environmentally harmful components associated with this monitoring equipment. NEON, Inc. would temporarily remove equipment from flood prone areas when flooding is forecast for the area.

### Common Vegetation and Plant Communities

#### *Affected Environment*

Many of the lower and intermediate elevation portions of the Great Basin were historically dominated by sagebrush steppe communities supporting a variety of desert shrubs and native grasses and forbs. These grade into juniper dominated landscapes at somewhat higher elevations. Fire suppression has allowed juniper to substantially expand its range. At the same time, the exotic annual grass, cheatgrass has become widely established throughout the Great Basin. The presence of cheatgrass in a stand of vegetation dramatically increases the fire hazard and frequency (USGS, 2009e). Cheatgrass is extremely flammable because it matures and dries out early in the growing season, allowing fires to spread very quickly. This fire hazard remains well into the fall. Repeated burning every few years or burning in early summer depletes stands of perennial grasses, forbs, and native shrubs.

The Onaqui-Benmore site (C-43, C-44, and C-45) has sagebrush steppe habitat that transitions into juniper woodland. The Advanced Tower (C-43) would be within the Wyoming big sage ecological type (NRCS 2009a), which is dominated by sagebrush with a cheatgrass understory. Basic Tower C-44 would be located in an area burned at least once in the past that has been planted with crested wheatgrass. The predominant vegetation type in the area proposed for Basic Tower C-45 is juniper woodland with some sagebrush.

Common plants that may occur near the NEON Core Site include bluebunch wheatgrass, Sandberg bluegrass, Indian ricegrass, squirreltail, Great Basin wild rye, western wheatgrass, Eureka milkvetch, northwestern Indian paintbrush, sego lily, shortstem buckwheat, cushion buckwheat, plains pricklypear, spiny phlox, gooseberryleaf globemallow, shaggyfruit pepperweed, Wyoming big sagebrush, mountain big sagebrush, yellow rabbitbrush, spineless horsebrush, shortspine horsebrush, shadscale, fourwing saltbush, spiny hopsage, winterfat, Utah juniper, and singleleaf pinyon.

Invasive exotic plants are common in this region. The most abundant exotic invasive species include cheatgrass, tall tumblemustard, pinnate tansymustard, clasping pepperweed, Canada thistle, prickly lettuce, and curveseed butterwort (Ehleringer, 2007).

Plant communities that occur in the vicinity of the proposed Red Butte Canyon sites (R-30 and A-35) are variable because of the range in elevation and the effect of slope and aspect on soils and moisture availability. The lower canyon is dominated by cheatgrass and sagebrush, which transition into shrub woodland dominated by Gambel oak and bigtooth maple in the immediate vicinity of the proposed Relocatable Tower (R-30) and proposed Aquatic Array (A-35) sites. The drier southeast-facing slopes have more grassy openings than adjacent northeast-facing slopes. The canyon is dominated by quaking aspen and Douglas-fir. The riparian zone is dominated by bigtooth maple, box elder, and water birch (Ehleringer et al., 1992).

The proposed Relocatable Tower R-29 in Murray City is in an urban area with no native vegetation remaining.

### *Environmental Consequences*

Minor clearing of vegetation would occur during construction to prepare for tower pads, fencing, and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Clearing at any location would be less than 0.01 ha. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at proposed Relocatable Sites (R-29 and R-30) and 30 years at the proposed Core Site (C-43, C-44, and C-45). Red Butte Creek is a designated Riparian Habitat Conservation Area and no vegetation clearing is allowed within 91.5 m of the stream.

The spread of noxious weeds is a serious concern in this region. Areas disturbed through trenching or other construction activities would be stabilized and seeded with native vegetation in accord with the land management agency BMPs. This would be most important in Red Butte Canyon, where weeds are not well established except along roads.

The extension of overhead utility lines is not expected to result in the removal of trees along the route. There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines.

## Common Fauna

### *Affected Environment*

The proposed Core Site towers (C-43, C-44, and C-45) are located within the Onaqui-Benmore Experiment Station. Small and moderate-sized mammals that could occur at the Onaqui-Benmore site include montane vole, sagebrush vole, Ord’s kangaroo rat, Desert woodrat, Great Basin pocket mouse, northern grasshopper mouse, black-tailed jackrabbit, white-tailed antelope squirrel, and mountain cottontail. The deer mouse is locally abundant and can be up to 50 percent of the small-mammal fauna in a given location. Larger mammals that may occur include pronghorn, mule deer, badgers, and coyote. Sixty-eight species of birds are listed from the Vernon Breeding Bird Survey route, including the northern harrier, sharp-shinned, Swainson's, red-tailed, and ferruginous hawks, golden eagle, American kestrel, prairie falcon, killdeer, long-billed curlew, Wilson's snipe, mourning dove, great horned, burrowing, and short-eared owls, red-shafted flicker, western kingbird, loggerhead shrike, western scrub-jay and pinyon jay, black-billed magpie, horned lark, mountain bluebird, northern mockingbird, sage thrasher, Brewer’s sparrow, vesper sparrow, lark sparrow, savannah sparrow, and western meadowlark. Wild horses are present in the mountains of the area (Ehleringer, 2007).

There are 32 permanent resident avian species in Red Butte Canyon, 44 summer resident bird species, and 30 migrant or winter resident bird species (Red Butte Canyon Research Natural Area, 2009a). Permanent resident birds include northern goshawk, sharp-shinned hawk, Cooper's hawk, blue grouse, ruffed grouse, California quail, ring-necked pheasant, chukar, flammulated owl, great horned owl, long-eared owl, belted kingfisher, red-shafted flicker, yellow-bellied sapsucker, hairy woodpecker, downy woodpecker, Steller's jay, scrub jay, black-billed magpie, black-capped chickadee, mountain chickadee, common bushtit, red-breasted nuthatch, brown creeper, American dipper, Townsend's solitaire, golden-crowned kinglet, western meadowlark, house finch, pine siskin, and Oregon junco (Red Butte Canyon Research Natural Area, 2009a).

Summer resident birds at Red Butte Canyon include mallard, red-tailed hawk, golden eagle, sparrow hawk, spotted sandpiper, mourning dove, black-chinned hummingbird, broad-tailed hummingbird, dusky flycatcher, western flycatcher, western wood peewee, violet-green swallow, tree swallow, bank swallow, northern rough-winged swallow, barn swallow, cliff swallow, house wren, rock wren, American robin, hermit thrush, Swainson's thrush, mountain bluebird, blue-gray gnatcatcher, warbling vireo, orange-crowned warbler, Virginia's warbler, yellow warbler, yellow-rumped warbler, MacGillivray's warbler, Wilson's warbler, Bullock's oriole, brown-headed cowbird, western tanager, black-headed grosbeak, lazuli bunting, Cassin's finch, American goldfinch, green-tailed towhee, rufous-sided towhee, vesper sparrow, gray-headed junco, chipping sparrow, and song sparrow (Red Butte Canyon Research Natural Area, 2009a).

Mammals that occur in Red Butte Canyon include bobcat, mountain lion, and moose. Others, such as the mule deer, elk, and coyote occur with high frequency seasonally. A rich rodent fauna inhabits the canyon, with many species preferentially occupying the moist riparian communities of grasses, forbs, and shrubs. The western red-backed vole, heather vole, montane vole, long-tailed vole, water vole, and meadow jumping mouse are restricted to the small mesic meadows along Red Butte Creek and its tributaries and the three species of shrew in the canyon occur almost exclusively in the riparian habitats. Lower reaches of the canyon provide winter range for mule deer and elk (Red Butte Canyon Research Natural Area, 2009b).

Aquatic resources in Red Butte Creek include cold water biota such as salmonid fishes and a diverse macroinvertebrate assemblage. Red Butte Creek harbors brook trout, brown trout, cutthroat trout, rainbow trout, and rainbow/cutthroat hybrids (Robinson, 1978). While this study is not recent, conditions in Red Butte Creek remain pristine because the drainage is closed to public access and it has never been grazed. Therefore, a similar fish community would be expected.

### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide wildlife refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding is expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Towers that would be placed in sagebrush or crested wheatgrass habitat would be relatively short (approximately 8 m) and would not be expected to pose a risk to birds and bats.

Towers and guy wires placed in juniper forest areas would pose a minimal risk to sensitive bird species and sensitive bat species. Towers and guy wires would be within the canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and bats would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Utah Division of Wildlife Resources prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

There would be a long-term loss of habitat at towers and IHs, but the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall, impacts to wildlife would likely be negligible.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). The sagebrush-steppe habitat provides little aerial cover for wildlife. Animals in these habitats would likely startle and a flight response could occur. The response would likely be greater for flights that are proposed at 150 m above the ground. Because the flights would occur only once per year, any impact would be considered minor and no population-level impacts would be expected.

Because impacts would be separated in space and time, no potential for interaction among proposed NEON project or between NEON projects and other projects would be expected.

### Sensitive Ecological Communities

#### *Affected Environment*

Healthy sagebrush communities in the Great Basin are disappearing or being severely fragmented due to non-native plant invasion, woodland encroachment, large and catastrophic wildfire, energy development, and urban/suburban development.

Sagebrush communities have been identified as one of the most threatened land types in North America, and as much as half of this land type has already been lost in the Great Basin (SageSTEP, 2008). Much of the land surrounding the proposed Core Site tower locations (C-43, C-44, C-45) is sagebrush habitat.

Biological crusts occur in the vicinity of the proposed towers at Onaqui-Benmore (C-43, C-44, C-45) (Sakai, 2008b). Undisturbed soils in the vicinity could be covered by cryptobiotic crusts, a collection of cyanobacteria, algae, lichens and mosses, that stabilize soil against wind and water erosion, enhance water infiltration, and fix atmospheric nitrogen (USGS, 2006a).

Red Butte Canyon has never been grazed and the riparian community along Red Butte Creek is as near to pristine conditions as can be found in the western United States. Because of its undisturbed nature, Red Butte Canyon is a sensitive resource. Cheatgrass has become established in the understory of the upland oak /maple community in the canyon.

### *Environmental Consequences*

Minor short-term and long-term impacts to sensitive ecological communities would result from installation of NEON infrastructure. No cumulative impacts to sensitive ecological communities would be expected.

The construction of proposed towers C-43 and C-45 could result in minor loss of sagebrush habitat (less than 0.01 ha at each site). The locations of the tower pads and associated fencing would be selected to minimize the amount of sagebrush habitat lost. These impacts would be minor considering the amount of surrounding sagebrush habitat that would not be disturbed.

NEON, Inc. would reseed disturbed areas with local native species approved by the BLM and would monitor for and control weeds until native species become well established.

Biological crusts are poorly adapted to compressional disturbances such as those caused by domestic livestock grazing and recreational activities. Disruption of crusts results in decreased organism diversity, soil nutrients, soil stability, and soil organic matter. Direct damage to crusts usually comes in the form of trampling by humans and livestock or driving by vehicles. Full recovery of crust from disturbance is a slow process, particularly for mosses and lichens. Recovering crust thickness can take up to 50 years, and mosses and lichens can take up to 250 years to recover. Limiting the size of the disturbed area also increases the rate of recovery, provided that there is a nearby source of propagules. NEON, Inc. would strictly limit new paths and use existing disturbed ground as much as possible to limit the loss of biological soil crusts. Boardwalks would be used if particularly sensitive areas need to be crossed. Excess soils would be stored on lands that have been previously disturbed. NEON, Inc. would reseed spoil areas with local native species approved by the BLM and would monitor for and control weeds until native species become well established (USGS, 2009f).

The area of vegetation removal for placement of Relocatable Tower R-30 and Aquatic Array A-35 would be less than 5 $m^2$ at each site. Buried power lines would affect an additional small area. Native riparian vegetation removal would be avoided. NEON, Inc. would reseed disturbed areas with local native species approved by the USFS and would monitor for and control weeds until native species become well established.

### Sensitive Species

#### *Affected Environment*

No sensitive species would occur at or adjacent to the proposed Murray City Relocatable Site R-29 due to the urban nature of the area.

Sensitive species identified as having potential to occur in the region around proposed NEON locations in Domain 15 are identified in Table Domain 15 in Appendix B, along with their legal status and preferred habitat types. The following discussion is limited to those species that may occur in or near the proposed project locations.

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 15 (Table 3.5.15.3-2). However, there are known occurrences of species listed under ESA and state, USFS, and

**TABLE 3.5.15.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 15, Great Basin
*National Ecological Observatory Network (NEON) EA*

| | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-43 | 0-ESA<br>5-BLM | 0 | 10-BLM | 2 | 0 | 3 |
| C-44 | 0-ESA<br>5-BLM | 0 | 10-BLM | 2 | 0 | 3 |
| C-45 | 0-ESA<br>5-BLM | 0 | 10-BLM | 2 | 0 | 3 |
| R-29 | 0 | 0 | 0 | 0 | 0 | 0 |
| R-30 | 1-ESA<br>5-USFS | 0 | 1-ESA<br>9-USFS | 4 | 0 | 4 |
| A-35 | 1-ESA<br>5-USFS | 0 | 1-ESA<br>9-USFS | 4 | 0 | 4 |

Source: Appendix B Domain 15

BLM protected species within 5 km of all the proposed NEON locations, excluding proposed Relocatable Site (R-29). In addition, potentially suitable habitat for protected species is present at or adjacent to all of the proposed NEON locations, excluding Relocatable Site (R-29) (Table 3.5.15.3-2). The following discussion is limited to those species that may occur in or near the proposed project locations in Domain 15.

### Federally Protected Species

Red Butte Reservoir, downstream of proposed NEON sites, includes a refugium population of Federally endangered June sucker. Fish from the reservoir are being used to restock this species' historic native habitat, the Provo River and Utah Lake. The species could occur at or adjacent to the proposed Relocatable Site (R-30) and Aquatic Array (A-35).

### BLM Sensitive Species

The greater sage grouse, a species proposed for listing under the ESA, is a sagebrush-steppe obligate bird that is characteristic of and dependent on healthy tracts of native sagebrush steppe, such as those in the areas around proposed towers (C-43, C-44, and C-45). Sage grouse leks occur in the region, but none are in proximity to the proposed Core Site towers.

In Utah, the BLM follows the Utah Division of Wildlife Resources (UDWR) Utah Sensitive Species List for identifying sensitive species on lands it manages. No sensitive plant species occur in Tooele County, where the Core Site towers would be located (UDWR, 2009a). In addition to the greater sage grouse discussed above, nine sensitive wildlife species occur in Tooele County that may occur at the proposed NEON Core Site (Table 3.5.15.3-2) (UDWR, 2009b).

The bobolink is a small bird that prefers grasslands, hayfields, prairies, and deep cultivated grains. Bobolinks nest on the ground within a small hollow of herbaceous vegetation. This migratory bird arrives to nesting areas in late April and early May. Clutch size is between four and seven and incubation lasts 11 to 13 days. The young leave the nest at 10 to 14 days, not able to fly (NatureServe, 2009). This species has not been known to occur within 5 km of proposed sites; however, potential (but poor) habitat occurs around Basic Tower C-44 (Table Domain 15, Appendix B).

The kit fox is a small fox that prefers desert, grassland, playa/salt flats, savanna, and shrubland habitat, similar to habitat found at the proposed Onaqui-Benmore sites. This nocturnal animal feeds mainly on nocturnal rodents, but also feeds on birds, reptiles, and insects. Kit foxes create burrows and breed from December to February with a litter of four to five born in February or March (NatureServe, 2009). This species has not been documented as occurring within 5 km of proposed NEON sites (Table Domain 15, Appendix B).

Townsend's big-eared bat, also a USFS sensitive species, is relatively sedentary. These bats typically roost during the day in caves and abandoned mines and forage at night in sagebrush steppe, juniper woodlands, and mountain brush vegetation similar to the vegetation of Onaqui-Benmore. There are no known caves or mines near the proposed towers at Onaqui-Benmore (C-43, C-44, C-45); however, some bats are known to travel up to 32 to 64 km. On average, females travel up to 3.2 km and males travel up to 1.3 km from the roost to the forage area (NatureServe, 2009). This species is not known to occur within 5 km of the proposed towers at Onaqui-Benmore or the proposed Red Butte Canyon sites (Table Domain 15, Appendix B).

The dark kangaroo mouse has not been identified within 5 km at any of the proposed sites in Domain 15, but there is potential habitat for this species at the proposed Onaqui-Benmore sites (Table Domain 15, Appendix B). This species prefers desert, playa/salt flat, sand dunes, and shrubland habitat. The dark kangaroo mouse is a nocturnal animal that mainly feeds on seeds. Burrows are dug into the soil where it spends much of the daytime and where it avoids predators such as owls, foxes, and badgers (NatureServe, 2009).

The long-billed curlew has been documented occurring within 5 km of the proposed Onaqui-Benmore sites (Table Domain 15, Appendix B). This migratory species prefers low grassland habitat, which can be found near the proposed Onaqui-Benmore sites, typically arriving in late March and departing usually by mid-August. Long-billed curlews forage for various insects in herbaceous wetlands and grasslands and nest on the ground in small patches of short vegetation near barren ground, generally near water. Egg laying typically starts between April and May and young leave the nest after 41 to 45 days (NatureServe, 2009).

The burrowing owl has been known to occur within 5 km of the proposed Onaqui-Benmore sites (Table Domain 15, Appendix B). This species prefers open grasslands, prairies, and savannas habitat, similar to the open habitat at Onaqui-Benmore, and feeds mainly on large insects and rodents. This long-legged owl is a migratory bird that breeds in Utah and may sometime overwinter there. The owl nests in abandoned burrows usually made by other mammals and roosts on low perches (NatureServe, 2009).

### USFS Sensitive Species

The bald eagle, Bonneville cutthroat trout, northern goshawk, Burke's draba, Wasatch jamesia, Columbia spotted frog, and starveling milkvetch are USFS sensitive species potentially occurring at or adjacent to proposed NEON locations.

The bald eagle typically inhabits forest stands near streams, lakes, and other water bodies. The eagle has been recently spotted within the vicinity of proposed sites R-30 and A-35, but Red Butte Creek does not provide useable habitat for the species.

Bonneville cutthroat trout, a Regional Forester's sensitive species and a species also covered by range and state-wide conservation agreements, is also found in the reservoir and Red Butte Creek. This species also reproduces in the drainage (Cowley, personal communication, 2009). This species could occur at or adjacent to proposed Relocatable Tower (R-30) and Aquatic Array (A-35).

The proposed Relocatable Site and Aquatic Array in Red Butte Canyon would be on lands managed by the Wasatch-Cache National Forest (W-CNF). The 2003 W-CNF Revised Forest Plan lists the threatened and endangered species and the USFS sensitive species and MIS that occur on the W-CNF. The northern goshawk has been documented in Red Butte Canyon and often uses riparian areas during the winter. The Wasatch jamesia and Burke's draba are W-CNF sensitive plant species that occur on talus slopes, rocky outcrops, or rocky soils within oak-maple and mountain brush communities (W-CNF Revised Forest Plan, 2003a). These species are not known from Red Butte Canyon, but potentially suitable habitat for each occurs in the canyon.

The Columbia spotted frog typically inhabits small springs, ponds, or slough with a variety of herbaceous emergent, floating, and submerged vegetation. The species is unlikely to occur at or adjacent to proposed Relocatable Tower (R-30) and Aquatic Array (A-35) because of the number of Salmonid predator species present in Red Butte Creek.

The starveling milkvetch prefers sagebrush and sagebrush juniper communities on windswept ridges. Marginal habitat for the species may exist on the lower elevation cheatgrass-invaded sagebrush sites adjacent to proposed Relocatable Tower (R-30) (W-CNF Revised Forest Plan, 2003a).

### State Sensitive Species

The ferruginous hawk, grasshopper sparrow, and short-eared owl are considered conservation agreement species in the State of Utah, meaning wildlife species or subspecies that are currently receiving special management under a conservation agreement developed or implemented by the State to preclude the need for listing under the ESA. These species could occur at or adjacent to proposed NEON locations.

The ferruginous hawk, also a BLM sensitive species, typically occurs in shortgrass prairie, shrub-steppe, and juniper woodlands, similar to the habitat at the proposed Onaqui-Benmore sites (C-43, C-44, C-45). In Utah there are migratory breeding residents and permanent residents. Ferruginous hawks at Onaqui-Benmore would likely be breeding residents, arriving between February and early March and departing by late October. They prefer to nest in solitary trees rather than forests, but have been found nesting on the ground in grassland areas (NatureServe, 2009). This species has been known to occur within 5 km of the proposed Onaqui-Benmore sites (Table Domain 15, Appendix B).

The grasshopper sparrow, also a BLM sensitive species, has historically occurred within 5 km of the proposed Red Butte Canyon sites, but has not been documented near the proposed Onaqui-Benmore sites (Table Domain 15, Appendix B). This small, migratory songbird prefers grasslands and open savannas, feeding mainly on grains and insects. It arrives to the area in mid-April and departs in mid-September (NatureServe, 2009). This species could occur at or adjacent to the proposed Core Site locations, the Relocatable Site (R-30), and the Aquatic Array (A-35).

The short-eared owl, also a BLM sensitive species, prefers grassland and savanna habitat similar to that of Onaqui-Benmore and has been known to occur within 5 km of the proposed towers at Onaqui-Benmore (C-43, C-44, C-45) (Table Domain 15, Appendix B). The owl is typically a nonbreeding resident of Utah, though Utah is on the edge of its permanent resident territory, which stretches across the extreme northern U.S. This species of owl is unique in that it creates a nest on the ground, which it defends (NatureServe, 2009).

The Utah Natural Heritage Program database contains records for three Utah sensitive species within 5 km of the Red Butte Canyon Relocatable Site and Aquatic Arrays. These records are for the least chub, smooth green snake, and western toad (Table Domain 15, Appendix B).

The least chub historically occurred in slow rivers, clear creeks, springs, ponds, and marshes. Currently, the species is mostly found in alkaline springs with moderate-dense submerged and emergent vegetation, at depths of 10 to 90 cm, over bottoms of clay, muck, mud, and peat. The species could occur at or adjacent to proposed Relocatable Site (R-30) and the Aquatic Array.

The smooth green snake is found in a variety of habitats, including meadows, grassy marshes, moist grassy fields at forest edges, mountain shrub lands, stream borders, bogs, and open moist woodland. The species could occur at or adjacent to proposed Relocatable Site (R-30) and the Aquatic Array.

The western toad is found in a variety of habitats ranging from desert springs to mountain wetlands. The toad also inhabits upland areas around ponds, lakes, reservoirs, and slow-moving rivers and streams. The species could occur at or adjacent to proposed the Relocatable Site (R-30) and the Aquatic Array.

### *Environmental Consequences*

Minor short-term and long-term impacts to sensitive species would result from installation of NEON infrastructure. No cumulative impacts to sensitive species would be expected.

No impacts to greater sage grouse would be expected as this species does not lek (breed) or nest at the proposed NEON locations.

NEON, Inc. would work with property owners and site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted to avoid any such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility to avoid impacts to the species or its required habitat.

There is the potential to disturb sensitive wildlife in the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Towers that would be placed in sagebrush or crested wheatgrass habitat would be relatively short (approximately 8 m) and would not be likely to pose a risk to sensitive bird species.

Towers and guy wires placed in forested areas would pose a minimal risk to sensitive bird species and sensitive bat species. Towers and guy wires would be within the canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and bats would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Utah Division of Wildlife Resources prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

AOP overflights would likely have impacts on sensitive wildlife species similar to those described above for common fauna. Any impacts would likely be negligible in forested areas and minor in areas with no tree canopy.

State- or federal-protected birds and MBTA listed birds would have the potential to be disturbed during construction and operation. Foraging or migrating birds would be expected to avoid areas adjacent to construction activity for the period of construction, but would likely resume use of the area following construction. The W-CNF prohibits construction activities during the nesting season. However, should nesting MBTA species be found in or adjacent to a planned construction area, work would be delayed until after the young have fledged. Similar impacts would be expected at site closure and work during the nesting and pre-fledging period would be avoided. The towers would provide perch sites that may be used by burrowing and short-eared owls or ferruginous hawks, perhaps enhancing their ability to locate potential prey items.

The passive sensors in place on Red Butte Creek about 900 m upstream of Red Butte Reservoir would not affect water quality or macroinvertebrate availability in the reservoir. Therefore, no impacts to the June sucker or Bonneville cutthroat trout would be expected.

There are no caves or mine tunnels present in the immediate area of the proposed NEON tower locations that would provide hibernacula for maternal colonies or hibernating bats. The towers would not be tall enough to require lights, so there would be no light to attract insects, which would in turn attract bats.

### Cultural Resources

#### *Affected Environment*

The proposed NEON locations for Domain 15 are in the eastern portion of the Great Basin culture area in the State of Utah. The proposed Core Site (Advanced Tower C-43, Basic Tower C-44, and Basic Tower C-45) is at the base of the Onaqui Mountains on the western edge of Rush Valley in Tooele County. The proposed Core Site towers would be clustered at the mouth of Faust Canyon on undeveloped lands managed by the BLM. Proposed Relocatable Site R-29, proposed Relocatable Site R-30, and proposed Aquatic Array A-35 would be in the Salt Lake Valley in Salt Lake County. Relocatable Tower R-29 would be in a developed area in Murray, Utah, adjacent to the Jordan River. R-30 and A-35 would be in the Red Butte Canyon Research Natural Area, an undeveloped area of 1,880 ha that is managed by the USFS.

### Prehistoric Context

The general cultural chronology of this particular culture area includes the Paleoindian Period, the Archaic Period, the Fremont Period, and the Late Prehistoric Period (Jennings, 1986). The Paleoindian Period is defined by artifacts including Clovis and Folsom fluted lanceolate projectile points and Lake Mojave lanceolate projectile points.

Reliance on big game hunting dominated the Paleoindian subsistence strategy. The shift to the Archaic Period is evidenced by a change to a broader strategy focused on hunting and gathering of resources. The projectile points became smaller and more suited for hunting smaller game, and there was an increase in the number and type of stone grinding implements used for plant and seed processing (Holmer, 1978). Near the beginning of the first millennium A.D., horticulture was introduced and adopted in the Great Basin. At this point, the Fremont culture arrived in the archaeological record, with evidence of a semi-sedentary lifestyle centered on horticulture, but maintaining a reliance on hunting and gathering (Madsen and Simms, 1998). The material culture diversified greatly with the contemporaneous introduction of pottery and the bow and arrow with smaller projectile points. By around A.D. 1200, an expansion of Numic-speaking peoples into the area seems to have replaced or displaced the Fremont culture (Bettinger and Baumhoff, 1982). Archaeologically, the primary material culture of the Numic includes Intermountain Brownware pottery and Desert Side Notched and Cottonwood Triangular arrow points. The subsistence strategy appears to have shifted back to a focus on hunting and gathering, although there is some evidence of at least limited reliance on horticulture. The Numic-speaking peoples, including the Ute, Shoshone, and Paiute, were the occupants of the Great Basin upon the initial arrival of Europeans in 1776.

### Historic Context

The Historic Period opened with the first explorations of the Great Basin by Europeans. The Domingues-Escalante expedition in 1776 marks the earliest recorded entry of Europeans into Utah. The earliest Euro-American settlements came with the entry of the pioneer members of the Church of Jesus Christ of Latter Day Saints in 1847. The discoveries and extraction of precious metals and mineral ores in the area resulted in the construction of rail lines from mines to markets, ultimately connecting Utah with the rest of the nation. Silver and gold ore deposits brought settlers and fortune seekers into the deserts of western Utah. The first permanent settlements that were not directly related to mining but to the growth and development of an agricultural industry in west-central Utah were aided by the railroad networks created to sustain the mining industry. Farming and ranching quickly developed as a more stable and economically viable option to replace mining. Later periods show Utah becoming part of the overall national economy and subject to the same major events such as World Wars and the Great Depression.

### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 15, including a 1.6-km radius around the proposed location. A literature search was conducted at the Utah Division of State History (UDSH) on January 20, 2009. The files at the UDSH contain information on surveyed historical resources in the State of Utah. The search included the NRHP, archaeological surveys and sites, and historic building surveys and records.

None of the proposed NEON locations in Domain 15 have been previously surveyed for cultural resources, although previous studies have been conducted within a 1.6-km radius of all of the locations.

There are no archaeological resources previously documented within the 1.6-km study area of any of the proposed NEON locations in Domain 15 (Table 3.5.15.3-3). The only resource identified near any of the proposed NEON locations is a structure called the "Red Butte House" just below the Red Butte dam. This site has not been recommended eligible for the NRHP or any other state or local register.

**TABLE 3.5.15.3-3**
Literature Search Results—Domain 15, Great Basin
*National Ecological Observatory Network (NEON) EA*

| | | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | | |
|---|---|---|---|---|---|---|---|
| **NEON Site Number** | **Previously Surveyed** | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON Location | Within 1.6-km Study Area | **Number Evaluated** | **Number Eligible** |
| C-43 | No | 0 | 0 | 0 | 0 | n/a | n/a |
| C-44 | No | 0 | 0 | 0 | 0 | n/a | n/a |
| C-45 | No | 0 | 0 | 0 | 0 | n/a | n/a |
| R-29 | No | 0 | 0 | 0 | 1 | 1 | 0 |
| R-30 | No | 0 | 0 | 0 | 1 | 1 | 0 |
| A-35 | No | 0 | 0 | 0 | 1 | 1 | 0 |

Source: Utah Division of State History and National Register Information System (NRIS). n/a = not applicable

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 15 did not identify any significant known historic properties within the areas of proposed disturbance for any of the proposed facilities and there are no known NRHP eligible historic properties within the study areas.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 15, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

## Utilities

### *Affected Environment*

Electricity would be available for the proposed Onaqui-Benmore sites (C-43, C-44, and C-45) from Vernon, a town on SR 36 approximately 9 km south of proposed sites or from a transformer at the intersection of SR 36 and the dirt road beside which the proposed NEON sites would be located (Sakai, 2008b). It is approximately 8.7 km from Vernon to the dirt road that would lead to proposed towers (C-43, C-44, and C-45). Proposed Advanced Tower C-43 would be located approximately 2.4 km from SR 36 and 280 m from the dirt road. Basic Tower C-44 would be approximately 7 km from SR 36 and adjacent to the dirt road. Basic Tower C-45 would be approximately 5.9 km from SR 36 and 160 m from the dirt road.

The proposed Relocatable Tower (R-30) in Red Butte Canyon would be 30 m away from Red Butte Canyon Road. The proposed Aquatic Array (A-35) would be located 30 m across Red Butte Canyon Road on Red Butte Creek. The closest source of power is USGS Station 1017220 near Red Butte Creek Reservoir (Sakai, 2008a). In 2003 approximately 27 ha were deeded to the Central Utah Water Conservancy District (CUWCD). This area includes the reservoir, Red Butte dam, the access road, and the power source.

Power would be readily available for the proposed Relocatable Tower (R-29) in Murray City, as it would be in an urban area.

#### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed in trenches along existing roads to the point nearest proposed tower locations. Buried lines are required at the proposed Red Butte Canyon sites. A portal would be placed at the point nearest the existing access road where access for maintenance activities would be available. From the AP, the buried line extends beneath a new boardwalk from the edge of the road to the proposed tower components. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for impacts. If biological crusts were encountered at proposed Onaqui-Benmore sites (C-43, C-44, and C-45), power would be extended entirely above ground through surface conduits to limit disturbance and loss of biological crusts.

### Transportation

#### *Affected Environment*

There are unpaved roads open to public access within about 600 m of both the proposed Advanced Tower C-43 and Basic Tower C-45 locations, and proposed Basic Tower C-44 is located adjacent to an unpaved road. These roads may need to be improved to provide all-weather access. Biological soil crusts occur in the vicinity of each of the proposed Core Site tower locations (Sakai, 2008b).

The proposed Relocatable Tower (R-30) and Aquatic Array (A-35) sites in Red Butte Canyon are adjacent to the existing Red Butte Canyon Road, which is closed to public access. The proposed Murray City site (R-29) is located in an urban setting with a developed public road system.

#### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and transported by hand from that point to the construction site. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur. Care would be taken to minimize disturbance of biological soil crusts during movement of materials and construction of facilities at the proposed Core Site towers (C-43, C-44, and C-45) in Onaqui-Benmore.

Materials would be transported by hand from the road to the proposed NEON location. Improved trails would be created to move from the road to a proposed NEON location. Existing trails would be used to the extent that they exist in the required locations. If new trails were required, some loss of biological soil crusts would be expected. Selection of precise tower pad locations would minimize the amount of disturbance of biological soil crusts that would occur. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

### Human Health and Safety

### Affected Environment

Proposed Onaqui-Benmore (C-43, C-44, and C-45) and Red Butte Canyon sites (R-30 and A-35) are in rural locations, away from population sources. The proposed Relocatable Tower (R-29) in Murray City is in a highly populated urban area. The proposed tower (R-29) would be located behind an established business and adjacent to an electrical substation.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

Tower locations would be on land with relatively gentle to level slopes. The proposed Red Butte Canyon tower would be placed near the bottom of the canyon. Workers would not be exposed to hazards as a result of steep slopes or precipices at a worksite.

Towers would be fenced and locked, reducing the risk of unauthorized access to the tower. This would limit public health and safety issues.

There is the potential for the researchers or public riding ATVs or snowmobiles to contact the guy wires during outdoor activities, routine work, or NEON maintenance or data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential of an injury. Any impacts to site users would likely be negligible.

## Recreation

### *Affected Environment*

All-terrain vehicle use occurs on existing roads in the vicinity of the proposed locations at Onaqui-Benmore (C-43, C-44, and C-45). Red Butte Canyon is closed to all public access. Murray City is an urban area.

The historic route of the Pony Express NHT passes within 2.5 km of the proposed Core Site. There are no other NSTs or NHTs within 10 km of proposed NEON locations in Domain 15.

### *Environmental Consequences*

Minor short-term impacts to recreation could occur at some proposed NEON locations during construction. Long-term impacts on recreation would be negligible. Because NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would be likely.

Because there is no recreation in Red Butte Canyon, no recreation impacts would occur there.

Proposed NEON sites in Onaqui-Benmore (C-43, C-44, and C-45) are in areas where outdoor public recreational activities could occur. Elevated noise levels during construction at proposed Onaqui-Benmore sites (C-43, C-44, and C-45) would be noticeable by persons hiking on nearby trails. Construction noise at the proposed tower site (R-29) in Murray City could interfere with outdoor activities in the nearby residential area. This noise would be a nuisance, but the elevated noise would cease following construction. Any impacts would be temporary and negligible.

At proposed NEON locations where recreational vehicle activity could occur, guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

The nearest point along the Pony Express NHT to the proposed NEON Core Site is the historic marker erected near the site of the Faust Station along Utah Highway 36, approximately 2.4 km from the proposed Core Site. The rest of the old Pony Express Trail in this area has been paved as a result of the Pony Express Highway, which follows the route of the trail through a mountain pass to the southwest. The Faust Station Historic Marker abuts a cleared field that is cultivated periodically and is within an area where there are numerous modern structures, including utility poles with solar panels. The presence of 3 NEON towers ranging from 11 m to 15 m in height at a distance of approximately 2.4 km from the historic marker would not impact the NHT.

#### Protection of Children

##### *Affected Environment*

Proposed Relocatable Tower R-29 in Murray City is discussed in this section. There is no routine use of the proposed Onaqui-Benmore or Red Butte Canyon sites by children and implementation of NEON would not attract children to these areas. The proposed Relocatable Tower (R-29) in Murray City would be near a residential area.

##### *Environmental Consequences*

No impacts to the environmental health and safety of children would be expected. Because NEON projects would be separated spatially, no cumulative impacts on the health and safety of children would be likely.

Because proposed tower R-29 would be in an urban setting and near residential areas, unsupervised children would routinely be active near the tower. There could be potential safety issues for children from the temptation to climb the tower (R-29) at Murray City. The tower would be secured with fencing and locked gated to deter unauthorized access. No pathway exists for children to have direct exposure to an environmental health or safety risk. No impacts to the environmental health and safety of children would be expected.

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**Figure 3.D15-1** Domain 15 Proposed Site Locations

**Figure 3.D15-2** Domain 15 Proposed Site Locations

**Figure 3.D15-3** Domain 15 Proposed Site Locations

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### 3.5.16 Domain 16 Pacific Northwest

#### 3.5.16.1 Introduction

Domain 16 is the Pacific Northwest, extending from northern California to southeast and southern Alaska (Figure 2-1). This domain was shaped by tectonic activity that produced the rugged, mountainous, heavily forested ecoregion. The eastern boundary is the crest of the Cascade Mountains. Volcanic activity shaped much of Domain 16 and the volcanoes of the Cascade Range are active. Glacial activity also was a major factor in the history of Domain 16 and created a diverse geology with low-mountains and many lakes in the interior central and southern parts of the domain, as well as glacially deposited sandy soils forming a broad plain with many ponds near the Pacific Ocean. The northern part of Domain 16 is more mountainous, with alpine peaks and fast-flowing, coldwater rocky rivers (LandScope America, 2009a; 2009b). The proposed Core Site towers (C-46, C-47, C-48) and the proposed Aquatic Array (A-36) would be in the Wind River Experimental Forest (WREF) in Skamania County, Washington, approximately 60 km northeast of Portland, Oregon. NEON would use the Wind River Canopy Crane, which is already constructed, as Advanced Tower C-46 (Loescher, 2008). Proposed Relocatable Sites (R-31 and R-32) would be in the Yacolt Burn State Forest (YBSF), approximately 30 km northeast of Vancouver in Clark County, Washington. The proposed STREON Site (S-37) would be in Oregon, in the H.J. Andrews Experimental Forest (AEF) approximately 70 km northeast of Eugene in Lane County. The AEF also is an LTER site.

The proposed action would require permits from multiple agencies. These permits are discussed in detail in Section 5.

#### 3.5.16.2 Resource Areas Considered But Not Addressed for Domain 16

Preliminary analysis indicated that there would be no potential to significantly impact four of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Airspace: There is no special use airspace near any of the proposed NEON locations in Domain 16 (FAA, 2009). No potential for airspace constraints would be expected in this domain.
- Environmental Justice: The proposed NEON sites would be located on unpopulated lands. All potential impacts would be confined to the project footprint and there would be no potential to disproportionately impact minority or low-income populations.
- Protection of Children: The proposed NEON sites would be located on land that is used by the public for recreational purposes, but there would be no features that would attract unsupervised children. All sites would have restricted access by means of fences or gates. All potential impacts would be confined to the restricted areas and there would be no environmental health and safety risks to children.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 16 are designated research areas that are not routinely viewed for aesthetic quality or in areas where evergreen canopy would obscure towers from ground observation.

Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

#### 3.5.16.3 Resource Areas Considered in Detail

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 16 where site-specific conditions would influence the anticipated environmental consequences.

### Geology/Seismology

#### *Affected Environment*

Domain 16 is within the Pacific Province. The underlying geology is variable due to the Cascade subduction zone, which is the convergence of the North American Plate and the Juan de Fuca Plate. There are two distinct geologic regions: the younger volcanic crest composed of prominent mountains formed by extrusive volcanic activity such as Mount St. Helens, and the older mountain features consisting of remnants of long-extinct volcanoes and mountain ridges with steep sides and wide glaciated valleys (LandScope America, 2008 and USGS, 2004). The WREF, YBSF, and AEF are in the Middle Cascade Mountain Subprovince, which is characterized by older mountain features (USGS, 2009a).

The Middle Cascade Mountain Subprovince is relatively stable from the standpoint of seismic risk. For the area surrounding WREF, YBSF, and AEF, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 40 to 80 % pga for short wave motion and 20 to 40 % pga for long wave motion. The coastal zone of the Pacific Province is at greater seismic risk, with areas of instability having a maximum % pga with a 2 percent probability of occurrence in 50 years that exceeds 80 % pga for short wave motion and 160 % pga for long wave motion (USGS, 2008a, 2008b).

#### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity, and NEON activities would not impact subsurface geological features. The seismic hazard is low in the locations where NEON infrastructure is proposed and no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

### Soils

#### *Affected Environment*

Soils within the vicinity of the proposed locations on WREF in the Gifford Pinchot National Forest consist primarily of the Stabler soil series. Stabler soils were formed from a parent material of volcanic ash and pumice that accumulated on terraces. The soils at the proposed locations for C-46, C-47, C-48, and A-36 would be similar and would consist of deep, well drained soils with slopes ranging from 3 to 5 percent. The typical soil profile would be slightly decomposed plant material to 3 cm, medial loam with a weak medium granular structure to 8 cm, medial loam with a weak coarse granular structure to 25 cm, medial loam with a weak blocky structure to 69 cm, hard medial loam to 97 cm, and a medial sandy loam extending to 155 cm (Loescher, 2008 and NRCS, 2009a).

Soils within the vicinity of proposed Relocatable Tower R-31 are dominated by silt loams, stony silt loams, and cobbley silt loams in the uplands and hydric silt loams and silty clay loams in drainages (NRCS, 2009b). Tower R-31 would be located on an upland Kinney cobbley silt loam with a 30 to 60 percent slope. Kinney soils typically occur on mountain slopes formed by residuum weathered from igneous rock with a mantle of volcanic ash (NRCS, 2009b). A typical soil profile is cobbley silt loam to a depth of 13 cm, with gravelly silty loam extending to 152 cm (NRCS, 2009b). The soils in the vicinity of R-31 are not considered significantly susceptible to rill or sheet erosion by water (NRCS, 2009b).

Soils within the vicinity of proposed Relocatable Tower R-32 are upland silt loams, clay loams, and stony clay loams. Relocatable Tower R-32 would be located on Olympic stony clay loam, 30 to 60 percent slope soil. The Olympic soil typically occurs on mountain slopes and has formed by residuum and colluvium from igneous rock. A typical profile of Olympic stony clay loam is stony clay loam to a depth of 33 cm, clay loam below that to 112 cm, and gravelly clay loam extending to 152 cm (NRCS, 2009c). The K factor rating for the Olympic stony clay loam and for most of the soils in the vicinity of R-32 are not considered highly susceptible to rill or sheet erosion by water (NRCS, 2009c).

Soils within the vicinity of the STREON (S-37) site are a complex of two soil types, designated as map units (MUs) by the USFS (USFS, 2001). MU 21 makes up 60 percent of the soils and MU 31 makes up the remaining 40 percent (USFS, 1994). Characteristics of MU 21 include surface soils that are thin gravelly loams with subsoils that are the same material, with clay loams mixed throughout (USFS, 1994). Slopes are typically steep, ranging from 60 to greater than 90 percent. MU 31 is characterized by excessively drained gravelly loam surface soils and thin gravelly to gravelly cobbley loams and clay loams as subsurface soils (USFS, 1994). Typical slopes also range from 60 to greater than 90 percent (USFS, 1994). It is likely soils within and adjacent to the tributary of Lookout Creek would be more hydric, but parent materials would possess the same qualities as those of the surrounding area.

#### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils during construction would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

No impacts to soils would occur at the site of the proposed Advanced Tower. The Wind River Canopy Crane was installed in 1994 and the Advanced Tower would be established by attaching sensors and equipment to the crane.

At each of the additional proposed NEON locations in Domain 16, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would be less than 0.16 ha at C-47, less than 0.10 ha at C-48, less than 0.02 ha at R-31, less than 0.06 ha at R-32, and would be 0.01 ha at C-46 and the proposed Aquatic Array and STREON Site. The greater disturbance at the proposed Basic Towers and the proposed Relocatable Sites would result from extension of utility lines co-located with roadways. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are highly prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and also for indirect impacts to surface waters from transport of eroded materials into nearby waterbodies.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

### Climate

#### *Affected Environment*

Domain 16 has a highly variable climate due to the north-south oriented mountain ranges and elevations that range from sea level to 4,392 m (Loescher, 2008). The climate within Domain 16 is characterized by maritime-type climactic patterns with mild wet winters and warm dry summers.

Within the domain, 90 percent of the average annual precipitation falls between October and April. Due to the mountain effect, annual precipitation varies from 80 to 100 cm, along the western base of the Cascade Range, up to 380 cm along the Cascade crest. Snow zones with deep winter snowpacks develop at elevations above 1,500 m. Much of Domain 16 is located in a transient snow zone, which is subject to intermittent winter snow accumulations (Loescher, 2008). In southwestern Washington and the northern part of Oregon, the precipitation patterns have resulted in a natural fire regime that historically produces less frequent but more severe fires (Popper et al., 2007).

The proposed Core Site towers (C-46, C-47, C-48), Aquatic Array (A-36), and Relocatable Towers (R-31 and R-32) are in areas where precipitation ranges from 178 to 254 cm annually (Loescher, 2008 and WDNR, 2006). The proposed STREON (S-37) site would be in an area where precipitation averages 225 cm annually (Swanson and Jones, 2001).

The average annual temperature at all proposed NEON infrastructure locations is 8.7 °C with monthly averages from 0.1°C to 17.7°C (Loescher, 2008; Swanson and Jones, 2001). Extreme temperatures are the main limiting factor for conducting field work at the proposed locations in Domain 16. Winter access can be difficult due to heavy snowpacks (AEF, 2002a).

### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. Due to the potential for extreme weather conditions from heavy snow and ice storms, towers would be designed and secured to minimize the risk of loss from snow and ice accumulation. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind and snow accumulation. Site design would incorporate appropriate insulation and equipment to allow operation during prolonged periods of extremely cold temperatures.

## Air Quality

### *Affected Environment*

The WREF and YBSF sites are in rural areas of Washington State and the proposed NEON locations would be within areas designated as in attainment for all criteria air pollutants (USEPA, 2009a). The proposed STREON (S-37) site is in AEF in the eastern portion of Lane County, Oregon, which is a nonattainment area due to moderate levels of particulate matter (PM-10) (USEPA, 2009a). AEF is located approximately 65 km from downtown Eugene, the capital of Oregon.

There are six designated Class I Wilderness Areas within 161 km of WREF and YBSF: Mount Hood, Mount Adams, Goat Rocks, Mount Rainier, Mount Jefferson, and Mount Washington. The Mount Hood Wilderness Area in northern Oregon is the closest designated Class I Wilderness Area to each of these proposed sites, approximately 50 km southeast of WREF and 60 km southeast of YBSF (USEPA, 2009b and Google Earth, 2009a).

There are six designated Class I Wilderness Areas within 161 km of AEF: Three Sisters, Mount Washington, Mount Jefferson, Crater Lake, Diamond Peak, and Mount Hood. S-37 in the AEF would be approximately 33 km west of the Mount Washington Wilderness Area and approximately 35 km southwest of the Three Sister Wilderness Area (USEPA, 2009b and Google Earth, 2009b).

The Columbia River Gorge Natural Scenic Area is located approximately 9 km south of the Core Site at WREF and is not a Class I Wilderness Area. However, the Gorge Commission recognizes some potential risk from air pollution and will continue to monitor air pollution and visibility levels in the Gorge and analyze monitoring and emissions data to identify sources inside and outside the Scenic Area (Oregon Department of Environmental Quality, 2008).

### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure.

Because emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts on air quality. The amount of ground disturbance would be less than 0.01 ha at any proposed location and no large earthmoving equipment would be used. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

NEON would not contribute to the regional air quality problem in Lane County, Oregon because there would be no land disturbance or exposed soil at the proposed STREON Site.

The NEON project would not contribute to regional haze or deterioration of air quality and would not impact visibility at any designated Class I Wilderness Area.

### Noise

#### *Affected Environment*

The noise environments at all proposed NEON locations in Domain 16 would be similar. All proposed NEON sites are in rural areas with low surrounding populations. Existing noise levels at each location would likely be approximately 40 dBA (USEPA, 1974).

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would have no impacts on residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. Equipment and materials would be brought in by hand. No new roads would be constructed. During construction, noise levels would be elevated periodically during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Similar temporary noise impacts would be expected at the time of site closure during removal of infrastructure.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to relocate from the construction area, but would likely resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

Noise from the atmospheric sampling equipment pumps also] could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at Core Site tower locations and up to 5 years at Relocatable Sites).

There are residences near the proposed NEON locations. Therefore, noise from AOP overflights would have no potential to impact residents. Potential impacts of AOP overflights on wildlife are discussed below.

### Water Quality

#### *Affected Environment*

There are numerous streams and ponds in the general vicinity of proposed NEON infrastructure in Domain 16 (Table 3.5.16.3-1).

**TABLE 3.5.16.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 16, Pacific Northwest United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-46 | 30-60 | 1 | 7 | 0 | 30 | 0 |
| C-47 | 30-60 | 0 | 7 | 0 | 8 | 0 |
| C-48 | 30-60 | 0 | 2 | 0 | 6 | 0 |
| R-31 | 30-60 | 0 | 4 | 0 | 7 | 0 |
| R-32 | 30-60 | 0 | 7 | 0 | 7 | 0 |
| A-36 | 30-60 | 1 | 2 | 0 | 6 | 0 |
| S-37 | 30-60 | 0 | 1 | 0 | 2 | 0 |

Sources: USFWS, 2008-2009; USFWS, 2009; USGS, 2008-2009; USGS, 2009b.

NEON would use the Wind River Canopy Crane as the frame for the proposed Advanced Tower C-46 in the WREF (Loescher, 2008). The crane is less than 30 m from an unnamed tributary to the Wind River. Basic Tower C-47 would be placed in an upland area at the top of a confined watershed and upslope from an unnamed tributary to Trout Creek. Basic Tower C-48 would be adjacent to Planting Creek. The proposed Aquatic Array (A-36) would be on Planting Creek, a tributary to Trout Creek (Loescher, 2008). The proposed NEON Core Site infrastructure would be in the Middle Columbia Hood watershed (USEPA, 2009c). Trout Creek and the Wind River are on the Washington CWA Section 303(d) list of impaired waters for elevated levels of fecal coliform bacteria, elevated temperature, low concentrations of dissolved oxygen, and pH (NRCS, 2006).

Proposed Relocatable Tower R-31 at Good Seed would be in an upland area that drains to tributaries of Rock Creek, which flows into the East Fork of the Lewis River. Streams in the area are buffered by a minimum of 30 m of forest on each side and the larger streams are protected by forested areas (WDNR, 2006). Proposed Relocatable Tower R-32 at Thyme would be located in an upland area, but the streams around R-32 flow west into North Fork Lacamas Creek (WDNR, 2001). Rock Creek and North Fork Lacamas Creek are in the Lewis River watershed (USEPA, 2009d). Rock Creek is on the Washington CWA Section 303(d) list of impaired waters for elevated levels of fecal coliform bacteria (WDE, 2005b). North Fork Lacamas Creek is classified as meeting designated uses and is not impaired (WDE, 2005b).

The proposed STREON (S-37) site would be on a tributary to Lookout Creek, which flows into the Blue River Reservoir. The proposed site would be in the Mackenzie River watershed (USEPA, 2009e). Lookout Creek is on the Oregon CWA Section 303(d) list of impaired waters for elevated temperatures (USEPA, 2009f).

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. Long-term moderate impacts to water quality in Lookout Creek could occur from STREON experiments. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand from the nearest road. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

Elevation of $NH_4NO_3$ or $H_3PO_4$ concentrations in Lookout Creek to 5 times ambient concentrations for a 10-year period could result in long-term impairment of water quality in this stream and lead to eutrophication within the experimental reach. Because the stream reach is mature evergreen forest, low ambient light levels would likely prevent substantial increases in growth of algae and periphyton. This could lead to greater downstream transport of soluble nitrogen and phosphorus, which could impact downstream waters. There also could be periodic die-offs of algal and periphyton biomass, which could lead to oxygen depletion in the stream from aerobic decomposition. Oxygen depletion could in turn result in changes to vertebrate and invertebrate communities in the immediate area (Hauer and Lamberti, 2006). Impacts would likely be long-term and moderate.

The STREON Study would not further contribute to elevated temperature in Lookout Creek and would not affect the stream’s status on the Oregon CWA Section 303(d) list of impaired waters. No impacts would be expected from the recirculation tracer experiments.

There would be potential for transport of soluble nitrogen and phosphorus to incrementally interact with other human and natural events and produce cumulative impacts to downstream water quality, including accelerated eutrophication of ponds and lakes. Lookout Creek flows into the Blue River Reservoir. The assimilative capacity of this reservoir, due to its volume relative to the flow from Lookout Creek, would prevent the STREON Study from interacting with other actions. No cumulative impacts would be expected.

### Wetlands

#### *Affected Environment*

WREF includes several ponds and wetlands. The Wind River Canopy Crane area (proposed Advanced Tower C-46) contains several emergent wetlands along nearby streams and Trout Creek Pond to the south. There are several ponds and wetlands along Wind River approximately 1 km east of the Canopy Crane. Proposed Basic Tower C-47 would be west of Trout Creek Pond and south of two small emergent wetlands that are near the Canopy Crane (Table 3.5.16.3-1). Proposed Basic Tower C-48 is near to Planting

Creek but would not be in or adjacent to wetlands. The proposed Aquatic Array (A-36) would be on Planting Creek but would not be in or adjacent to wetlands.

The YBSF contains several small wetlands along streams. The proposed NEON Relocatable Towers (R-31, R-32) would be in upland areas and away from wetlands.

The proposed STREON Site (S-37) would not be located in or adjacent to wetlands. Lookout Creek and its tributaries have scattered small riparian wetlands, but none are near the proposed STREON Site.

### Environmental Consequences

There would be no direct impacts to wetlands from installation of NEON infrastructure in Domain 16. Should access routes for maintenance or data collection require crossing wetland areas, NEON, Inc. would construct small footbridges to avoid impacting these areas. No indirect wetland impacts would be likely from implementation of NEON in Domain 16. No cumulative impacts to wetlands would be expected from this project.

Because all work would be confined to uplands, no direct impacts to wetlands would occur at the proposed NEON locations in Domain 16. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for indirect impacts to offsite wetlands as a result of erosion and sedimentation from the construction sites. No indirect impacts to offsite wetlands would be expected.

NEON, Inc. would plan access routes to avoid crossing wetlands to the extent practicable. Should an access route cross a wetland area, NEON would align the crossing to minimize the distance and construct a footbridge to minimize the potential for impacts. NEON would obtain all required local, state, and federal permits regulating activities in wetlands prior to construction at this site and would comply with all permit conditions during construction activities (see Section 5.5 for a discussion of permits and approvals required).

## Floodplains

### Affected Environment

The proposed NEON sites in Domain 16 are in remote areas where FEMA has not designated floodplains or flood prone areas. The proposed WREF Advanced Tower site (C-46), proposed Basic Tower C-48, proposed Aquatic Array (A-36), and proposed STREON Site (S-37) would be in or adjacent to streams where overbank flooding could occur. These areas would be part of a transient snow zone, where winter snowpacks may form and substantial rain-on-snow flood events may occur when warm wet fronts pass through the area (Loescher, 2008). All other proposed NEON infrastructure in Domain 16 would be outside of flood prone areas.

### Environmental Consequences

There would be negligible direct impacts to flood prone areas as a result of implementation of NEON. The Aquatic Array and STREON Site that would be placed in flood prone areas would cause a minimal displacement and result in a negligible impact on flood storage, flood elevations, or flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected. The equipment would be positioned to minimize the potential to snag debris and any impacts on flood conveyance would likely be negligible.

At WREF, the proposed Advanced Tower (C-46) would use the existing Wind River Canopy Crane and would not place new structures in the flood prone area. No impacts would occur from establishment of the Advanced Tower.

There would be the potential for equipment to be damaged during flood events. NEON would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage. Aquatic monitoring devices are small, light-weight instruments that would create negligible impacts on existing water quality if they were to be lost in streams. There are no environmentally harmful components associated with this monitoring equipment. NEON would temporarily remove equipment from flood prone areas when flooding is forecast for the area.

### Common Vegetation and Plant Communities

#### *Affected Environment*

The locations proposed for Advanced Tower C-46and Aquatic Array A-36 would be in a protected research forest with a natural undisturbed old growth forest ecosystem in transition from Douglas-fir to western hemlock. Basic Tower C-47 would be in 100-year old forest naturally regenerating from fire, and Basic Tower C-48 would be located in 40-year old second-growth forest. The dominant common vegetation on WREF includes Douglas-fir and western hemlock. Other species include: Pacific silver fir, grand fir, western red cedar, and western white pine (Loescher, 2008). The understory at WREF is composed primarily of salal, Oregon grape, huckleberry, vine maple, bracken fern, vanilla leaf, queencup beadlily, beargrass, and twinflower (USFS, 2007). The proposed Advanced Tower C-46 (the Canopy Crane) would be in a 500-year-old forest stand dominated by Douglas-fir and western hemlock, with the tallest trees reaching 67 m (Organization of Biological Field Stations, 2009).

The proposed Relocatable Towers (R-31 and R-32) would be in the YBSF, which is a managed maturing forest with dominant trees between 50 and 60 years of age. The proposed NEON towers would be in stands dominated by Douglas-fir, with small components of western red-cedar, western hemlock, Pacific silver fir, red alder, and big leaf maple occurring in natural openings and along larger streams. The understory is composed primarily of salal, salmonberry, blackberry, sword fern, huckleberry, vine maple, bracken fern, maidenhair fern, Oregon oxalis, and vanilla leaf (WDNR, 2006 and WDNR, 2001).

The proposed STREON Site (S-37) would be in the AEF in an area dominated by Douglas-fir and western hemlock of various ages. The understory would be similar to that of WREF and YBSF (USFS, 2008; AEF, 2002a).

#### *Environmental Consequences*

There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate.

### Common Fauna

#### *Affected Environment*

Because of the habitat similarity and proximity (all sites within 50 km), common wildlife species would likely be similar for each of the proposed NEON locations in Domain 16. AEF has identified approximately 20 native species of fish, 20 species of reptiles and amphibians, more than 100 species of birds, and more than 50 species of mammals on the property. Common mammals include the black-tailed deer, red fox, common raccoon, elk, black bear, coyote, chickaree, long-tailed weasel, short-tailed weasel, and porcupine. Other mammals include species of squirrels, chipmunks, hares, rabbits, shrews, voles, bats, and moles and shrew-moles (AEF, 2002b; AEF, 2002c; AEF, 2002d; AEF, 2002e). Common reptiles and amphibians include bull frog, Pacific tree frog, painted turtle, western pond turtle, and salamanders. Common birds include the great horned owl, barn owl, long billed curlew, great blue heron, dipper, cedar waxwing, raven, ruffled grouse, and Cooper's hawk (WDNR, 2001; WDNR, 2006; WDFW, 2009). In addition, more than 3,000 species of invertebrates have been identified on AEF (AEF, 2002f).

#### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide refuge for displaced wildlife during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding would be expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Towers and guy wires would pose a minimal risk to common birds and flying mammals. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds and flying mammals would be eliminated at site closure.

There would be a long-term loss of habitat at towers and IHs, but the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall, impacts to wildlife would be negligible.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because flights would be conducted after canopy leaf-out, visual stimuli would be minimal and the closed canopy could reduce airplane noise. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening wildlife from the flight.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate scientific collection permits would be obtained from the Washington Department of Fish and Wildlife and the Pacific Northwest Region 6 Research Station for research natural areas prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

Because impacts would be separated in space and time, no potential for interaction among or between NEON projects and other projects would be expected.

### Sensitive Habitats

#### *Affected Environment*

The proposed Core Site C-46, including proposed Aquatic Array A-36, is within an old growth forest area designated by USFWS as critical habitat for the northern spotted owl (USFWS, 2008b). Proposed Core Site Basic Tower C-47 would be in 100-year old forest naturally regenerating from fire, and Basic Tower C-48 would be in 40-year old second-growth forest. No other proposed NEON locations in Domain 16 are within areas designated as critical habitat for any species listed under the ESA and no other proposed NEON locations in Domain 16 would be within sensitive habitats.

### *Environmental Consequences*

Impacts to designated critical habitat would be negligible. Prior to any habitat disturbance or construction, consultation with USFWS would be necessary to receive authorization for modification or alteration of the designated critical habitat for the northern spotted owl that would result from construction of Core Site Basic Towers and extension of utility services to those towers. NEON, Inc. would implement any reasonable and prudent measures (RPMs) or other mitigation measures specified through the consultation process prior to or concurrent with construction. Any RPMs or other mitigation specified for operation of the NEON projects would be implemented by NEON, Inc., as appropriate throughout the duration of the NEON experiments.

During construction of C-47, C-48, and A-36, NEON, Inc. would avoid removal of trees, minimize removal of downed woody debris, and minimize alteration of features that contribute habitat requirements of the northern spotted owl through selection of specific locations for infrastructure and routes for access trails and utility lines. Construction of above-ground and below-ground utility lines, clearing for IHs and towers, fencing, and construction of the two towers would constitute a minor impact to critical habitat for the northern spotted owl.

Because the Canopy Crane would be used for the Advanced Tower, no impacts to designated critical habitat would occur at the proposed Advanced Tower location. No other impacts to sensitive habitats would be expected.

## Sensitive Species

### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 16 (Table 3.5.16.3-2). However, there are known occurrences of federal and state protected species within 5 km of all the proposed NEON locations. In addition, potentially suitable habitat for federally protected species is present at or adjacent to the proposed NEON locations, excluding the proposed Relocatable Sites and C-47 (Table 3.5.16.3-2). The following sections discuss the species with potential to occur at or adjacent to proposed NEON sites in Domain 16.

**TABLE 3.5.16.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 16, Pacific Northwest
*National Ecological Observatory Network (NEON) EA*

| | **Number of Federal Protected Species Potentially Occurring** | | | **Number of State Protected Species Potentially Occurring** | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-46 | 1-ESA | 0 | 1-ESA | 3 | 0 | 0 |
| C-47 | 1-ESA | 0 | 0 | 3 | 0 | 0 |
| C-48 | 1-ESA | 0 | 1-ESA | 3 | 0 | 0 |
| R-31 | 1-ESA | 0 | 0 | 3 | 0 | 0 |
| R-32 | 1-ESA | 0 | 0 | 3 | 0 | 0 |
| A-36 | 1-ESA | 0 | 1-ESA | 3 | 0 | 0 |
| S-37 | 10-ESA | 0 | 1-ESA | 9 | 0 | 0 |

Source: Appendix B Domain 16

### Federally Protected Species

The Clackamas corydalis is a federal species of concern that occurs along mountain streams in the western Cascade Range in Washington and in Clackamas and Multnomah Counties in Oregon (Kozloff, 2005). This species may occur near the proposed Advanced Tower (C-46), Basic Tower C-48, and Aquatic Array (A-36).

The northern spotted owl is listed as threatened in Washington and Oregon. The preferred habitat is old growth forests that contain multi-layered, multi-species canopy with moderate to high canopy structure (USFWS, 2008a; USFWS, 2008b). The northern spotted owl could occur in or adjacent to proposed Core Site locations and proposed Aquatic Array A-36, which are within designated critical habitat for the species (USFWS, 2008a). The northern spotted owl also could occur near the proposed STREON Site (S-37), but this area is not within designated critical habitat for the northern spotted owl (Oregon Natural Heritage Information Center, 2008; USFWS, 2008a).

The gray wolf is listed as endangered. Their territories range in size from 80 to 1,609 $km^2$. The species may occur anywhere there is sufficient prey, such as native ungulates, to serve as a prey source (USFWS, 2007). There are no known populations in the vicinity of any of the proposed NEON infrastructure.

Chinook salmon traditionally inhabit a variety of freshwater areas but normally spawn in larger rivers. There are seven distinct populations or Evolutionary Significant Units (ESUs) of Chinook salmon remaining in Washington. From the standpoint of recovery efforts and regulation, each ESU is treated as a distinct population segment. The Lower Columbia River ESU is classified as threatened and all Chinook salmon populations in Washington State are in decline. Adults migrate from the marine environment into the freshwater streams and rivers of their birth to spawn. The adults die after spawning (NOAA, 2009a). WREF and AEF contain streams and rivers that are considered critical habitat for Chinook salmon and steelhead trout. The creeks in the proposed Relocatable Tower study areas in YBSF feed into the Lewis River, which is considered a sensitive ecological community for several species of fish (NOAA, 2009b).

Thyme and Good Seed are in the Columbia River Flyway, which is part of the Pacific Flyway, and would be frequented by migratory birds in addition to providing potential breeding and foraging habitat for birds listed under the MBTA. The other areas proposed for NEON infrastructure also would likely be used by birds listed under the MBTA (WDNR, 2001; 2006).

### State Sensitive Species

There are no other documented occurrences of state protected species that are not also protected at the federal level near the proposed locations of NEON infrastructure at WREF, YBSF, or AEF (Table 3.5.16.3-2) (Oregon Natural Heritage Information Center, 2008 and Washington Natural Heritage Information System, 2008).

### *Environmental Consequences*

Any impacts to sensitive species as a result of NEON implementation would likely be negligible. Limited disturbance would occur around proposed construction sites, but no population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction of C-47, C-48, and A-36, NEON, Inc. would avoid removal of trees, minimize removal of downed woody debris, and minimize alteration of features that contribute habitat requirements of the northern spotted owl through selection of specific locations for infrastructure and routes for access trails and utility lines. While construction of above-ground and below-ground utility lines, clearing for IHs and towers, fencing, and construction of the two towers would constitute a minor impact to critical habitat for the northern spotted owl, this impact to habitat would not affect the survival of the species.

Proposed NEON construction activities would not be expected to impact sensitive aquatic or water-dependent species. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for indirect impacts to sensitive aquatic species from sedimentation as a result of stormwater runoff. Data collection at Aquatic Arrays also would not impact sensitive aquatic species.

NEON, Inc. would work with property site managers to minimize ground-disturbing or vegetation-clearing activities in areas where MBTA species are known to occur and would schedule construction to avoid times when migratory birds are nesting or rearing young. Each proposed area of disturbance would be investigated prior to initiating construction activity, and infrastructure locations would be adjusted slightly if required to avoid any such disturbance while retaining the scientific merit of the location.

All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat nearby during construction. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Washington Department of Fish and Wildlife and the Pacific Northwest Region 6 Research Station for research natural areas prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

### Cultural Resources

#### *Affected Environment*

The proposed NEON locations for Domain 16 would be the WREF, the YBSF, and the AEF. The WREF is in Washington State near the Colombia River Gorge and consists of undeveloped old growth conifer forests. The YBSF in southeast Washington and the AEF in Oregon are in undeveloped areas.

### Prehistoric Context

The Lower Columbia River Basin has been inhabited for at least 12,000 years. Early inhabitants were highly mobile and primarily hunted large game. Diversification in subsistence patterns resulted in floodplain dwelling peoples who increasingly subsisted on riverine and botanical resources. Archaeological evidence of early settlement and culture, approximately 8,000 to 4,000 years ago, is difficult to discern due to deep soils within the low lying floodplains, and the inundation of much of the area due to recent dam-building efforts. The Cayuse Phase culture group, which dates to approximately 2,500 to 250 years ago, was more reliant on fish and root collecting and less on hunting until the introduction of the horse in about 1730 A.D. Prior to the arrival of the horse, the technologies consisted of well developed ground stone, small corner notched, and side notched projectile points, scrapers, lanceolate and pentagonal knives, net weights, pestles, grinding stones, hopper mortars, and cobble implements (Galm et al., 1981). Seasonal rounds of travel were implemented by culture groups during this period that incorporated collecting plants in the spring and as they matured at the lower elevations and gradually working toward higher elevations as the year progressed. In addition to collected plants, fish were a primary food source that was harvested during annual migrations. Excess food was stored for use in winter months, which were spent in villages along the rivers.

The native peoples that occupied the Lower Columbia Basin spoke the Chinook language. The area was called the "Wappato Valley," and consisted of both sides of the Columbia River from the lower end of the Columbia Gorge down to the lower end of Deer Island, just above the mouth of the Cowlitz River (Hajda 1994:32). Dramatic changes in Indian life began prior to the arrival of white explorers and traders in the last years of the 18th Century as a result of goods and diseases acquired from whites in other regions. The population of the area probably fluctuated widely depending upon the season. Lewis and Clark estimated the population of the Wappato Valley (between present-day Vancouver and the mouth of the Lewis River) to be 1,620 in the fall of 1805, and on their return trip they estimated that 5,590 individuals were living there. The most dramatic upheaval was the reduction of population resulting from a series of annual malaria outbreaks introduced by Euro-American traders in 1830. Within 4 years, between 75 and 90 percent of the native population had died (Hajda 1994:32). Prior to the disruptions caused by disease and removal of Indian people to reservations in the mid-1850s, the Chinook inhabitants of the area probably pursued a settlement pattern of seasonally shifting locales. By 1853, the horse was widely used by the Cayuse and Yakama groups (Walker, 1998). Native populations were dispersed to more specialized activity areas, often at higher elevations. Prior to contact with Euro-Americans, Chinook speaking peoples were extensively involved in trade up and down the Columbia River.

### Historic Context

Spanish explorers first reached the southern Oregon coast in 1543. Sir Francis Drake sighted the Washington coast in 1579 and claimed the land for England. The lands of the Northwest Region, however, were first explored by French, Russian, and British trappers and traders in the early 1800s. Lewis and Clark traveled through the Pacific Northwest in 1805 and 1806. During the War of 1812, the British gained control of all the Pacific Fur Company forts. In the early 1840s American emigration to Oregon began, via the Oregon Trail and in 1850, the Donation Land Act enabled settlers to stake claims along the Columbia and its tributaries. In 1855, the United States established treaties with local tribes that reserved lands for Native Americans and guaranteed off-reservation rights. Homesteading in the area did not become common until 1857, when most of the Native American Tribes were relocated from the Columbia River area. Although trapping continued throughout the Northwest well into the 1840s, by the 1850s, gold miners largely replaced the fur traders. The mining industry grew in the region throughout the 1860s, creating a large demand for cattle. The Columbia Basin was ideal for livestock production. During this period, steamboats began landing at selected points along the Columbia River to support the rapidly expanding industries and demands for goods.

Settlers of the Northwest region pursued agriculture and established orchards, vineyards, and other crop fields groups (Griffin and Churchill, 2001). In 1862, Congress passed the Homestead Act, which allowed qualified individuals an opportunity to homestead 160 acres of public domain land. The Homestead Act provided the opportunity for agricultural expansion wherever open land was available (Rasmussen, 1960; Johansen, 1967). The transcontinental line of the Northern Pacific Railroad reached Spokane by the late 1800s, bringing more settlers into the Northwest. Oregon was admitted into the Union in 1859. Washington finally achieved statehood in 1889. The 20th Century saw an increase in agricultural production and river transportation of goods in the Lower Columbia Basin. Railroads rivaled waterways as viable transportation routes. Metal technologies, the timber industry, and the shipping industry developed along the Columbia River and nearby inland areas. These industries persist today.

### Archival Literature Search

To assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 16 and the surrounding area within 1.6 km of each proposed location. The literature search within the State of Washington was conducted at the Department of Archaeology and Historical Preservation (DAHP) in Olympia, Washington. The files at the DAHP include all known archaeological resources, all historic resources listed by the Office of Historic Preservation (OHP), all resources either listed on or determined to be eligible for listing on the NRHP, the Washington Heritage Register, the Washington Heritage Barn Register, and cultural resource reports dated after 1995. The database also contains information for all known cemeteries, regardless of age, in approximately half of the counties in the state. The literature search for the proposed location within the State of Oregon was conducted onsite at the Heritage Conservation Division of the Oregon SHPO in Salem. The Oregon SHPO Archaeological Inventory Database contains information on all known cultural resources and archaeological surveys in Oregon. Scanned archaeological site forms, survey reports, a bibliographic database, General Land Office (GLO) survey maps, and orthographic photo maps, as well as various periodicals and publications related to Oregon and Pacific Northwest archaeology are available at the Oregon SHPO. In addition to the GIS database, the Above Ground Resources database, the general reference library, the NRHP files, and the Oregon Burial Index were reviewed.

None of the proposed NEON locations in Domain 16 have been previously surveyed for cultural resources, although four studies have been conducted within 1.6 km of the proposed NEON location in Oregon and the proposed NEON locations in the WREF.

Resources previously documented within the vicinity of the proposed NEON locations include prehistoric lithic scatters, historic cabins and associated outbuildings, historic trails, historic campsites, and one large site with evidence of prehistoric occupation as well as historic logging and homesteading (Table 3.5.16.3.3). The literature search revealed that there are no known historic properties located within any of the areas of disturbance for the proposed NEON facilities in Domain 16. Several resources are located within 1.6 km of proposed NEON facilities located in the WREF. Proposed Core Site Towers C-46 and C-47 partially overlap due to their proximity. By accounting for resources identified twice in Table 3.5.16.3.3, there were eight resources identified within the combined study area for C-46 and C-47; three of these resources have been evaluated for the NRHP. Two resources are recommended as eligible for the NRHP. The remaining five sites have not yet been evaluated for the NRHP or any other state or local register.

**TABLE 3.5.16.3.3**
Literature Search Results–Domain 16, Pacific Northwest
*National Ecological Observatory Network (NEON) EA*

| | | **Number of Archaeological Resources Present** | | **Number of Historic Resources, including Architecture Present** | | | |
|---|---|---|---|---|---|---|---|
| **NEON Site Number** | **Previously Surveyed** | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | **Number Evaluated** | **Number Eligible** |
| C-46 | No | 0 | 8 | 0 | 0 | 2 | 1 |
| C-47 | No | 0 | 6 | 0 | 0 | 3 | 2 |
| C-48 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R-31 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R-32 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| A-36 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| S-37 | No | 0 | 0 | 0 | 0 | 0 | n/a |

Source: Department of Archaeology and Historical Preservation (DAHP), Oregon SHPO Archaeological Inventory Database

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 16 did not identify any known significant historic properties within the proposed areas of disturbance for any of the proposed NEON infrastructure.

Of the historic properties that have been previously documented or appear on historic maps within 1.6 km of proposed NEON locations, none of these resources are within the area of disturbance and the NEON infrastructure would not alter the viewshed of any of the known historic properties.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 16, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

### Utilities

#### *Affected Environment*

The proposed Advanced Tower would use the Wind River Canopy Crane as the tower structure. Electric power and telecommunications are available at this location.

The power for the proposed Basic Towers would originate near the Trout Creek Pond dam at the USFS Civilian Conservation Corps Camp. Electrical transmission lines would be extended in underground trenches approximately 2 km to Basic Tower C-47 and approximately 6.5 km to Basic Tower C-48 and Aquatic Array (A-36) (Loescher, 2008).

The proposed Relocatable Towers would be in remote areas with no nearby electrical transmission lines. R-31 could receive power by extending transmission lines underground from the community of Dole for approximately 3.2 km along Dole Valley Road (L-1210) and then placing a ground line through approximately 0.5 km of forest to reach the proposed tower site. R-32 would likely receive power by extending transmission lines from the end of NE Vinemaple Road in the Craswell Heights community through the forest for approximately 1.6 km from the portal to the IH.

The proposed STREON Site (S-37) at AEF would be located approximately 1 km west of the AEF Headquarters and utilities would be extended from the AEF Headquarters area.

#### *Environmental Consequences*

Minor short-term and long-term impacts to common vegetation and wildlife, as discussed above, would result from installation of utilities to serve NEON infrastructure. Because of the spatial separation of projects, no cumulative impacts would be expected.

Power would be extended from the grid terminus, with underground lines placed in trenches along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the existing access road where access for maintenance activities would be available. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for impacts. If extended electrical transmission lines would cross streams, an overhead crossing would be constructed to avoid impacts to streams.

### Transportation

#### *Affected Environment*

WREF is located within Gifford Pinchot National Forest. Access for the proposed NEON infrastructure is off Wind River Road. The proposed Core Site towers (C-46, C-47, and C-48) and Aquatic Array would be accessed from the town of Stabler and west on Hemlock Road. There is an internal network of roads to provide access to each tower and array and each proposed NEON infrastructure component is within 0.35 km of a road (Loescher, 2008).

The proposed Relocatable Towers would be in the YBSF. The primary access to the proposed Relocatable Tower (R-31) would be along forests roads that intersect Dole Valley Road (WDNR, 2006). The primary access to the proposed Relocatable Tower (R-32) would be from forest roads off of Rawson Road (WDNR, 2001).

The proposed STREON Site (S-37) would be in the AEF in the Willamette National Forest. The primary access to the proposed S-37 would be from forest roads off of Blue River Reservoir Road (SH-126).

#### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

No new roads would be constructed. Materials would be brought as near a proposed location as possible on existing roads and transported by hand from that point to the construction site. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur.

Improved trails would be created to move materials from the road to a proposed NEON location. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access.

### Human Health and Safety

#### *Affected Environment*

NEON locations at the WREF, YBSF, and AEF would be on public property and accessible by the public. WREF and AEF are research forests and access usually consists of employees and researchers, with the public rarely visiting these locations. The Advanced Tower would be placed on the Wind River Canopy Crane. The crane and surrounding area are closed to the general public because of safety concerns (USDA, 2003).

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users and maintenance workers for the duration of NEON. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

Personnel accessing the sites in winter would wear appropriate clothing for weather conditions and use appropriate vehicles to reach the site. Sites would not be accessed when severe storms are forecast.

Proposed NEON infrastructure would be in rural settings that are not frequented by the public. Trails leading to the towers would be gated and signed to deter public use. Towers would be secured with fencing and locked gates to deter unauthorized access.

Aquatic instruments would not be fenced, but would not impact human health or safety. These instruments would be secured in place.

There would be potential for recreational users, employees, or researchers riding ATVs to strike guy wires during routine work or during NEON maintenance and data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

### Recreation

#### *Affected Environment*

The area around the Wind River Canopy Crane (C-46) is closed to the general public because of safety concerns. However, the remaining areas in WREF are open to the public. There are several hiking trails and campgrounds, although none are near proposed NEON locations (USDA, 2003).

The areas around proposed Relocatable Sites R-31 and R-32 are popular for outdoor recreation. The DNR Tarbell trail system is near R-31. Several informal recreation activities take place in the area such as hunting, horseback riding, hiking, mountain biking, and berry and mushroom picking (WDNR, 2006; WDNR, 2001).

The AEF is inside the Willamette National Forest and north of the Blue River Reservoir. This area is used for outdoor recreation including camping, picnicking, hiking, fishing, swimming, boating, and water skiing. There are no hiking trails in the AEF (USFS, 2004).

The Pacific Crest NST passes through the proposed Core Site area. There are no other NSTs or NHTs within 10 km of proposed NEON locations in Domain 16.

#### *Environmental Consequences*

Minor short-term impacts to recreation could occur at some proposed NEON locations during construction. Long-term impacts on recreation would be negligible. Because the

NEON project facility locations would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would be likely.

Construction activities could result in temporary use restrictions near the proposed Relocatable Tower sites on YBSF. Any impacts would be short–term and persons could conduct recreational activities in other parts of these properties. Any impacts would be negligible. To the extent practicable, NEON would time construction to avoid peak recreational use periods.

Towers would be secured with fencing and locked gates to deter unauthorized access. The towers, guy wires, and security fencing could be visible to recreational users but would not prevent typical recreational uses. It is likely that aesthetic impacts would be negligible due to the presence of intervening vegetation.

At proposed NEON locations where recreational vehicle activity could take place, guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

The Pacific Crest NST passes through the proposed Core Site. The NST crosses the proposed Core Site on the valley floor. The Advanced Tower would be placed on the existing Canopy Crane and would have no impact on the Pacific Crest NST. The basic towers would be screened from persons on the trial by the forest vegetation. No impacts to the Pacific Crest NST would be expected.

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**Figure 3.D16-1** Domain 16 Proposed Site Locations

**Figure 3.D16-2** Domain 16 Proposed Site Locations

**Figure 3.D16-3** Domain 16 Proposed Site Locations

**Figure 3.D16-4** Domain 16 Proposed Site Locations

## 3.5.17 Domain 17 Pacific Southwest

### 3.5.17.1 Introduction

Domain 17 covers most of California from the Baja California border to the Shasta National Forest, excluding the southeastern desert and the northwestern mountains. The domain includes the California Coastal Range, the Central Valley, and the Sierra Nevada Mountains. The climate is Mediterranean, characterized by dry, hot summers and cool, wet winters. The California Montane Woodland and Chaparral is the dominant ecosystem and includes a mix of chaparral shrubs, open forests, and savannahs. The higher elevations include the Sierra Nevada Cliffs and Canyon ecosystem of coniferous forests and rock outcroppings. The Central Valley receives an average of 50 cm of precipitation and grassland vegetation is dominant (LandScope America 2008a, 2008b, and 2008c). NEON infrastructure would be placed in the San Joaquin Experimental Range (SJER) and the Sierra National Forest (SNF). The proposed STREON Site would be in the Kings River Experimental Watershed (KREW) in the SNF.

### 3.5.17.2 Resource Areas Considered But Not Addressed for Domain 17

Preliminary analysis indicated that there would be no potential to significantly impact two of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Environmental Justice: The proposed NEON sites would be located on unpopulated lands. All potential impacts would be confined to the project footprint and there would be no potential to disproportionately impact minority or low-income populations.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 17 are designated research areas that are not routinely viewed for aesthetic quality. Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

### 3.5.17.3 Resource Areas Considered in Detail

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 17 where site-specific conditions would influence the anticipated environmental consequences.

#### Geology/Seismology

#### *Affected Environment*

Crustal basement rocks underlying sedimentary rocks are the two major rock types of Domain 17. Crustal basement rocks are complexes of hard crystalline metamorphic and igneous rocks. The intrusion of magma created metamorphic and granite rock complexes. These granite rocks are now exposed on hillsides in the southern California coastal mountain ranges. The overlying sedimentary rock is of marine origin from various time periods. Tectonic movement of the Pacific Plate has caused rock uplifting and folding, creating the mountainous landscape of the area (USFS, 2008a).

The Pacific Southwest is seismically active. Throughout the domain, the maximum % peak ground acceleration (pga) with a 2 percent probability of occurrence in 50 years ranges from 40% pga to 160% pga for short wave motion and 20% pga to 80% pga for long wave motion. Seismic activity is higher near the coast along the San Andreas Fault. The proposed NEON locations are in the lower pga range away from the principal fault line (USGS, 2009a, 2009b).

#### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

The proposed NEON sites are not in areas with geological features that influence surface activity and NEON activities would not impact geological features below the ground surface. Seismic hazards at SJER and SNF are moderate to high; however, no impacts to NEON infrastructure or interruptions in data collection would be expected from seismic activity. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

### Soils

#### *Affected Environment*

Soils within the general area of all the proposed locations would consist mostly of sandy loams and gravelly coarse sandy loams. The soil at the proposed location for Advanced Tower C-49 (Figure 3.D06-3) is Ahwahnee and Vista rocky coarse sandy loam. Ahwahnee and Vista is well drained with slopes ranging from 8 to 30 percent. The typical soil profile for this soil type is coarse sandy loam to 20 cm, sandy loam to 121 cm, and weathered bedrock extending to 132 cm. This soil type is considered to be moderately susceptible to rill and sheet erosion (NRCS, 2009a; NRCS, 2009b).

The soil in the proposed area of Basic Tower C-50 (Figure 3.D06-2) consists mainly of Gerle-Cagwin families. Gerle-Cagwin families are well drained with slopes ranging from 5 to 35 percent. The typical soil profile is gravelly coarse sandy loam to 36 cm, cobbley coarse sandy loam to 66 cm, cobbley loamy coarse sand to 97 cm, and weathered bedrock extending to 107 cm. This soil type is considered mildly susceptible to rill and sheet erosion (NRCS, 2009c; NRCS, 2009d).

The soil at the proposed location for Basic Tower C-51 (Figure 3.D06-1) would consist of Stecum family-rock outcrop complex and Stecum family soils. Stecum family-rock outcrop complex (5 to 45 percent slope) and Stecum family soils (3 to 35 percent slope) are both excessively well drained. The typical soil profile for both Stecum family-rock outcrop complex and Stecum family soils is coarse sandy loam to 15 cm, cobbley loamy coarse sand to 81 cm, and extremely cobbley coarse sand to 165 cm. Both of these soils are considered mildly susceptible to rill and sheet erosion (NRCS, 2009e; NRCS, 2009f; NRCS, 2009g).

Soils within the general area of the proposed Relocatable Site R-33 (Figure 3.D06-4) are sandy loams and sandy clay loam. The soil at the proposed R-33 location is Holland, a well drained soil with a 35 to 65 percent slope. The typical profile for this soil type is sandy loam to 18 cm, sandy clay loam to 152 cm, sandy loam to 168 cm, and weathered bedrock to 178 cm. This soil type is considered to be mildly susceptible to rill and sheet erosion (NRCS, 2009h; NRCS, 2009i).

Soils near the proposed Relocatable Site R-34 (Figure 3.D06-5) are mostly gravelly loamy coarse sand. The soil at the proposed R-34 site is Cagwin-Cannell complex, a somewhat excessively drained soil with slopes ranging from 2 to 25 percent. The typical soil profile for this soil complex is gravelly loamy coarse sandy to 114 cm and weathered bedrock extending to 124 cm. This soil type is considered to be mildly susceptible to rill or sheet erosion (NRCS, 2009j; NRCS, 2009k).

The soil in the general area of the proposed Aquatic Array A-39 (Figure 3.D06-2) on Providence Creek is rock outcrop-Dystric lithic xerochrepts. This surface is completely unweathered bedrock with slopes ranging from 65 to 85 percent (NRCS, 2009l).

Soil within the general area of the proposed STREON Site S-40 (Figure 3.D06-5) is mostly loam and sandy loam. The soil at the proposed STREON Site and along Teakettle Creek is typic xerumbrepts (NRCS, 2009m; NRCS, 2009n).

### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

At each of the proposed NEON locations in Domain 17, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installation of fencing around towers, and trenching to extend electric power from portals. The total area of disturbed soils would range from approximately 0.07 ha to approximately 0.36 ha among the proposed NEON locations, with the more remote Relocatable Sites, Aquatic Array, and STREON site having greater soil disturbance. In all instances, where the amount of disturbed soils would exceed 0.01, the greater disturbance would result from extension of utility lines along roadways. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are highly prone to erosion. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby waterbodies.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

### Climate

#### *Affected Environment*

The climate for central coastal California is Mediterranean, characterized by wet, cool winters and dry, hot summers. The average annual temperatures range from 6 to 23°C with maximum temperatures exceeding 38°C in the summer. The proposed NEON locations are in higher elevations where temperatures are cooler.

Coastal mountain ranges, including the Santa Lucia Range and Santa Cruz Mountains, block and absorb ocean moisture. Inland areas generally receive half the precipitation recorded along the coastline, and periodic drought events are common in this area. Mean annual precipitation ranges from 376 mm near sea level in San Jose, California to 600 mm on Mount Hamilton at elevations above 1,000 m. Light winter snowfall occurs in areas with elevations above 750 m. The proposed Relocatable and STREON Sites in the KREW and the Teakettle Experimental Forest (TEF) would be at elevations above 750 m. The proposed Core Site would be at lower elevations in the SJER (Pacific Southwest Ecological Observatory Network, 2008).

#### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. Due to the extreme wind conditions on mountain tops, towers located in higher elevations (R-34 and C-51) would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind.

### Air Quality

#### *Affected Environment*

All the proposed NEON locations would be in the San Joaquin Valley in Fresno and Madera Counties. The San Joaquin Valley is designated as in non-attainment for particulate matter and severe 8-hour ozone levels. The city of Fresno is a major metropolitan area located approximately 30 km from proposed Core Site Tower C-49 and 55 km from Relocatable Site R-33. There are 13 Federal Class 1 Wilderness Areas within 161 km of the proposed NEON locations. The Kaiser and Ansel Adams Wilderness Areas are both located within 30 km of the proposed sites (USEPA, 2008a, 2009a, and 2009b).

#### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed infrastructure would have short-term, negligible impacts on air quality. The amount of ground disturbance would be less than 0.01 ha at any proposed location and no large earthmoving equipment would be used. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze or impairment of air quality at any designated Class I Wilderness Area.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

### Noise

#### *Affected Environment*

The noise environments at all of the proposed NEON locations would be similar; all are in rural areas with low populations. There are no residential areas near the proposed Relocatable Sites (R-33 and R-34) and STREON Site (S-40). Courtright Reservoir, which has a small camping area, is approximately 1.56 km northeast of the proposed C-51 site. Small residential areas are approximately 1.9 km southeast, 0.8 km northeast, and 0.7 km southwest of proposed locations C-49, C-50, and A-39, respectively. Existing noise levels at all locations would likely be approximately 40 dBA (USEPA, 1974).

#### *Environmental Consequences*

There would be short-term negligible direct noise impacts to onsite workers and minor direct impacts to wildlife from construction. Operation of atmospheric sampling equipment would produce long-term continuous minor noise impacts. Long-term intermittent minor impacts to wildlife would result from the noise of vehicle use during operation of NEON infrastructure. AOP overflights would have no impacts on residents. There would be no interaction among sites or with other projects, so no cumulative impacts from noise would occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. Equipment and materials would be brought in by hand with as little impact as possible. No new roads would be constructed. During construction noise levels would be elevated periodically during daytime from clearing, trenching, leveling, and other construction activities. Operation of the walk-behind trencher would create the loudest noise during construction, 88 dBA at 3 m (Charles Machine Works, Inc., Undated). Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction.

The residential areas near proposed tower C-50 could be impacted by noise from construction of NEON infrastructure. Absent intervening vegetation, the sound would be reduced to approximately 64 dBA as a result of natural attenuation from traveling the 0.8 km to the residential area (FHWA, 2007). The open vegetation would provide little additional reduction in noise, but persons inside of houses would experience a further reduction of 15 to 25 dBA (USEPA, 1974). Because of the attenuation, construction-related noise would be perceptible to persons outdoors in the residential area near C-50 but not perceptible to persons indoors. The elevated outdoor noise would be below nuisance levels and would not impact residents during outdoor activities.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to relocate from the construction area, but to resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

The pumps for atmospheric sampling equipment on an FIU would operate continuously. Typically, these pumps produce noise of approximately 65 dBA. NEON, Inc. would place the pumps within noise shielding to reduce the sound to less than 60 dBA at 12 m. Residents near proposed NEON locations would be unlikely to perceive noise from operation of pumps.

Noise from the atmospheric sampling equipment pumps also could impact wildlife. The constant nature of the noise could result in long-term displacement of some animals. Other animals would adjust to the constant noise and resume use of the area around an FIU. Any impacts to wildlife would likely be long-term and minor at all proposed tower locations.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at Core Site tower locations and up to 5 years at Relocatable Sites).

Noise from the AOP would have the potential to impact residents near the proposed Core Site. AOP flights at 1,000 m above the canopy would be expected to have no impact on residents. AOP flights at 150 m above the canopy would be a short-term nuisance, but any impacts to residents would be negligible. The potential for AOP flights to disturb wildlife is discussed below.

## Water Quality

### *Affected Environment*

The SNF has over 480 lakes and approximately 2,900 km of streams (EDISON, 2008). Proposed NEON locations in SJER, TEF, and KREW are in the SNF, excluding Core Site Advanced Tower C-49. The SJER has numerous intermittent streams, swales, and springs but no permanent flowing water bodies (Table 3.5.17.3-1. The SJER watershed drains into Cottonwood Creek, a tributary of the San Joaquin River (Purcell et al., 2007). Cottonwood Creek is on the California CWA Section 303(d) list of impaired waters for flow alteration (California Environmental Protection Agency, 2002).

**TABLE 3.5.1.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 17, Pacific Southwest United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-49 | 26 | 0 | 9 | 0 | ND | ND |
| C-50 | 100+ | 0 | 6 | 0 | ND | ND |
| C-51 | 100+ | 0 | 23 | 0 | ND | ND |
| R-33 | 100+ | 1 | 0 | 0 | ND | ND |
| R-34 | 100+ | 0 | 3 | 0 | ND | ND |
| A-39 | 100+ | 1 | 4 | 0 | ND | ND |
| S-40 | 100+ | 1 | 2 | 0 | ND | ND |

ND = No Data
Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009c.

No streams would be near the proposed Advanced Tower C-49. Proposed Basic Tower C-50 would be upstream from Glen Meadow Creek, a tributary to the Kings River.

Proposed Basic Tower C-51 would be directly upstream of Short Hair Creek, which flows into the Wishon Reservoir in the SNF. Clear Lake is also approximately 0.4 km southeast of proposed Basic Tower C-51. The streams in the immediate Core Site area meet their designated uses and none are included on the California CWA Section 303(d) list of impaired waters.

The proposed Aquatic Array (A-39) would be on Providence Creek, which flows into Big Creek. Proposed Relocatable Site (R-33) would be on a ridge between Big Creek and Rush Creek. Big Creek and Rush Creek connect and flow into the Kings River at the Pine Reservoir. The streams in this area meet their designated uses and none are included on the California CWA Section 303(d) list of impaired waters.

The TEF is located in the Kings River drainage of the SNF (USDA, 1990). The proposed Relocatable Site (R-34) and STREON Site would be adjacent to Teakettle Creek. The streams in this area meet their designated uses and none are included on the California CWA Section 303(d) list of impaired waters.

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. Long-term moderate impacts to water quality in Teakettle Creek could occur from STREON experiments. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure.

There would be a potential for in-stream monitoring equipment to be washed downstream during periods of heavy rain and strong currents. It is unlikely that any equipment would be recovered if washed away. Aquatic monitoring devices would create negligible impacts to existing water quality if they were lost because they are small and light-weight. There are no environmentally harmful components associated with this monitoring equipment. NEON would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage. If sufficient advance warning of flood events is received, NEON would temporarily remove equipment from floodplains to prevent damage or loss.

Elevation of $NH_4NO_3$ or $H_3PO_4$ concentrations in Teakettle Creek to 5 times ambient concentrations for a 10-year period could result in long-term impairment of water quality in this stream and lead to eutrophication within the experimental reach. Because the stream reach is in a hardwood forest area, nutrient additions in winter and early spring, prior to canopy leaf-out, would likely result in increased growth of algae and periphyton due to the direct exposure to sunlight and greater nutrient availability. Once the canopy closes and shades the stream, lack of sunlight would be expected to slow growth of algae and periphyton, which could lead to greater downstream transport of soluble nitrogen and phosphorus, which could impact downstream waters, particularly lakes and impoundments. There also could be a die-off of algal and periphyton biomass, which could lead to oxygen depletion in the stream from aerobic decomposition. Oxygen depletion could in turn result in changes to vertebrate and invertebrate communities in the immediate area (Hauer and Lamberti, 2006). Impacts would likely be long-term and moderate. No impacts would be expected from the recirculation tracer experiments.

There would be potential for transport of soluble nitrogen and phosphorus to incrementally interact with other human and natural events and produce cumulative impacts to downstream water quality, including accelerated eutrophication of ponds and lakes. Once Teakettle Creek flows into the North Fork Kings River, the greater assimilative capacity of the river would prevent cumulative impacts. No cumulative impacts would be expected.

## Wetlands

### *Affected Environment*

The Pacific Southwest includes a variety of wetland habitats, from alpine wet meadows to coastal tidal marshes. Some of the wetland habitats found in Domain 17 are vernal pools, seasonal farmed wetlands, tidal marsh, and freshwater marshes (USEPA, 2008b).

Vernal pools occur seasonally in the Mediterranean climate. The pools are typically inundated during the wet winter and spring seasons but dry out in the summer and fall. Vernal pools vary in size and are usually found in grassland areas. They are considered isolated except when connected through vernal swales. Because of their seasonal characteristics, vernal pools are easily destroyed or damaged from urbanization practices (USEPA, 2008c).

No wetlands are located near the proposed NEON sites R-33, A-39, or S-40. Emergent wetland areas occur within 0.1 km of the proposed Core Site and adjacent to proposed Relocatable Site R-34. No towers would be built in wetland areas.

### *Environmental Consequences*

Wetlands occur near or adjacent to proposed Core Site infrastructure and Relocatable Site (R-34) in the SNF. No towers associated with the sites or supporting infrastructure would be placed in wetlands. An Aquatic Array (A-39) would be located on Providence Creek and instruments would be placed below the ordinary high water mark. There would be no direct impacts to wetlands from installation of Core Site towers or the Relocatable Towers in Domain 17. No indirect wetland impacts would be likely from implementation of NEON infrastructure in Domain 17. No cumulative impacts to wetlands would be expected from this project.

Because all terrestrial based work would be confined to uplands, no direct impacts to wetlands would occur at the proposed NEON Core Site towers, the proposed Relocatable Towers, or the Aquatic Array. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for indirect impacts to offsite wetlands as a result of erosion and sedimentation from the construction sites. No indirect impacts to offsite wetlands would be expected.

No impacts to wetlands in Domain 17 would likely result from NEON implementation or site closure.

## Floodplains

### *Affected Environment*

Floodplain maps are not available for the proposed Domain 17 locations. The proposed Aquatic Array (A-39) would be located at Providence Creek in an area that would likely flood. The proposed Relocatable Tower (R-34) and STREON Site (S-40) would be located in areas adjacent to Teakettle Creek that would likely be subject to flooding. The remaining proposed NEON locations would not be in areas that would be subject to flooding.

### *Environmental Consequences*

There would be negligible direct impacts to flood prone areas as a result of implementation of NEON. One Relocatable Tower and the Aquatic Arrays would be placed in floodplains and areas subject to flooding. The minimal displacement of the proposed equipment would result in a negligible impact on flood storage, flood elevations, and flood conveyance. No indirect or cumulative impacts to flood prone areas would be expected.

The proposed Aquatic Array (A-39), Relocatable Tower (R-34), and STREON Site (S-40) would be located in areas where flooding would be likely. The Relocatable Tower and aquatic instrumentation would have small displacements and no increase in flood elevations would be expected. Any changes in flood storage capacity and flood conveyance would be negligible. There is the potential for sensors on R-34 to be damaged during flood events. NEON would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage. If sufficient advance warning of flood events is received, NEON would temporarily remove equipment from floodplains to prevent flood damage or loss.

## Common Vegetation and Plant Communities

### *Affected Environment*

The SJER is characterized as a mosaic of grasslands, oak-pine woodland, and chaparral shrubs. The canopy cover is sparse and the climate results in an open understory. Dominant tree species include blue oak, interior live oak, and foothill pine. Chaparral shrub species grow either individually or in thick clumps. Common species include wedgeleaf ceanothus, chaparral whitethorn, holly-leaf coffeeberry, hoary coffeeberry, and Mariposa manzanita. Grasslands generally dominate areas with thin overstory and consist of perennial grasses, annual grasses, rushes and sedges, and native forbs. Meadows can have wet or dry characteristics and different vegetation communities are associated with each (Purcell et al., 2007).

The TEF is located at higher elevations in the SNF where the vegetation community is predominantly coniferous. Dominant species include red fir, white fir, sugar pine, Jeffery pine, Western white pine, California incense-cedar, mountain hemlock, and Western juniper. Isolated wet and dry meadow habitats are also present. Common wet meadow species include California false hellebore, arrowleaf ragwort, and bigleaf lupine. Dry meadows are dominated by Bolander's milkvetch (USDA, 1990; Griffin, 1975).

### *Environmental Consequences*

There would be minor long-term impacts to vegetation and plant communities at tower pads and IHs and negligible short-term impacts to vegetation and plant communities along utility lines. Construction of fencing would result in a long-term negligible impact to vegetation. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Spread of noxious weeds is a serious concern in this region. Areas disturbed through trenching or other construction activities would be stabilized and seeded with native vegetation in accord with respective land management agency BMPs. Where overhead utility lines are extended, there could be limited removal of trees along the route. Because of the need to keep the utility lines clear of vegetation, these areas would remain free of trees until the end of the NEON project.

Minor clearing of vegetation would occur during construction to prepare for tower pads and IHs. There also would be minor clearing of vegetation to place trenches for extension of utility lines. Vegetation in areas cleared for tower pads and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site. Areas disturbed for trenching would be stabilized and allowed to naturally revegetate.

### Common Fauna

#### *Affected Environment*

The SJER is located in the foothill oak woodlands of California, which are considered species rich and provide breeding, wintering, and migratory stopover habitats. Vertebrate species have been monitored at SJER for over 70 years. Observations include 7 fish species, 8 amphibian species, 19 reptile species, 41 mammal species, and 198 bird species (Purcell et al., 2007).

Fish are limited to stocked species in man-made ponds and reservoirs. Relatively few amphibian and reptile species have been observed in the SJER habitat. Common amphibians include the bullfrog, Western toad, and Pacific tree frog. Three salamander species are present in the area but are rarely encountered. Common reptiles include the Western fence lizard, side-blotched lizard, Gilbert's skink, Tiger whiptail, striped racer, gophersnake, Sierra garter snake, common garter snake, western rattlesnake, and Western pond turtle (Purcell et al., 2007).

Common mammals include the Virginia opossum, desert cottontail, western pipistrelle, pallid bat, California myotis, Yuma myotis, bobcat, coyote, American badger, wild boar, mule deer, California ground squirrel, Heermann's kangaroo rat, San Joaquin pocket mouse, Botta's pocket gopher, big-eared woodrat, brush deermouse, North American deermouse, and Piñon deermouse (Purcell et al., 2007).

A variety of waterfowl, wading birds, raptors, and songbirds have been observed at SJER. Several migrating species are seasonal residents, and over 55 species nest onsite. The following are common permanent resident species at SJER: the California quail, red-tailed hawk, mourning dove, Anna's hummingbird, acorn woodpecker, Nuttall's woodpecker, Western scrub-jay, common raven, oak titmouse, bushtit, white-breasted nuthatch, Bewick's wren, western bluebird, California towhee, house finch, and lesser goldfinch (Purcell et al., 2007).

The TEF occurs at higher elevations where conifers dominate the landscape. The local red fir, white fir, and Jeffery pine habitats are considered particularly important to bird and mammal species. Over 169 wildlife species are associated with California red fir habitats, which includes 8 amphibian species, 4 reptile species, 104 bird species, and 53 mammal species (Barrett, 1988). Common red and white fir species are the yellow-rumped warbler, western tanager, mountain chickadee, chestnut-backed chickadee, golden-crowned kinglet, and blackheaded grosbeak (Shimamoto, 1988). Common Jeffery pine species include the nuthatch, brown creeper, woodpecker, and northern flying squirrel (McBride, 1988).

#### *Environmental Consequences*

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide wildlife refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding would be expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas and any impacts would be negligible.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because proposed NEON locations in Domain 17 would be in areas with predominantly open canopies, animals would be expected to startle at the noise and appearance of the plane. Short flight responses would be expected due to the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible because only one flight per year would occur at a given location.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate scientific collection permits would be obtained from the California Department of Fish and Game prior to any small mammal trapping (see Section 5.17). A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

### Sensitive Ecological Communities

#### *Affected Environment*

The SNF Forest Management Plan has designated Research Natural Areas (RNAs) for sensitive species and natural communities. The SJER was designated to research blue oak-digger pine communities. The TEF was established for watershed research and the dominant vegetation community consists of red and white fir (USDA, 1991).

Blue oak-foothill pinelands occur in mosaic foothill habitats. The oak and pine trees provide critical breeding habitats for a large variety of wildlife species. The blue oaks also supply (every few years) large acorn crops, an important food source for many species (Verner, 2008). The SNF Forest Management Plan also recommends designating an area to research the red and white fir ecosystem (USDA, 1991).

### *Environmental Consequences*

The proposed NEON locations would occur in either blue oak-foothill pinelands or red and white fir forests. Because the expected area of impacts would be less than 0.01 ha, the impact to these sensitive habitats at SJER, TEF, and SNF would be minor.

## Sensitive Species

### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 17 (Table 3.5.17.3-2).

**TABLE 3.5.17.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 17, Pacific Southwest
*National Ecological Observatory Network (NEON) EA*

| | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-49 | 1-ESA<br>1-USFS | 0 | 1-ESA<br>1-USFS | 5 | 0 | 5 |
| C-50 | 0-ESA<br>1-USFS | 0 | 1-ESA<br>1-USFS | 1 | 0 | 5 |
| C-51 | 0-ESA<br>1-USFS | 0 | 1-ESA<br>1-USFS | 1 | 0 | 5 |
| R-33 | 0-ESA | 0 | 1-ESA | 4 | 0 | 5 |
| R-34 | 0 | 0 | 1-ESA | 2 | 0 | 5 |
| A-39 | 0-ESA<br>1-USFS | 0 | 1-ESA<br>1-USFS | 1 | 0 | 5 |
| S-40 | 0 | 0 | 1-ESA | 2 | 0 | 5 |

Source: Appendix B Domain 17

However, there are known occurrences of species protected under ESA and state and USFS protected species within 5 km of all the proposed NEON locations. In addition, potentially suitable habitat for protected species is present at or adjacent to all of the proposed NEON locations (Table 3.5.17.3-2).

All sensitive species identified as having potential to occur on or near SJER and SNF are identified in Table Domain 17 (Appendix B), along with their legal status and preferred habitat types. The following discussion is limited to those species that may occur in or near the proposed project locations.

### Federally Protected Species

One federally threatened species, the tiger salamander, could occur at or around proposed NEON sites. The tiger salamander prefers seasonal ponds and vernal pools within grassland habitats. The tiger salamander is endemic to California and historically occupied the San Joaquin foothills area (San Francisco State University [SFSU], 2003). Breeding usually occurs nocturnally in early winter after a rain event (SFSU, 2003). This species could occur at the proposed Core Site and Relocatable Site (R-33).

### USFS Protected Species

The USFS also tracks designated MIS on its land. The northern goshawk is the only MIS that could occur at or adjacent to proposed NEON locations on USFS land. The northern goshawk prefers dense mature coniferous and deciduous mixed forests interspersed with meadows and riparian areas. Breeding populations have not been extensively studied (California Department of Fish and Game [CDFG], 2006). Noise and disruption are known to cause nest failure (CDFG, 2006). This species could occur at all the proposed NEON locations.

### State Protected Species

Five state threatened species could occur at or adjacent to proposed NEON sites. These species include the California wolverine, orangeflower lupine, tree anemone, Muir's raillardiopsis, and Yosemite lewisia. The California wolverine prefers mixed coniferous forest, barren and wet meadows, and montane chaparral at elevations from 1,900 m to 3,300 m.

The California wolverine is considered extremely rare and little is known about its reproductive and living habits (California Academy of Sciences, 2005). This species could occur at proposed locations of C-51 and R-34 in the higher elevations.

The orangeflower lupine and the tree anemone prefer chaparral and cismontane woodlands. The orangeflower lupine also may occur in lower montane coniferous forests. Both of these species could occur at proposed Core Site Tower C-49.

Muir's raillardiopsis and Yosemite lewisia occur in lower montane coniferous forests. The Muir's raillardiopsis also occurs in chaparral and cismontane woodlands. These species could occur at the proposed Advanced Tower C-49.

Four California Species of Special Concern could occur at or adjacent to proposed NEON sites. These species include the Western spadefoot, American badger, pallid bat, and foothill yellow-legged frog.

The Western spadefoot prefers seasonal ponds within annual grassland. The Western spadefoot is an opportunistic breeder but typical breeding season is January to May. The Western spadefoot lays eggs in temporary pools that last at least 3 weeks before drying out. This species could occur at the proposed Core Site and Relocatable Site R-33 (CaliforniaHerps.com, 2009).

The American badger prefers herbaceous shrubland and open habitats with friable soils. The American badger digs extensive burrows and gives birth to litters of 1 to 5 young. Mating usually occurs in fall with delayed implantation in February. Badgers are also somewhat tolerant of human activities. The American badger could occur at Core Site Tower C-49 (CDFG, 2009a).

The pallid bat prefers rocky outcrops, cliffs, and crevices. The pallid bat inhabits a range of habitats but is less prevalent in higher elevations with mixed deciduous and coniferous forests. Pallid bats may travel over 2.4 km a day for foraging. Typically, reproduction occurs among hardwood forests in the early spring. The pallid bat could occur at the proposed NEON sites C-49, C-50, R-33, and A-39 in lower elevations (CDFG, 2009b).

The foothill yellow-legged frog prefers rocky stream habitats. The frog's entire life cycle is associated with stream environments and it depends on seasonal runoff flows associated with local climate conditions. This species could occur at proposed Aquatic Array A-39 (USFS, 2008b).

### *Environmental Consequences*

Proposed NEON construction activities would not be expected to impact sensitive aquatic species. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for indirect impacts to sensitive aquatic species from sedimentation as a result of stormwater runoff. Data collection at Aquatic Arrays also would not impact sensitive aquatic species.

NEON, Inc. would work with property site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid any such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat.

There would be potential to disturb sensitive terrestrial wildlife of the area during construction activities. All of the proposed construction sites are surrounded by larger amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat nearby during construction. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Towers and guy wires would pose a minimal collision risk to the pallid bat at the Core Site and R-33. Because the tower and wires would be stationary, they would be detectable and flying bats would be able to avoid them. Any impacts would likely be negligible from a population standpoint. This potential risk would be removed at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the California Department of Fish and Game prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

### Cultural Resources

#### *Affected Environment*

The proposed NEON locations for Domain 17 would be in Fresno and Madera Counties in the San Joaquin Valley and the Sierra Foothills, near Fresno, California. NEON infrastructure is proposed within the TEF, a relatively undeveloped 1,300-ha area around Teakettle Creek, the KREW, the Sierra National Forest, and within the San Joaquin Experimental Range. The Sierra National Forest encompasses 526,000 ha of oak foothills, forested slopes, and alpine ridges. The San Joaquin Experimental Range encompasses approximately 1,400 ha and is managed for research and education.

### Prehistoric Context

The general trend throughout California prehistory has been an increase in population density over time, coupled with greater sedentism and the use of a greater diversity of food resources. There is abundant evidence that humans were present in the New World for at least the past 11,500 years. There is also fragmentary, but growing, evidence that humans were present long before that date, but there are no currently known sites within Domain 17 that date to this period. Several chronologies have been proposed for central California archaeology. Generally, these chronologies are variations based on the general California chronology, which consists of an Early Horizon, a Middle Horizon, and a Late Horizon (Fredrickson, 1974; Elsasser, 1978). However, wide regional differences in central California, as well as significant temporal overlap between site types classified into these three horizons, have prevented clear distinctions between horizons. Eventually, a model was proposed for central California that primarily emphasized the patterns of cultural identity and deemphasized associated occupation dates (Moratto, 1984).

The earliest sites in the San Joaquin Valley are Fluted Point Tradition and Western Pluvial Lakes Tradition sites found at Tracy, Tulare, and Buena Vista Lakes. These sites are few in number and remain undated by scientific means but the assemblage types indicate probable ages of 11,500 to 7,500 years old. Deposition in the San Joaquin Valley is active; many older sites are likely buried under rapidly building alluvial deposits (Moratto, 1984). The southern Sierra Nevada is not nearly as well studied and few excavations have been conducted within the foothills. The Windmiller Pattern generally coincides with Fredrickson’s Early Horizon (Fredrickson, 1974) and the majority of the known Windmiller Pattern sites date to approximately 5,000 to 2,250 years ago. Windmiller sites are characterized by tools related to hunting, fishing, and milling and include mortars, baked clay balls, trident fish spears, two types of angling hooks, pecan sized pieces of baked clay that appear to have been used as fish line sinkers, bone awls and needles, polished charmstones, shell working and shell appliqué, and flaked tools, including projectile points. The Berkeley Pattern coincides roughly with the Middle Horizon and the majority of known Berkeley Pattern sites date to approximately 2,500 to 1,250 years ago. The Augustine Pattern coincides approximately with the Late Horizon and generally dates from 1,250 to 250 years ago. Augustine Pattern sites are much more widespread than Berkeley Pattern sites and are characterized by intensive fishing, hunting, and acorn gathering. The project area was occupied ethnographically by the Yokuts, specifically the Southern Valley Yokuts who spent time in both the foothills and the adjoining valley (Kroeber, 1925; Wallace, 1978). The Yokuts are unique among Native Californians in that they were divided into true tribes. Each tribe had a unique name, a distinctly different dialect, and a defined territory (Kroeber, 1925). During the Spanish and Mexican Periods, 1769-1846, the Yokuts rapidly declined in population as European disease swept through the San Joaquin Valley.

### Historic Context

In 1542, Juan Rodriguez Cabrillo explored the California coast by ship. Much of the early exploration of California was conducted this way and the interior of California, including the San Joaquin Valley, remained unexplored by Europeans until the beginning of the Spanish Period. The Spanish Period spans the years from 1769 to 1822 in California beginning with the founding of the first mission, the Mission San Diego de Alcala in 1769. It was not until March of 1772 that the first formal European expedition, led by Pedro Fages, entered the northern San Joaquin Valley. In 1821, Mexico gained independence from Spain (Cleland, 1941).

The period from 1821-1848 is referred to as the Mexican Rancho Period. It was during this period that large tracts of land termed *ranchos* were granted by the various Mexican Governors of *Alta* California, usually to individuals who had worked in the service of the Mexican government. Following the end of hostilities between Mexico and the United States in January of 1847, the United States officially obtained California from Mexico through the Treaty of Guadalupe Hidalgo on February 2, 1848 (Cleland, 1941). Thus, the American Period begins in 1848. In 1850, California was accepted into the Union of the United States, primarily due to the population increase created by the Gold Rush of 1849. In April of 1848, gold was first discovered in the San Joaquin Valley at Captain Sutter's now famous sawmill near present-day Sacramento. Gold was never found in great quantities in the San Joaquin Valley, although mining in the adjacent foothills was prolific (Smith, 2004: 179).

The cattle industry in California reached its greatest prosperity during the first years of the American Period. Although no land grants were given to the Central Pacific in the San Joaquin Valley, the company financed itself and construction of the first railroad in San the Joaquin Valley began in 1870 at a new railroad town named Lathrop. By the close of 1870, this line reached the Stanislaus River. The Central Pacific connected to the main Southern Pacific line at Goshen, approximately 240 km south of Lathrop. Subsequently, other rail lines were constructed in the San Joaquin Valley and served as feeders to this main line. In 1903, the Western Pacific Railway incorporated and between 1905 and 1909, the company constructed a railroad that ran from Oakland through the San Joaquin Valley and into the Sierra Nevada Mountains (Smith, 2004). During the American Period, in addition to cattle and sheep ranches, a growing number of farms appeared. A rural community cultural pattern existed in the study area from approximately 1870 to 1930. These farmsteads and dispersed farming communities then gave way to horse ranches, dairies, nurseries, and large agricultural fields. Today, Fresno is the economic center of the Central Valley and is tied to large-scale agricultural production.

### Archival Literature Search

In order to assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 17 within a defined study area that extended 1.6 km from each proposed location.

A literature search was requested from the California Historical Resources Information System (CHRIS) Central California Information Center. The review included all recorded archaeological sites as well as all known cultural resource survey and excavation reports. The NHRP, the California Register of Historic Resources (CRHR), California Historical Landmarks, and California Points of Historical Interest were all examined.

With the exception of Relocatable Site R-34, the remaining NEON locations in Domain 17 have been previously surveyed for cultural resources, with all previous studies occurring prior to 1998. Resources previously documented within the vicinity of the proposed NEON locations include prehistoric habitation sites, bedrock milling sites, lithic scatters, prehistoric rock rings, and historic home sites with associated rock features or refuse scatters (Table 3.5.17.3-3). There are currently no known sites located within the areas of disturbance of any of the proposed NEON locations. Of the sites located within the 1.6-km study area, one site within the 1.6-km study area of proposed Core Site Basic Tower C-50 has been determined eligible for the NRHP and is listed on the CRHR, but is located well outside the area of disturbance. Of the remaining sites located within the study areas, none have been evaluated for the NRHP or any other state or local register.

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 17 did not identify any significant known historic properties. There is only one known NRHP eligible cultural resource located within the 1.6-km study area of C-50; however, this site is located well away from the area of disturbance. Proposed NEON infrastructure would not alter the viewshed of any known historic property.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 17, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

**TABLE 3.5.17.3-3**
Literature Search Results– Domain 17, Pacific Southwest
*National Ecological Observatory Network (NEON) EA*

| NEON Site Number | Previously Surveyed | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | Number Evaluated | Number Eligible |
|---|---|---|---|---|---|---|---|
| | | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | | |
| C-49 | Yes | 0 | 13 | 0 | 0 | 0 | n/a |
| C-50 | Yes | 0 | 23 | 0 | 0 | 1 | 1 |
| C-51 | Yes | 0 | 2 | 0 | 0 | 0 | n/a |
| R-33 | Yes | 0 | 10 | 0 | 0 | 0 | n/a |
| R-34 | No | 0 | 4 | 0 | 0 | 0 | n/a |
| A-39 | Yes | 0 | 7 | 0 | 0 | 0 | n/a |
| S-40 | | | | | | | |

Source: California Historical Resources Information System (CHRIS), Central California Information System

## Utilities

### *Affected Environment*

The proposed Advanced Tower (C-49) would be approximately 1.2 km east of Highway 41 and electrical power could be extended in trenches along USFS roads to within approximately 200 m of the proposed tower location. Proposed Basic Tower C-51 would be approximately 3.5 km north of an electrical transmission corridor and service could be extended along the road to the Courtright Reservoir campgrounds (USFS, 2008c). The Glen Meadow Forest Service Facility (FSF) is approximately 1.3 km north of the proposed location of Core Site Tower C-50 and electrical service is available along Dinkey Creek Road approximately 1 km east of the location of C-50. Electrical power could be extended along Providence Creek Road from Dinkey Creek Road to the proposed location of Aquatic Array A-39.

Proposed Relocatable Site (R-33) would be approximately 1.6 km west of Bretz Mill FSF and 0.3 km north of Big Creek Road. If electrical power is not available along Big Creek Road, it could be extended along that road from the Bretz Mill FSF.

Proposed Relocatable Site (R-34) would be approximately 2.2 km south of an electrical transmission corridor. Electrical power could be extended to within approximately 200 m of this site along an unpaved road leading to a transmission tower. The proposed STREON Site (S-40) would be 2.5 km southeast of R-34.

### *Environmental Consequences*

Power would be extended from the grid terminus, with underground lines placed in trenches along existing roads to the point nearest proposed tower locations. A portal would be placed at the point nearest the existing access road where access for maintenance activities would be available. Power would extend to proposed NEON sites through buried lines or lines in surface conduits. Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. Erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for environmental impacts from land disturbed by trenching.

## Transportation

### *Affected Environment*

The proposed location of Advanced Tower C-49 is approximately 1.8 km north of Road 8063 and 2.2 km south of Road 200. A dirt road connecting Road 8063 and Road 200 would provide access to the proposed tower location.

The remaining proposed NEON locations for Domain 17 are in the SNF, which can only be accessed from Highway 168 and connecting paved and dirt roads. Proposed NEON infrastructure would range from approximately 13.5 km to approximately 49 km from Highway 168.

### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Traffic associated with construction and operation of NEON would have a negligible impact on traffic at any of the proposed NEON locations.

The SNF and the SJER have an extensive network of USFS roads and the proposed NEON locations are within a short distance of these roads. No new roads would be constructed. Materials would be brought as near to the proposed locations as possible on existing roads and transported by hand from that point to the construction site. Unpaved roads may be improved, such as through the placement of gravel for stability, but no additional paving or widening would occur.

Materials would be transported by hand from the road to each proposed NEON location. Improved trails would be created to allow access from the road to a proposed NEON location. Where unauthorized recreational vehicle use could be an issue, these trails would be gated and signed to deter access.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any traffic impacts at site closure would be negligible.

### Human Health and Safety

#### *Affected Environment*

Proposed NEON locations in the SNF would be accessible to the public and recreation facilities would be nearby. Access to the SJER and proposed Core Site Tower C-49 would be limited. Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

#### *Environmental Consequences*

There would be minor potential for injuries to workers during site construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury.

No infrastructure would be placed in areas commonly used by the public, which would limit public health and safety issues. Towers would be secured with fencing and locked gates to deter unauthorized access.

There would be potential for employees or researchers riding ATVs to strike guy wires during routine work or during NEON maintenance and data gathering trips. Guy wires would be clearly marked and flagged to reduce the potential for accidental collision. Any impacts to site users would likely be negligible.

### Recreation

#### *Affected Environment*

All the proposed NEON locations except C-49 would be in the SNF. The SNF offers camping, fishing, picnicking, whitewater rafting, and winter sport recreational opportunities. The towers may be visible to individuals participating in nearby recreational activities.

There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 17.

#### *Environmental Consequences*

All of the proposed NEON locations in Domain 17 are in areas where recreational activities occur. Minor short-term impacts to recreation could occur during construction. NEON infrastructure could be a nuisance to recreational users in the area, but long-term impacts on recreation would be negligible. Because the NEON projects would be separated spatially, no interaction effects would be expected. No cumulative impacts on recreation would occur.

Construction activities could result in temporary use restrictions near proposed tower sites. Any impacts would be short–term and persons could conduct recreational activities in other parts of these properties. Any impacts would be negligible. To the extent practicable, NEON would schedule construction to avoid peak recreational use times.

The presence of towers and guy wires could be visible to persons hiking on nearby trails. Minor negative aesthetic impacts could occur, but recreational activities would not be prevented.

Towers would be secured with fencing and locked gates to deter unauthorized access.

### Protection of Children

#### *Affected Environment*

SJER hosts educational livestock and archeological educational programs for children (USFS, 2008e). The proposed Advanced Tower (C-49) at SJER would be near conference centers, barracks, and a livestock facility where adults with children may visit.

The remaining proposed NEON locations would be in the SNF, which offers a variety of recreational activities that would attract families and children. Several campsites and USFS facilities are located near all of the proposed SNF sites.

#### *Environmental Consequences*

NEON would not create any environmental health risks to children. No impacts to the safety of children would be expected. Because NEON projects would be separated spatially, no cumulative impacts on the health and safety of children would be likely.

Because there would be opportunities for children to routinely be in the areas where NEON towers would be placed, there could be potential safety issues for children from the temptation to try to climb towers. Access to the tower would be restricted with secure fencing and locked gates. No impacts to the safety of children would be expected.

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**Figure 3.D17-1** Domain 17 Proposed Site Locations

**Figure 3.D17-2** Domain 17 Proposed Site Locations

**Figure 3.D17-3** Domain 17 Proposed Site Locations

**Figure 3.D17-4** Domain 17 Proposed Site Locations

**Figure 3.D17-5** Domain 17 Proposed Site Locations

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## 3.5.18 Domain 18 Tundra

### 3.5.18.1 Introduction

Domain 18 is the Tundra Domain in Alaska. To further differentiate it from other areas of Alaskan tundra, it is typically called arctic tundra because it lies above the Arctic Circle. This domain is characterized by areas of poorly drained, treeless plains interspersed with thaw ponds, lakes, rolling hills, and plateaus grading from the coastal plain to the uplifted sedimentary rock of the Brooks Range on the south. This area receives little precipitation and is characterized as a cold desert. The arctic tundra is underlain by permafrost. The complex of vegetation communities is a result of the interaction of permafrost, surface water, fire, elevation, and aspect.

The proposed infrastructure for Domain 18 includes a Core Site (Advanced Tower C-52, Basic Tower C-53, and Basic Tower C-54) in the Toolik Lake Research National Area (RNA), an Aquatic Array (A-42) also in the Toolik Lake RNA, a Relocatable Site (R-35) on Alaska State Forest land north of the Toolik Lake RNA, and a STREON Site (S-43) on the Kuparuk River. The Toolik Lake RNA is north of the Arctic Circle along the foothills of the Brooks Range and adjacent to the Arctic National Wildlife Refuge (Figure 3.D18-1). Toolik Lake RNA was established by the BLM for scientific research and has been an arctic field research station LTER site since 1975.

Toolik Lake RNA encompasses three major physiographic provinces of the Tundra Domain: the Brooks Range, the arctic foothills, and the arctic coastal plain. The vegetation within the Toolik Lake RNA is characteristic of most of the Tundra Domain. It also contains adjacent landscapes of three different glacial ages, providing a diversity of soil characteristics. Toolik Lake RNA contains the headwaters of several low-order streams, including the Kuparuk River and the inlet stream for Toolik Lake, as well as a large number of lakes of different sizes.

The Advanced Tower (C-52) would be located at the headwaters of the Kuparuk and Toolik Rivers, approximately 0.8 km north of the Trans-Alaska Pipeline and 1.6 km south of Winter Road. Basic Tower C-53 would be approximately 1 km south of Toolik Lake and Basic Tower C-54 would be approximately 1.6 km northeast of Toolik Lake.

Toolik Lake is the proposed location for Aquatic Array A-42 (Figure 3.D18-1). The Aquatic Array would be on the lake and between the two proposed Basic Towers. The proposed STREON Site (S-43) is proposed for a location on the other side of Toolik Lake RNA near the proposed location for Advanced Tower C-52 (Figure 3.D18-1). The STREON Site would be on the Kuparuk River, near the crossing of the Trans-Alaska Pipeline. The proposed Relocatable Site (R-35) would be on Alaska State Forest land in the arctic coastal plain north of the Toolik Lake RNA along the Sagavanirktov River and approximately 4 km southwest of its confluence with the Ivishak River (Figure 3.D18-2).

### 3.5.18.2 Resource Areas Considered But Not Addressed for Domain 18

Preliminary analysis indicated that there would be no potential to significantly impact five of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Noise: Effects to humans from the noise of operating generators and annual low flying plane flights would likely be negligible. Impacts from construction and operational noise on wildlife are discussed below.
- Airspace: The proposed NEON locations are not within restricted airspace or designated special use airspace (Bret-Harte et al., 2008). The nearest restricted or proposed restricted airspace is allocated for a weather balloon at Oliktok, which is approximately 125 km northeast of R-35.
- Environmental Justice: The proposed NEON sites would be located on state or federal lands. There would be no impacts to subsistence hunting or fishing. All potential impacts would be confined to areas with few or no human dwellings or disadvantaged people. There would be no potential to disproportionately impact minority or low-income populations.
- Protection of Children: None of the proposed sites are in or near areas where children congregate or live. There would be no indirect impacts to children from pollution or other sources of contamination. Therefore, no environmental health and safety risks to children would result.

#### 3.5.18.3 Resource Areas Considered in Detail

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 18 where site-specific conditions would influence the anticipated environmental consequences.

### Geology/Seismology

#### *Affected Environment*

Domain 18 has geologic and topographic uniformity from west to east because the Lisburne Limestone Formation extends along the front of the Brooks Range at the surface from the Beaufort Sea on the west to the Canadian Border on the east (The Arctic LTER Project at Toolik Lake, 2007). Over the past 500,000 years, glaciers have synchronously moved out of the Brooks Range across the North Slope and deposited similar types of glacial till (soil and rocks) across the foothills. This uniformity can be broken down by the difference in the ages of glacial deposits (<12,000 years old, between 12,000 and 60,000 years old, and more than 300,000 years old) (The Arctic LTER Project at Toolik Lake, 2007). The locations of the Advanced Tower (C-52) and the two Basic Towers (C-53 and C-54) were selected to include all three ages. The Core Site Advanced Tower C-52 would be on the oldest deposits from the Sagavanirktok River glacial advance. Tower C-53 would be on the edge of intermediate age deposits on drift from the Itkillik Phase I glaciation period. It is acidic tussock tundra. C-54 would be on the youngest glacial deposits, which are outwash from the Itkillik Phase II period. C-54 would be on non-acidic tundra. All proposed NEON sites in Domain 18 are north of the Denali Fault, which is a major fault that runs across the lower-middle portion of interior Alaska.

### *Environmental Consequences*

No direct or indirect impacts to geology would be expected. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

All of the proposed NEON sites for Domain 18 would be in areas of permafrost, which is a geological feature that influences surface activity. Proposed Domain 18 NEON activities would include boardwalks instead of footpaths and transport of construction materials would take place during the period with snow cover to avoid impacting permafrost. Where generators would be used, they would be placed in structures with floor insulation to prevent heat from generator operation transferring to the permafrost.

Towers and boardwalks would be supported by helical piling that would be inserted into permafrost to a depth sufficient to support the structure without drilling holes. The depth of helical piling would be determined based on the mass of a given structure and the stresses expected to be placed on the piling. The specific structures would be insulated from the piling at the point of attachment. Any impacts to permafrost from placement of towers and boardwalks would likely be negligible.

NEON infrastructure would not impact seismic activity. However, NEON infrastructure may require seismic safeguards to avoid interruptions in data collection should seismic activity occur. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

## Soils

### *Affected Environment*

The Toolik Lake RNA contains adjacent landscapes of three different glacial ages, providing a breadth of tundra soil characteristics. The parent material for the soils in the Toolik RNA is glacial till and outwash derived from a series of glaciations. These soils have been modified by the vegetation and chemical weathering (Bret-Harte et al. 2008). On the Toolik Lake RNA, non-acidic soils are relatively young and were deglaciated approximately 12,000 years ago in the retreat of the Itkillik II glaciation. Basic Tower C-54 is proposed for a site on these young soils. Older, acidic soils in the Toolik RNA were deglaciated either 65,000 years ago, in the retreat of Itkillik I glaciation, or more than 300,000 years ago. Basic Tower C-53 would be on the edge of the intermediate age site (acidic tussock tundra, >60,000 years) and the youngest age site (<12,000 years). Advanced Tower C-52 is proposed for a site with the oldest soils (>300,000 years). The fine-textured soils at the proposed C-52 site are from the Sagavanirktok Glaciation Period.

Soils at the three proposed Core Site tower locations have different pH values (acidic to neutral) and different chemistry (weathered to slightly weathered). The glacial history of the landscape affects ecological properties, such as net primary productivity, decomposition, and species composition, in both terrestrial and aquatic ecosystems. Having soils of three glacial ages within the Toolik RNA provides a diversity of landscapes in proximity that are characteristic of much of the tundra domain.

Tussock tundra typically occurs on gently rolling topography with silty to gravely soils, both glaciated and unglaciated. Soils are moist and are unevenly covered with an organic mat up to 30 cm thick, underlain by a silty mineral soil. The maximum depth of thaw is 30 to 50 cm, so in many locations the soils do not thaw to the mineral layer.

### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

Construction and transportation of materials would occur when soils are protected by snow to limit incidental soil disturbance as a result of clearing and grading to place tower pads and IHs. Boardwalks would be built to access sites from nearby roads or trails to avoid disturbance of permafrost as a result of data collection or long-term site maintenance. Boardwalks also would be used to attach conduits to extend electrical power from portals to towers and sensors.

At each of the proposed NEON locations in Domain 18, construction would disturb soils as a result of clearing and grading to place tower pads and IHs, installing fencing around towers, and installing boardwalks to access sites and extend utilities from portals. The total area of disturbed soils would be less than 0.01 ha at each location. There would be the potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. Permafrost soils are highly prone to erosion when disturbed. NEON, Inc. would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby waterbodies.

A similar potential for impacts to soils would occur during site closure. In areas covered by buildings and tower pads, soils would be replaced. Similar BMPs would be used to minimize the potential for erosion. At site closure, pre-construction site conditions would be restored to the extent practicable.

Soil sampling at FSUs would result in negligible direct disturbance of soils throughout the operation of NEON, for up to 5 years at Relocatable Sites and for 30 years at the Core Site.

## Climate

### *Affected Environment*

Domain 18 has a low Arctic climate with an average annual temperature of -8°C. During the summer months of June, July, and August the average temperature may climb above 10°C. In the coldest months of winter, temperatures average -20°C and snow can accumulate to depths of approximately 30 cm (The Arctic LTER Project at Toolik Lake, 2007). Climate in the Toolik Lake RNA is typical of much of the tundra domain and mean annual precipitation is approximately 30 cm, with 45 percent falling as snow (Bret-Harte et al., 2008). The growing season is approximately 100 days long, from mid-June to mid-August, but below-freezing temperatures and snowfall can occur at any time. The sun is above the horizon from mid-may to mid-July, and is below the horizon from mid-November to mid-January.

The low annual temperature supports a permafrost layer that can extend to depths of approximately 200 m (The Arctic LTER Project at Toolik Lake, 2007). The Toolik Lake RNA is underlain by continuous permafrost, which exerts a major influence on hydrology and the distribution, structure, and function of terrestrial and aquatic ecosystems (Bret-Harte et al., 2008). The top layer of soil thaws to a depth ranging from 29 to 46 cm (The Arctic LTER Project at Toolik Lake, 2007). Permafrost restricts the rooting zone of plants, seals soils to water penetration and creates moist soils, and causes rapid and flashy runoff after precipitation events. Temperatures at a depth of 20 m have been warming over the past decades but are still approximately –5°C, so the permafrost is in no danger of imminent melt (The Arctic LTER Project at Toolik Lake, 2007).

### *Environmental Consequences*

With measures to protect the permafrost and vegetation during and after construction, implementation of proposed construction is not expected to impact the regional climate. Due to the potential for extreme winter weather conditions, primarily cold, deep snow, and potential for frost heaving, towers would be designed to protect instrumentation from severe cold and snow. Instrument huts would be constructed with a low profile to protect from damage by high winds.

## Air Quality

### *Affected Environment*

Eagle River and Juneau are the only non-attainment areas in Alaska, and Domain 18 would not be within the vicinity of either of these cities (USEPA, 2009). The proposed NEON locations would be in areas designated as in attainment. There are no Federal Class 1 Wilderness Areas within 161 km of the proposed NEON locations in Domain 18 (USEPA, 2008).

### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles and generators at the proposed Core Site Advanced Tower and the Relocatable Tower (R-35) during the operation of NEON infrastructure. Because emissions associated with NEON projects would be intermittent and/or small, no cumulative impacts to air quality would be expected. The amount of ground disturbance from construction would be less than 0.01 ha at any proposed location and no large earthmoving equipment would be used. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The two 100-kW diesel-powered generators would provide fulltime power at the proposed Core Towers and Relocatable Tower. NOx emissions are the largest emission by volume (2,350 kg/yr) when generators are operating (Cummins Power Generation, Undated). Annual total emissions from a 100-kW diesel-powered generator would be less than 670 kg of any criteria pollutant at the proposed Core Site tower location and Relocatable Tower. This would be a long-term minor impact on regional air quality.

The NEON project would not contribute to regional haze or impairment of air quality at any designated Class I Wilderness Area.

### Water Quality

#### *Affected Environment*

The proposed NEON locations at the Toolik Lake RNA include the headwaters of several low-order and well-studied streams (the Kuparuk River and the inlet stream for Toolik Lake), as well as a large number of lakes of different sizes supporting different trophic structures (Table 3.5.18.3-1) (Bret-Harte et al., 2008).

**TABLE 3.5.18.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 18, Tundra United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-52 | 9 | 0 | 12 | 0 | ND | ND |
| C-53 | 21 | 0 | 28 | 0 | ND | ND |
| C-54 | 16 | 0 | 30 | 0 | ND | ND |
| R-35 | 7 | 0 | 1 | 0 | ND | ND |
| A-42 | 18 | 1 | 36 | 1 | ND | ND |
| S-43 | 12 | 1 | 34 | 0 | ND | ND |

ND = No Data
Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009.

Streams in the area have rocky bottoms, are small, 1 to 10 m wide, and shallow (The Arctic LTER Project at Toolik Lake, 2007). The Toolik Lake RNA contains numerous pristine lakes and streams, including several low-order watersheds that occur on landscapes with different glacial histories (Bret-Harte et al., 2008). Ammonia and phosphate levels are close to the level of detection, with most of these nutrients bound as dissolved organic matter (DOM). Only limited amounts of nutrients in the DOM are available to microbes and algae (The Arctic LTER Project at Toolik Lake, 2007).

Primary productivity in coldwater aquatic systems is exceedingly low, and Domain 18 waters are no exception. Most photosynthesis occurs from diatoms attached either to the rocks of the stream bottom or other submerged substrates (The Arctic LTER Project at Toolik Lake, 2007).

The only large lake in the LTER site is Toolik Lake, with a maximum depth of 25 m and an area of 1.5 $km^2$. Numerous small lakes are located in moraines near Toolik Lake. All the lakes are ultra-oligotrophic, with both nitrogen and phosphorus at limiting concentrations (The Arctic LTER Project at Toolik Lake, 2007).

No streams or lakes at or near proposed NEON infrastructure in Domain 18 are included on the Alaska CWA Section 303(d) list of impaired waters. All surface waters in these areas meet their designated uses (Alaska Division of Water Quality, 2008).

### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. Negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. Long-term minor impacts to water quality in the Kuparuk River could occur from STREON experiments. Because any impacts would be localized, there would be no potential for cumulative impacts to occur.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure. Measures discussed above that would be implemented to prevent permafrost thaw also would contribute to minimizing the potential for water quality impacts.

NEON would place a 100-kW diesel-powered generator at the Advanced Tower AP to provide primary power to the Core Site. A second 100-kW diesel-powered generator would provide primary power at R-35. Generators would be supplied from double-walled fuel tanks to minimize the potential for spills. Generators would be placed inside of buildings to reduce noise. Refueling would be done approximately every 2 weeks. No impacts to water quality would be expected from use of generators.

Elevation of $NH_4NO_3$ or $H_3PO_4$ concentrations in the Kuparuk River to 5 times ambient concentrations for a 10-year period could result in long-term impairment of water quality in this stream. However, due to the cold temperatures that prevail in the river, biological activity may not increase greatly, allowing more nutrients to be transferred downstream. Any increased growth would likely be limited to periphyton. The proposed STREON location is approximately 10 km from the headwaters of the Kuparuk River, and the river flows for approximately 210 km through undeveloped land from the proposed STREON location before joining the Toolik River. There also could be periodic die-offs of periphyton biomass, which could lead to oxygen depletion in the stream from aerobic decomposition. Oxygen depletion could in turn result in changes to vertebrate and invertebrate communities in the immediate area (Hauer and Lamberti, 2006). Impacts would likely be long-term and minor, due to the increase in volume in the river as it flows downstream and the low temperatures. No impacts would be expected from the recirculation tracer experiments.

Because there is no development in the Kuparuk River watershed, no cumulative impacts would be expected.

There would be a potential for in-stream monitoring equipment to be washed downstream during flood events and it is unlikely that equipment would be recovered if washed away. Aquatic monitoring devices are small and would create negligible impacts to water quality if they were to be lost because there are no environmentally harmful components associated with this monitoring equipment. NEON would secure STREON infrastructure to withstand expected flood levels and thus minimize the potential for damage. If sufficient advance warning of flood events is received, NEON would temporarily remove equipment from the Kuparuk River to prevent damage or loss.

### Wetlands

#### *Affected Environment*

NWI maps have not been developed for the proposed Core Site area, but wetlands occur over approximately 61 percent of northern and western Alaska covering approximately 38 million ha. Almost half of the extensive wetlands that occur across Alaska are in the tundra (USACE, 2007). Although the tundra climate is dry, permafrost prevents deep water drainage and cold temperatures lower evapotranspiration rates. Permafrost controls soil moisture, creates lakes and ponds, and allows the tundra to stay moist despite low precipitation (Bret-Harte et al., 2008). Soils over much of the tundra typically vary from moist to soggy and it is likely that proposed towers would be within or adjacent to wetlands

#### *Environmental Consequences*

Minor direct and indirect impacts to wetlands are likely during construction of proposed NEON towers and boardwalks. No additional impacts to wetlands would be expected from operation of NEON infrastructure. Because NEON sites would be separated spatially and have small, if any, localized impacts no cumulative impacts to wetlands would be expected.

To the extent practicable, NEON, Inc. would place towers outside of wetlands, and would select construction sites either outside of wetlands and permafrost areas or in areas of stable permafrost where deep melting would not occur. Boardwalks would be installed on all permafrost and across any wetland areas to minimize impacts resulting from access activities as a result of construction, maintenance, or data collection. The Toolik Lake Research Station has constructed boardwalks and tower pads on permafrost areas as part of its ongoing research activities and NEON, Inc. would follow these established construction methods to avoid and minimize impacts to wetlands and permafrost to the extent practicable. Boardwalks also would be used to attach conduits to extend electric power and communications from portals to infrastructure locations. Transport of construction materials to proposed project sites would take place when soils are protected by snow to limit incidental disturbance to wetlands as a result of site access for construction. If wetlands and/or permafrost are present, temporary minor impacts would also be expected at the time of site closure. However, site closure would result in removal of the NEON tower and boardwalk from the wetland, which would then be a long-term benefit to the wetland as the area would be returned to its pre-construction condition.

NEON, Inc. also would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for direct and indirect wetland impacts. NEON would obtain all appropriate permits prior to conducting any land disturbing activities in wetlands. NEON, Inc. would comply with all conditions of any issued permits.

### Floodplains

#### *Affected Environment*

The proposed NEON locations in Domain 18 would be in undeveloped areas of arctic tundra where FEMA has not designated floodplains or flood prone areas. Hydrology is primarily from snowmelt in late May and early June that produces meltwater that quickly enters the stream system (Stieglitz et al., 1999). The Kuparuk River begins to flow in late May and ceases flow in late September (The Arctic LTER Project at Toolik Lake, 2007).

#### *Environmental Consequences*

The proposed STREON Site would be subject to flood events on the Kuparuk River. An abnormally high flood event could inundate the proposed Aquatic Array on Toolik Lake, but this would be unlikely. No other proposed NEON sites in Domain 18 would be subject to flood events.

The STREON and Aquatic Array equipment would not result in increased flood elevations and any changes in flood storage capacity or flood conveyance from these would be negligible. There is the potential for equipment to be damaged during flood events on these waterways. NEON would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage, but these designs would not likely increase impacts. If sufficient advance warning of flood events is received, NEON would temporarily remove equipment from flood prone areas to prevent flood damage or loss.

### Common Vegetation and Plant Communities

#### *Affected Environment*

Wet sedge tundra covers the entire coastal plain, while tussock tundra covers the foothills of the Brooks Range (The Arctic LTER Project at Toolik Lake, 2007). The proposed NEON sites are all in the foothills. The distribution of types of vegetation is dependent upon topography (dry ridge tops, moist hill slopes, areas of water-saturated soils) and upon the soil chemistry as determined by the age of the soils, that is, the time since the soils were deposited as till by advances of glaciers moving north from the Brooks Range.

The Toolik Lake RNA supports a mixture of characteristic tundra vegetation types, including wet sedge tundra (characteristic of the coastal plain), riparian shrub tundra, and dry heath tundra (characteristic of the Brooks Range mountains) (Bret-Harte et al., 2008). This area includes both acidic and non-acidic tundra. Tussock tundra is widespread and occurs primarily on level or gently rolling lowlands (Walker et al., 1994).

Tussock tundra occurs on older, more acidic soil profiles, such as at the proposed Advanced Tower (C-52) location. Tussock tundra sites are typically dominated by cottongrass with a mixture of dwarf shrubs, including dwarf birch, marsh Labrador tea, tealeaf willow, blueberry, and mosses (Walker et al., 2003). Non-acidic vegetation grows on the youngest soils, which lack dwarf birch and tussocks (The Arctic LTER Project at Toolik Lake, 2007). More diverse vegetation occurs on the non-acid soils, such as at the proposed location of C-54, where sedges and dwarf shrubs (prostrate shrub tundra) would typically dominate with a variety of other species including Bostock's minerslettuce, weasel snout, glacier avens, naked-stem wallflower, two-flowered cinquefoil, and narrowleaf saw-wort (Walker et al., 1994). Proposed Basic Tower C-53, which is proposed for an intermediate-aged glacial substrate, has acidic soils and primarily supports a moist or wet low shrub community, also called shrub tundra. Shrub tundra typically supports resin birch, Labrador tea, American green alder, mountain alder, and grayleaf willow (Tape et al., 2006).

#### *Environmental Consequences*

There would be minor long-term impacts to vegetation and plant communities at tower pads, IHs, and along boardwalks. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation would occur during construction to prepare for tower pads, IHs, and boardwalks. Vegetation in areas cleared for tower pads, fencing, and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site, and recovery of plant communities following removal of NEON infrastructure would be extended due to the short growing season in this region.

### Common Fauna

#### *Affected Environment*

The Toolik Lake NRA is home to more than 15 small- to medium-sized arctic mammals and large mammals cross this area as well. Thousands of caribou migrate through the area twice each year (Bret-Harte et al., 2008). All of the proposed sites for Domain 18 would be located in Game Unit 26B, which encompasses the area between the Canning River and the Itkillik River. This unit is home to approximately 300 muskoxen (Reynolds et al., 2002). Small mammals that occupy proposed NEON sites include brown lemmings, voles, and arctic ground squirrels (ADFG 2006; The Arctic LTER Project at Toolik Lake, 2007).

Migratory passerine bird species that may breed in the vicinity of proposed NEON sites include Smith's longspur, Lapland longspur, snow bunting, common redpoll, hoary redpoll, and savannah sparrow.

Waterfowl and other birds that typically nest in or near ponds and lakes in tundra habitat are tundra swan, long-tailed duck, yellow-billed loon, red-necked phalarope, pectoral sandpiper, semipalmated sandpiper, and buff-breasted sandpiper.

Tundra-breeding raptor species include snowy owl, gyrfalcon, rough-legged hawk, and peregrine falcon (ADFG 2006). Grizzly bear and wolves are the chief predators of caribou and arctic ground squirrels (The Arctic LTER Project at Toolik Lake, 2007).

Arctic grayling are the only fish that have been identified as living in streams in the NEON locations. In fall, as streams begin to freeze completely, arctic grayling must migrate tens of kilometers to deep lakes where they survive beneath the ice cover (The Arctic LTER Project at Toolik Lake, 2007). It is highly probable that other fish such arctic char, slimy sculpin, and round whitefish utilize the streams during spring and summer months for forage and/or migratory corridors. Some lakes in the Toolik Lake RNA support populations of arctic char, slimy sculpin, lake trout, and round whitefish, while other lakes in this region have lost one or more of these species to extinction (Hershey et al., 2006).

### *Environmental Consequences*

During construction activities there would be the potential to disturb and displace wildlife. However, since work in Alaska would be conducted when snow is on the ground, negligible disturbance to breeding birds and mammals would be expected. Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed Core and Aquatic Arrays have adequate habitat surrounding the proposed locations, which could provide refuge during construction. No disruption of wildlife breeding would be expected.

During operation of the primary generators at the Core site and at R-35, there would be the potential to disturb wildlife. Wildlife species would likely relocate initially when the generators begin operation. However, because the noise would be relatively constant and reduced to less than 60 dBA through insulation, it is likely that some wildlife would become accustomed to the noise and resume use of the area around the generators. Any impacts from generator noise would likely be minor.

There would be a long-term loss of habitat at towers and IHs, but the area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Impacts to common wildlife species would likely be negligible.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Alaska Department of Fish and Game Division of Wildlife Conservation prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

Large animals, such as moose and brown bear, tend to use vertical objects as scratching posts. These animals would likely use towers and guy wires for scratching and could topple towers or pull guy wires loose through continued use. Towers would be secured with fencing to prevent such impacts. Should it be necessary to anchor guy wires outside of fencing, these wires would be secured to concrete anchors. Routine maintenance checks would determine whether anchors would need repair or replacement.

### Sensitive Ecological Communities

#### *Affected Environment*

The arctic tundra has long been considered an ecological community sensitive to disturbance. The tundra can recover relatively quickly from natural disturbance; however, tundra vegetation is fragile when subjected to disturbances that are different from those with which it has evolved (Vavrek et al., 1999). At Toolik Lake RNA, off-road vehicles are not allowed on the tundra because of the sensitivity to disturbance of vegetation and permafrost-influenced soils (Bret-Harte et al., 2008).

#### *Environmental Consequences*

Minor clearing of vegetation would occur during construction to prepare for tower pads, fencing, and IHs. Appropriate erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for direct and indirect impacts. Boardwalks rather than trenches would be used for extension of utility lines, with conduits attached to the boardwalks to minimize or avoid impacts. Vegetation in areas cleared for tower pads, fencing, and IHs would be lost for the duration of the NEON project and recovery would likely be slow due to the short growing season at this latitude. Construction materials for the proposed project locations would be moved into place when soils are protected by snow to limit incidental soil disturbance. Boardwalks would be built to avoid further impacts from long-term site maintenance and data collection.

### Sensitive Species

#### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 18 (Table 3.5.18.3-2). However, there are known occurrences of BLM protected species within 5 km of all the proposed NEON locations. In addition, potentially suitable habitat for BLM protected species is present at or adjacent to all of the proposed NEON locations (Table 3.5.18.3-2). The following sections discuss the species with potential to occur at or adjacent to proposed NEON sites in Domain 18.

**TABLE 3.5.18.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 18, Tundra
*National Ecological Observatory Network (NEON) EA*

| | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-52 | 2-BLM | 0 | 8-BLM | 0 | 0 | 0 |
| C-53 | 2-BLM | 0 | 8-BLM | 0 | 0 | 0 |
| C-54 | 2-BLM | 0 | 8-BLM | 0 | 0 | 0 |
| R-35 | 1-BLM | 0 | 8-BLM | 0 | 0 | 0 |
| A-42 | 2-BLM | 0 | 8-BLM | 0 | 0 | 0 |
| S-43 | 2-BLM | 0 | 8-BLM | 0 | 0 | 0 |

Source: Appendix B Domain 18

### U.S. Fish and Wildlife Protected Species

There are no USFWS species protected under the ESA that are known to occur in the vicinity of the proposed NEON locations for Domain 18.

### BLM and State of Alaska Sensitive Species

The buff-breasted sandpiper, which is classified as a sensitive species by BLM, may occur near proposed NEON infrastructure (Lenz, 2009). Seven sensitive plant species may occur near proposed NEON locations in Domain 18 (Table 3.5.18.3-2). Two sensitive plant species are known to occur within 5 km of several proposed NEON sites and potentially suitable habitat for five other sensitive plant species occurs near proposed NEON locations (Lenz, 2009).

The buff-breasted sandpiper breeds in Alaska and is considered imperiled there because less than 20 known occurrences remain in the state. Male buff-breasted sandpipers perform courtship displays in drier areas of rolling tundra that have a mixture of low marshy areas interspersed with small ponds and higher drier slopes and knolls (Prevett and Barr 1976). Closely spaced sedge tussocks approximately 20 cm high and 25 to 50 cm wide also are characteristics of these areas. Courtship is short and occurs in the first week of June. Nests occur over relatively dry slopes with numerous sedge tussocks and are not concentrated near mating areas (Prevett and Barr, 1976). This species has been observed within 5 km of all proposed NEON sites in the domain.

Muir's fleabane is a BLM Sensitive species that is known to occur within 5 km of proposed Relocatable Tower R-35 and proposed Advanced Tower C-52 (Lenz, 2009). This species is endemic to Alaska with less than 20 known occurrences, all north of the Arctic Circle (Carlson et al., 2006). Muir's fleabane occurs on dry, south-facing slopes, usually in sparsely vegetated communities with eightpetal mountain-avens, prostrate shrub, forbs, and tundra (Lipkin and Murray, 1997).

Bostock's minerslettuce occurs within 5 km of proposed Basic Towers C-53 and C-54 and proposed Aquatic Array A-42 (Lenz, 2009). Basic Tower C-53 would be at or adjacent to one known occurrence of this species (Carroll et al., 2003). Bostock's minerslettuce occurs in wet alpine meadows, along the edges of stream floodplains, and in areas of intense frost disturbance at high altitudes (Hulten, 1968; Murray, 1968). Recent surveys by BLM have determined that the species is more common in the area than previously thought and occurs most frequently in moist and dry non-acidic tundra complexes (Carroll et al., 2003).

Alpine smelowksia occurs on rocky hillsides and gravel tundra, including Dryas fellfield, heath slopes, screes, shrub thickets, and sparsely vegetated ridges (Carlson et al., 2006; Hulten, 1968). The spring beauty occurs on stony and scree slopes in the mountains (Hulten, 1968). Arctic pennycress occurs on well-drained or dry areas, such as ridges and river gravel deposits. Near the Toolik Lake RNA, this species occurs as a coastal disjunct (Hulten, 1968). Rocky Mountain cinquefoil occurs on dry tundra. Palander's whitlow-grass grows on dry rocks and in polygon soil on the tundra and mountains. These five sensitive plant species are not known to occur near proposed NEON locations in Domain 18 and no potentially suitable habitat for these species occurs at proposed NEON locations. However, potentially suitable habitat for each of these five species occurs near proposed NEON locations and could be crossed by access routes.

### *Environmental Consequences*

NEON, Inc. would work with property site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. For Domain 18, surveys likely would be required in July to maximize the potential for locating these species (Carlson et al., 2006; Carroll et al., 2003). If surveys indicate that an impact is likely, NEON would relocate the facility a short distance to avoid impacts to the species or its required habitat.

There is the potential to disturb sensitive terrestrial wildlife of the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat nearby during construction. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Towers and guy wires would pose a minimal collision risk to the buff-breasted sandpiper. Any impacts would likely be negligible from a population standpoint. This potential risk would be removed at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Alaska Department of Fish and Game Division of Wildlife Conservation prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

Operation of the primary generators would create noise. The noise from the generators would be above ambient levels but would be consistent and at a level at which sensitive animal species would be expected to resume normal activity. Any impacts would be minor.

## Cultural Resources

### *Affected Environment*

The majority of the proposed NEON locations for Domain 18 would be in the general vicinity of Toolik Lake. R-35 would be located north of the Toolik Lake area near the branching of the Sagavanirtok and Ivishak Rivers. Several of the proposed NEON locations are situated within the Toolik Field Station in the northern foothills of the Brooks Range and on the southeast shore of Toolik Lake. The field station is operated by the University of Alaska, Fairbanks and serves researchers who study the transition area that connects the tundra to the boreal forests of Alaska.

## Prehistoric Context

Among the unique factors in Alaskan archaeology is the continuing contact between prehistoric Alaskans and the prehistoric peoples of northeast Asia. Techniques, trade items, such as iron, and people moved across the Bering Strait between Alaska and Siberia until well into the 19th Century when Siberian raiders still frequently landed on the Seward Peninsula (NPS, 2004a). The earliest migrations from Asia into Alaska are generally believed to have taken place as early as 20,000 years ago (Cole, 2009). The Paleoindian Tradition, which is characterized by the Clovis, Folsom, and other archaeological traditions, is found throughout the continental U.S. and also appears in small pockets in Alaska. Current thought suggests the Clovis culture, a big game hunting tradition which focused on now-extinct megafauna, evolved south of the continental ice sheets during the late Pleistocene and moved north as the glaciers retreated. Fluted points associated with these hunting traditions have been found in Alaska but are not well dated (NPS, 2004a). The Paleoarctic Tradition, also referred to as the Denali Tradition, dates from approximately 8,000 to 10,000 years ago. This tradition is characterized by a core and blade technology that featured microblades, microcores, and burins. Within the tundra and northern taiga, people of this tradition lived in small mobile groups. The earliest peoples who lived along the northern areas of Alaska may have coexisting Northern Paleoindian and Paleoarctic traditions (Lobdell, 1999).

The Northern Archaic Tradition appears in Alaskan prehistory around 6,000 years ago. This culture seems to be related to the Archaic cultures of the boreal forest in southern and eastern Alaska. Some sites dated to this period exhibit the earlier microblade technology, but the culture appears to be a predominantly interior tradition. The Arctic Small Tool Tradition (AST) is one of the most widespread Arctic cultural traditions. Originally referred to as the Denbigh Flint complex, it dates from approximately 4,000 years ago and has been found through the tundra and the Arctic Zone. The AST is characterized by very small and finely flaked stone tools. Subsistence was generally based upon the hunting of caribou and fishing.

Fiber tempered and linear stamped pottery appears to be imported from Asia around 3,000 years ago. Projectile points became larger, and oil lamps and slate tools appeared. By 2,500 years ago, settlement patterns had shifted to those of large coastal communities, which relied heavily upon sea mammal hunting. Some researchers propose that the AST encompasses a number of phases, including the Choris, Norton, and Ipiutak phases, which follow the Denbigh Flint complex, and lasts until approximately 1,000 years ago. Still others propose a hiatus within the AST after the Denbigh, which is followed by the Norton Tradition. Within this view, the Choris, Norton, and Ipiutak cultures fall under the Norton Tradition (NPS, 2004b). The Thule Tradition, also referred to as the Northern Maritime or Neo Eskimo Tradition, is characterized by the use of polished slate tools, the umiaq, a large skin boat for whale hunting, the dog sled, and a heavy reliance on coastal resources, particularly open water hunting (Lobdell, 1999). Dates for the start of this tradition range from approximately 100 A.D. on the northwest coast to 1000 A.D. on the southern coast.

Although Europeans did move into Alaska in the 1700s and 1800s, much of the native population within the state remained unaffected for many years after these initial forays. Many of the Native American sites that exhibit the effects of European contact and expansion on native populations are more recent than those found in the continental U.S. and are often part of a remembered past. Another unique aspect of Alaskan archaeology is the continued subsistence hunting by Native American peoples throughout rural Alaska. Many traditional lifeways from historic times have continued into the present out of necessity, providing insight into past cultures that is not visible elsewhere in the United States (NPS, 2004a). Historically, the area around Toolik Lake was occupied by the Nunamiut. The Nunamiut subsistence pattern depends upon the caribou. During the early 1900s many Nunamiut left the Toolik Lake area and moved closer to the coast. In the years before World War II, many Nunamiut families returned to the Toolik Lake area.

### Historic Context

Early Russian explorers sent by Peter the Great reached the North Pacific in the early 1700s. The first European explorer known to reach Alaska was Georg Steller, who landed on Kayak Island in 1741. The first permanent Russian settlement was established in 1772, at Unalaska, by Russian fur trappers (Borneman, 2003). Other European explorers, including Juan Perez, James Cook, and George Vancouver, found their way to Alaska in the late 1700s. Throughout the 1700s, Russian fur trappers continued to move into Alaska and created several other permanent settlements. In 1821, the Russians prohibited trading in Alaska waters by other nations. The Hudson’s Bay Company established Fort Yukon in 1847 and American whalers entered the Arctic Ocean the following year. The first gold discoveries were made on the Russian River that same year and oil was discovered in Cook Inlet 5 years later. In 1867, William Seward, the U.S. Secretary of State, bought Alaska from Russia for $7.2 million, less than 5 cents per ha. Critics labeled the purchase Seward’s Folly and Seward’s Icebox (Cole, 2009; Borneman, 2003). The decades following this purchase were characterized by an influx of prospectors and fortune hunters as several large gold strikes and the first staked oil claims made national news in the continental U.S.

The early decades of the 1900s saw the expansion of gold production and the start of copper production in Alaska. In 1912, Alaska gained territorial status. Almost immediately, the push for statehood began. The Alaska Railroad was completed in 1923. During World War II, the U.S. military built its presence in Alaska, particularly after the bombing of Dutch Harbor and the occupation of two of the Aleutian Islands by the Japanese. The first overland highway connecting Alaska to the continental U.S. was completed during World War II to provide better military access and remains the sole land link between Alaska and the continental U.S. today. Following the war, the U.S. Air Force began planning the Alaskan radar air defenses to protect the Alaskan mainland and North America from the threat of a Soviet attack from Siberian air bases during the Cold War (Argonne, undated). Alaska finally achieved statehood in January of 1959. The late 1960s saw the discovery of the massive oil reserves on the Northern Slope at Prudhoe Bay and during the 1970s the Trans-Alaska pipeline was constructed across Alaska from Prudhoe Bay on the northern coast to Valdez on the southern coast of Alaska. Oil from the Slope was transported through the pipeline to Valdez and then to Puget Sound, Washington, via oil tankers. The last decades of the 1900s are characterized by oil field development and improvements to travel and communication within Alaska (Cole, 2009). Tourists began to travel to Alaska during these decades to visit Alaska's millions of hectares of national forest and reserves and tourism continues to be an important industry in the state.

### Archival Literature Search

To assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 18, within a defined study area that extended 1.6 km from each proposed location. This search consisted of a review of the files of the Alaska Heritage Resources Survey (AHRS), at the Office of History and Archaeology (OHA) in Anchorage, Alaska. The AHRS is an inventory of all reported historic and prehistoric sites within the State of Alaska and is maintained by the OHA. The inventory includes objects, structures, buildings, sites, districts, and trails, with a general provision that they be over 50 years old. To date, over 36,000 resources have been reported within Alaska, but only a small percentage of the state has been surveyed for resources. In addition to reviewing the AHRS database, hard copies of all pertinent USGS topographic quadrangle maps maintained by the OHA were reviewed, as not all sites have been entered into the database at this time. The NATREG Excel file, also maintained by the OHA, was checked for all pertinent quadrangle maps as well. This file contains all recorded resources considered eligible for or listed on the NRHP in the State of Alaska. In addition, the following archaeologists were contacted for additional information regarding resources within the proposed NEON locations: William Hedman of the Fairbanks BLM office, and Aaron Robertson of Fort Greely. One historic map was reviewed: the Map of the Davidson Ditch, ca 1927.

None of the proposed NEON locations in Domain 18 have been systematically surveyed for cultural resources. There have been 10 surveys or site investigations conducted previously within the 1.6-km study area of the proposed Core Site (C-53, C-54, and A-42). No other surveys have been conducted within the vicinity of the remaining proposed NEON locations.

The majority of the archaeological resources found within the 1.6-km study area of the proposed NEON sites within Domain 18 are located around Toolik Lake. These areas directly around the lake appear to be of moderate to high sensitivity for historic properties.

Resources previously documented within the vicinity of the proposed NEON locations include habitation sites, tent rings, and associated lithic materials (Table 3.5.18.3-3). No sites are located within the areas of disturbance for any of the proposed NEON locations within Domain 18. The study areas for the NEON locations in the Toolik Research Station significantly overlap due to the proximity of the proposed locations for C-53, C-54, and A-42. There were 15 resources identified within the combined study area of C-53, C-54, and A-42. None of these resources have been evaluated for the NRHP. A portion of the Trans-Alaska Pipeline is within 1.6 km of the proposed locations for C-52 and the proposed STREON Site (S-43). The Alaska SHPO revealed during the literature search that it considers the pipeline historically and culturally significant, regardless of its age. None of the remaining proposed locations have any known historic properties within the 1.6-km study areas.

**TABLE 3.5.18.3-3**
Literature Search Results– Domain 18, Tundra
*National Ecological Observatory Network (NEON) EA*

| NEON Site Number | Previously Surveyed | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | Number Evaluated | Number Eligible |
|---|---|---|---|---|---|---|---|
| | | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | | |
| C-52 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| C-53 | No | 0 | 8 | 0 | 0 | 0 | n/a |
| C-54 | No | 0 | 5 | 0 | 0 | 0 | n/a |
| R-35 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| A-42 | No | 0 | 14 | 0 | 0 | 0 | n/a |
| S-43 | No | 0 | 0 | 0 | 0 | 0 | n/a |

Source: Alaska Heritage Resources Survey (AHRS)

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 18 did not identify any significant known historic properties and there are no known NRHP eligible historic properties located within the study area.

A total of 15 archaeological resources have been documented within the 1.6-km study areas of C-53, C-54, and A-42. Some of these historic properties are situated within a few hundred meters of the proposed locations. However, location data gathered from the available literature are not precise enough to determine whether any of these sites are within the area of planned direct impact. Additionally, these resources have not been formally evaluated for significance. Absent a formal evaluation, appropriate measures would be taken during final design and construction to avoid impact to these resources.

A portion of the Trans-Alaska Pipeline is within 1.6 km of the proposed locations of C-52 and S-43. The area of disturbance of the proposed NEON facility is outside of the pipeline corridor and would not directly impact the pipeline. S-43 would not alter the viewshed of the pipeline. C-52 would be visible behind the pipeline for approximately 1 km along the Dalton Highway and would have a minor impact on the view of the pipeline for this short distance.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 18, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

### Utilities

#### *Affected Environment*

The University of Alaska's Toolik Field Station (TFS) is located on a gravel pad near Toolik Lake within the Toolik Lake RNA. The TFS provides year-round infrastructure and logistical support for research (Bret-Harte, 2008). Electric power and communications services would be accessed from the TFS.

#### *Environmental Consequences*

Electric power would be extended from TFS, with overhead lines placed along existing roads to the point nearest proposed tower locations. In areas where an existing road or trail is not available, a 1.4-m wide corridor would be established. A portal would be placed at the point where overhead transmission would no longer be possible and would extend power to proposed NEON locations through boardwalks fitted with aerial conduits. No trenching would be done to extend the power grid. Erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for environmental impacts from installation of utilities.

NEON would place a 100-kW diesel-powered generator at the Advanced Tower AP to provide primary power to the Core Site. A second 100-kW diesel-powered generator would provide primary power at R-35. Generators would be supplied from double-walled fuel tanks to minimize the potential for spills, and refueling would be done approximately every 2 weeks. Generators would be placed inside of buildings to reduce noise. Generators would be insulated from the ground to prevent transfer of heat resulting from operation of the generator to any underlying permafrost.

### Transportation

#### *Affected Environment*

The proposed Core Site, Aquatic Array, and STREON Site on or near the Toolik Lake RNA can be accessed from the James Dalton Highway. The Toolik Lake RNA is set aside for research, and no camping by the general public is permitted. No off-road vehicle traffic on the tundra is permitted.

### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

Existing field roads may be improved to facilitate year-round access, but no new roads would be constructed. Improvements could include addition of gravel in some locations. Construction materials would be hauled to proposed sites by sled or skis in winter to avoid impacts to the tundra.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, during cold weather, and around electrical hazards would be implemented to minimize risk of injury.

The proposed NEON locations are remote and would not receive routine visits from the public. Towers would be secured with fencing and locked gates to deter unauthorized access. Guy wires would be clearly marked and flagged to reduce the potential for accidental collision.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would be negligible.

## Recreation

### *Affected Environment*

The Toolik Lake RNA has been set aside for research, and no camping by the general public is permitted. No off-road vehicle traffic on the tundra is permitted. Visitors to the TFS, which is primarily used as a research facility, are allowed by prior arrangement only. There are no other restrictions on access to the site for casual use. However, scientists who wish to conduct research on the site must obtain a permit from the BLM. Caribou hunting continues as it has prior to the establishment of the Toolik Lake RNA and there have been no measurable effects from the TFS on caribou hunting (The Arctic LTER Project at Toolik Lake, 2007).

There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 18.

### *Environmental Consequences*

No impacts to recreation would be likely. The proposed NEON locations are remote and no routine recreational activities are conducted near these sites. There would be no impact on caribou hunting.

## Human Health and Safety

### *Affected Environment*

Proposed NEON locations would be remote and no public and recreation facilities would be nearby. Access to the Domain 18 towers would be limited. Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Materials would be brought in by hand from the AP.

### *Environmental Consequences*

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, during cold weather, and around electrical hazards would be implemented to minimize risk of injury.

The proposed NEON locations are remote and would not receive routine visits from the public. Towers would be secured with fencing and locked gates to deter unauthorized access. Guy wires would be clearly marked and flagged to reduce the potential for accidental collision.

## Aesthetics and Visual Resources

### *Affected Environment*

Proposed NEON infrastructure at C-52, C-53, C-54, and A-42 would be within the Toolik Lake Natural Research Area, an Area of Critical Environmental Concern (ACEC). All proposed NEON facilities would be within approximately 1.6 km of the Dalton Highway. The highway and the nearby Trans Alaska Pipeline are the primary human-made features in this area. The areas around the proposed NEON locations, including the ACEC, are within a BLM administered Utility Corridor. The BLM has a Visual Resource Management (VRM) system that provides direction for managing visual resources. The four proposed NEON locations in this area are within an area assigned a VRM Class IV. Of the five VRM classes identified by BLM, Class IV allows the second greatest amount of change to the viewed landscape (BLM, 1986). In a Class IV area a project can attract attention and be a dominant feature of the landscape in terms of scale, but efforts should be made to repeat the form, line, color, and texture of the characteristic landscape.

The other proposed NEON infrastructure locations in Domain 18 are in areas where human-made utilitarian features are present.

### *Environmental Consequences*

The presence of the four sites would be consistent with the management direction of a landscape with a VRM Class IV. Most viewers would see the 11-m high towers from the Dalton Highway at distances of approximately 1.6 km. Mitigation measures would include use of non-reflective coatings on visible structures and no night lighting.

Any impacts to aesthetics or visual resources near proposed NEON infrastructure other than at Toolik Lake would be minor.

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**Figure 3.D18-1** Domain 18 Proposed Site Locations

**Figure 3.D18-2** Domain 18 Proposed Site Locations

## 3.5.19 Domain 19 Taiga

### 3.5.19.1 Introduction

Domain 19 is the Taiga Domain. The Taiga is evergreen forest dominated by black spruce. Black spruce occurs across poorly drained and colder areas. White spruce grows on drier sites, such as south-facing slopes. These spruce stands are interrupted in places by stands of Alaska birch, quaking aspen, or balsam poplar. Taiga habitat is a product of undisturbed permafrost and cold temperatures.

The proposed Core Site for this domain would be in the CPCRW approximately 50 km northeast of Fairbanks. The CPCRW is representative of upland headwater basins in subarctic Alaska (Jones et al., 2008). CPCRW is unique within the United States because it is in a zone of discontinuous permafrost. The CPCRW is a relatively pristine, 104-$km^2$ basin reserved for meteorological, hydrological, and ecological research. There are no other human influences on this watershed. The proposed Core Site is on land owned by the State of Alaska, but ownership is scheduled to transfer to the University of Alaska, Fairbanks in 2010.

Three towers (C-55, C-56, and C-57) are proposed on the Domain 19 Core Site in the area where Little Poker Creek flows into Caribou Creek (Figure 3.5.19-1). This proposed Core Site is north of Milepost 30 on the Steese Highway. One advanced and two Basic Towers would be placed less than 0.8 km apart at the confluence of Caribou Creek and Little Poker Creek. One of the proposed tower sites (C-55) is underlain by permafrost. The STREON Site for Domain 19 (S-46) is proposed for this same area, just upstream of the confluence of Caribou Creek with Little Poker Creek (Figure 3.5.19-1). The proposed STREON Site is also underlain by permafrost.

Four Relocatable Sites (R-36, R-37, R-38, and R-41) are proposed for Domain 19. R-36 would be placed in an area of well-drained black spruce forest south of the Fort Greely Military Reservation near Delta Junction on land managed by the BLM (Figure 3.5.19-2). This site would not be on permafrost. R-37 is proposed for a hillside slope with black spruce forest approximately 2.4 km east of and across Poker Creek from the proposed Core Site on the Steese Highway (Figure 3.5.19-1). R-38 is proposed for an area of black spruce east of the City of Healy and just outside the Denali National Park (Figure 3.5.19-4). The proposed R-38 site is in an area interspersed with a series of creeks that drain into the Nenana River just north of Healy. R-41 is proposed for an area of predominantly black spruce east of Cooper's Landing on the Kenai National Wildlife Refuge (Figure 3.5.19-3). The proposed R-41 site is north of the Sterling Highway between Mystery Creek Road and the western boundary of the Mystery Hills Wilderness Area.

### 3.5.19.2 Resource Areas Considered But Not Addressed for Domain 19

Preliminary analysis indicated that there would be no potential to significantly impact six of the resource areas that were considered. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Noise: Effects to humans from the noise of annual low flying plane flights would likely be negligible because flights would be in remote areas with no potential sensitive human receptors. Impacts from construction noise on wildlife are discussed below.

- Sensitive Ecological Communities: None of the sites are located within designated sensitive ecological communities. There would be no environmental risks to sensitive ecological communities.
- Air Space: There is restricted airspace associated with Fort Greeley Military Reservation near the proposed location of R-36. The R-36 Relocatable Site was moved from Fort Greely onto BLM land. There would be no expected impacts to restricted airspace from the proposed project; however, NEON, Inc. would coordinate proposed AOP flight plans with Fort Greely.
- Environmental Justice: The proposed NEON sites would be located on state or federal lands. All potential impacts would be confined to areas with few or no human dwellings or disadvantaged people. There would be no potential to disproportionately impact minority or low-income populations. On the Core Site, there would be negligible impacts to accessibility to resources used for subsistence by people in Alaska, such as berries, caribou, and salmon, since access to the Core Site is currently controlled by a gated bridge across the Chatanika River.
- Protection of Children: None of the proposed sites are in or near areas where children congregate or live. There would be no indirect impacts to children from pollution or other sources of contamination. Therefore, no environmental health and safety risks to children would result.
- Aesthetics and Visual Resources: Areas proposed as NEON locations in Domain 19 are designated research areas that are not routinely viewed for aesthetic quality or urban lands where aesthetic quality is impaired. Implementation of NEON would not further reduce the aesthetic and visual quality of the proposed locations. No impacts would be likely.

It should be noted that the area investigated for potential impacts associated with R-36, as shown by the circle on Figure 3.5.19-2, encompasses some military land. Data collection and sampling during the NEON projects would be confined to BLM lands and none of this effort would occur on military land. As none of the activity would occur on military land and the impacts of NEON construction and research would not affect military operations, there is no further discussion of military lands.

### 3.5.19.3 Resource Areas Considered in Detail for Domain 19

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 19 where site-specific conditions would influence the anticipated environmental consequences.

#### Geology/Seismology

#### *Affected Environment*

The proposed Core Site and STREON Site would be in the Yukon-Tanana Uplands of the Northern Plateaus Physiographic Province. The Caribou-Poker Creek Research watershed is entirely underlain by the Yukon-Tanana metamorphic complex. This basement complex of meta-sedimentary rocks covers approximately 75 percent of the Yukon-Tanana Uplands. The Yukon-Tanana Uplands is a region of northeast-trending, round-topped ridges with gentle slopes. The elevations of these ridges range from 450 to 900 m with rises of 150 to 500 m above the adjacent valley bottoms. The alluvial-covered valley floors are generally flat.

The Core Site is representative of upland headwater basins in subarctic Alaska and is unique within the United States due to its location within an area of discontinuous permafrost. The permafrost mosaic of the taiga forest uplands exerts a powerful influence over hydrologic patterns and ecosystem processes within the watershed.

The proposed R-41 site is on unconsolidated sediments deposited by glaciation from the Quaternary Period and is adjacent to an area underlain by the McHugh Complex, which dates from the Permian to mid-Cretaceous Periods (Bradley and Wilson, 2000).

The Denali Fault is a major fault that runs across the lower to mid-portion of interior Alaska. It extends in a slight arc from the border with Canada and Denali National Park. The 2002 Denali Fault earthquake was accompanied by fault rupture over a distance of 340 km, with offsets up to 8 m (Wesson et al., 2007). The 2002 Denali Fault earthquake was the largest onshore earthquake to strike the United States since the San Francisco earthquake of 1906 (Wesson et al., 2007). Relocatable Site R-38 would be near the Denali Fault. The remaining proposed NEON locations in interior Alaska would be in areas with less potential for impact to equipment from seismic activity.

R-41, in the Kenai Peninsula, would be in a seismically active region that has an average of one earthquake of Magnitude 5 or greater per year per 12,300 $km^2$ (USGS, 2009a). The R-41 site would be adjacent to the Border Ranges Fault, which runs along the base of the mountain range west of the McHugh Complex thrust (Bradley and Miller, 2006).

### *Environmental Consequences*

None of the proposed projects would impact seismic activity. No direct or indirect impacts to geology would be expected due to implementation of appropriate BMPs. Project design would incorporate appropriate measures to minimize the risk from seismic hazard. There would be no potential for interaction with other projects and no cumulative impacts to geologic resources would occur.

BMPs for all NEON, Inc. activities on permafrost would require boardwalks instead of footpaths and construction would be limited to the time of year with snow cover. This would allow skis and sleds to be used and would avoid disturbing groundcover and subsequent risk of thawing permafrost.

The seismic hazard varies in the locations where NEON infrastructure is proposed. NEON infrastructure would not impact seismic activity. However, NEON infrastructure proposed for R-38 and R-41 could require seismic safeguards to avoid interruptions in data collection because of the potential for strong earthquakes at these locations. It is not expected that any long-term maintenance resources would be required to address seismicity in this domain.

## Soils

### *Affected Environment*

Soils within the three primary watersheds of the proposed Core Site and the proposed STREON location on the CPCRW are in the Entisol and Inceptisol soil orders, which occur across most of the Taiga Domain. The proposed NEON infrastructure in Domain 19 would be placed in areas where hydric soils predominate (NRCS, 2009a; 2009b; 2009c; 2009d; 2009 e; 2009f). The proposed Advanced Tower (C-55) location is underlain by permafrost, while the two proposed Basic Towers would not be placed on permafrost. Relocatable Tower R-36 would be underlain by soils derived from older moraine glacial sediments (Jorgenson, 2002).

Advanced Tower C-55 and the proposed STREON Site (S-46) would be on Hystic Pergelic Cryaquept fan with slopes from 1 to 20 percent (NRCS, 2009b). This soil type occurs on alluvial fans and is formed from loess deposition over colluvium. The typical soil profile is peat to a depth of 33 cm, with silt loam continuing to a depth of 66 cm. Bedrock occurs at depths between 66 cm and 183 cm, and the soil material between the silt loam and bedrock is not described (NRCS, 2009b). Because of the thick covering of peat, these soils are not highly susceptible to erosion.

Basic Tower C-56 would be on Gilmore silt loam, with 12 to 45 percent slopes (NRCS, 2009c). This soil type occurs on hills and was formed from loess deposits over residuum weathered from schist. The typical soil profile is slightly decomposed plant material in the upper 7.5 cm, silt loam extending to a depth of 30 cm, and a very channery silt loam to 49 cm. Weathered bedrock occurs at a depth of 48 cm (NRCS, 2009c). The only soil near the proposed location of C-56 that is moderately susceptible to rill and sheet erosion is the Typic Cryochrepts-Rock outcrop complex with 6 to 35 percent slopes, which makes up less than 1 percent of the soils in the area (NRCS, 2009c).

Basic Tower C-57 would be on Hystic Pergelic Cryaquept with 15 to 45 percent slopes (NRCS, 2009d). This soil type occurs on hills and is formed from loess deposition over colluvium. The typical soil profile is peat to a depth of 33 cm, with silt loam continuing to a depth of 66 cm. Bedrock occurs at depths between 66 cm and 183 cm, and the soil material between the silt loam and bedrock is not described (NRCS, 2009d). Even with the steep slopes typical of this soil type, the thick covering of peat makes it not highly susceptible to erosion.

The soil at the proposed location for the Tower R-36 would be on Butchlake-Southpaw complex with slopes from 0 to 12 percent and Donnelly-Nenana complex found on 0 to 3 percent slopes (NRCS 2009e). The Butchlake-Southpaw complex consists of 50 percent Butchlake, gently sloping and similar soils, and 40 percent Southpaw and similar soils. Butchlake gently sloping soils are located on moraine hills and are formed by loess over till. A typical soil profile is up to 7.6 cm of slightly decomposed plant material, with up to 10 cm mucky silt loam below the organic material. An extremely gravelly coarse sandy loam or cobbley sandy loam occurs to a depth of 23 cm and continues as a very cobbley sandy loam to 152 cm. The Southpaw soil occurs on moraine hills and is formed by loess deposition over glacial till. A typical soil profile is described as slightly decomposed plant material from to a depth of 10 cm, silt loam from 10 cm to 33 cm, fine sandy loam from 33 cm to 56 cm, and a gravelly sandy loam or a very gravelly loamy sand extending to a depth of 152 cm (NRCS, 2009e). This soil is not considered highly susceptible to rill or sheet erosion (NRCS, 2009e).

Donnelly-Nenana complex soils consist of slightly decomposed plant material at the surface, gravelly silt loam in the middle, and very gravelly sand on the bottom, and typically occur along stream terraces. These soils are somewhat excessively drained and do not typically flood or pond (NRCS, 2009g). These soils have not been rated by the NRCS for erosion; however, due to the layer of decomposing vegetation at the surface, it is unlikely these soils would be highly susceptible to erosion.

There are hydric soils within 5 km of the proposed location of R-36. Hydric soils in the area could include Typic Aquiturbels on 0 to 7 percent slopes. These poorly drained soils typically occur in depressions on moraines and are frequently flooded, with the water table at the surface. The soils is derived from deposited loess over glacial till and consists of decomposed plant material in the upper profile, very fine sandy loam in the middle, and gravelly very fine sandy loam on the bottom (NRCS, 2009g).

There are no NRCS soils data or other specific soils data available for the proposed R-38 location. R-38 soils would likely resemble those of R-36 due to the similar topography and elevation. R-38 would be in an area likely to be subject to flooding and would be expected to have hydric soils.

#### *Environmental Consequences*

Short-term minor direct impacts to soils would be expected as a result of construction and site closure. Any indirect impacts to soils would likely be negligible. Any direct impacts to soils during operation of NEON would be negligible and no indirect soil impacts would result from operation of NEON infrastructure. Because all impacts would be limited to the NEON footprint, there would be no potential for interaction with other projects and no cumulative impacts to soils would result.

Within the vicinity of proposed sites, there is a predominance of hydric soils and a permafrost layer at depths ranging from 20 cm to 76 cm. Construction in hydric and permafrost soils would use appropriate BMPs, as described in Section 2.2.2, for these sensitive soil types. Construction of proposed sites in permafrost would take place when soils are protected by accumulated snow to limit disturbance of ground cover and incidental soil disturbance as a result of clearing and grading. Boardwalks would be built rather than trails to allow access across permafrost for maintenance and data collection without impact to the underlying soils. Extended utilities also would be attached to boardwalks, rather than placed in trenches, to avoid soils impacts and potential permafrost thaw as a result of the utility lines.

NEON, Inc. would require implementation of BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into downslope waters.

### Climate

#### *Affected Environment*

The Upper Yukon Taiga-meadow Province has an average annual precipitation from 155 to 355 mm and an average air temperature from -10º C to -4º C. Climate on the Core Site is representative of climate for the Domain 19 taiga as a whole. The average January and

July temperatures are -22ºC and 13ºC, respectively. Average annual precipitation is 34.2 cm, with 22.5 cm occurring as summer rainfall and 11.7 cm as winter snowfall (Jones et al., 2008). The Kenai Peninsula climate is strongly influenced by the surrounding ocean and there is little variation in temperature throughout the year. Average annual minimum and maximum temperatures for the Kenai Peninsula are -3.2˚C and 6.5 ˚C, respectively (Alaska Research Center, 2009a). Average annual precipitation for the Kenai Peninsula is 55.4 cm, with approximately half of the precipitation occurring during autumn (Alaska Research Center, 2009b).

### *Environmental Consequences*

Construction and operation of NEON infrastructure would not impact the regional climate. The intense winter cold, snow, and potential for severe frost heave would influence project design. Tower bases and guy wires would be designed to withstand frost heave. Instrumentation would be selected and the sites designed to allow operation and data collection throughout the year. Instrument huts would be constructed with a low profile to withstand high winds and insulated from the ground to avoid heat transfer into permafrost.

## Air Quality

### *Affected Environment*

Eagle River and Juneau are the only non-attainment areas in Alaska and the proposed Domain 19 NEON facilities are not near these two cities (USEPA, 2009). All proposed NEON infrastructure would be placed in areas designated as in attainment for all criteria air pollutants. Denali National Park, a Federal Class 1 Wilderness Area, is within 30 km of proposed R-38 site. No other proposed NEON sites in Domain 19 are within 161 km of a Federal Class 1 Wilderness Area (USEPA, 2008).

### *Environmental Consequences*

Short-term negligible direct and indirect impacts to air quality would occur during construction of NEON infrastructure. There would be negligible long-term direct impacts to air quality from use of vehicles during the operation of NEON infrastructure. Because emissions associated with NEON projects would be intermittent and small, no cumulative impacts to air quality would be expected.

Construction of the proposed instruments would have short-term, negligible impacts to air quality. The size of construction would be less than 0.01 ha and no large earthmoving equipment would be used. BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions during construction.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not impact visibility or contribute to deterioration of air quality in Denali National Park.

### Water Quality

#### *Affected Environment*

The Core Site and the proposed STREON Site are located on the CPCRW, which is in the zone of discontinuous permafrost that underlies a large portion of Alaska (Jones et al., 2008). Permafrost distribution within this part of Alaska is influenced by low sun angle at high latitude and the interactions of changes in topography and the height and cover of vegetation shading the ground surface. The permafrost mosaic of the surrounding taiga forest uplands exerts a powerful influence over hydrologic patterns within the watershed. One proposed tower (C-55) would be underlain by permafrost.

Stream flow in the Core Site and at the proposed STREON Site is a mixture of highly variable shallow storm runoff events from permafrost-dominated areas and consistent groundwater base flows from permafrost-free areas (Jones et al., 2008) with scattered streams (Table 3.5.19.3-1). Within the CPCRW, up to 55 percent of first order stream basins are underlain by permafrost (Jones et al., 2008). The Little Poker Creek, Poker Creek, and Caribou Creek system is considered pristine and meets its designated uses. No waters in CPCRW are included on the Alaska CWA Section 303(d) list of impaired waters (Alaska Division of Water Quality, 2008). All roads in this area were constructed to minimize influence of the road on watershed dynamics within the research area (Jones et al., 2008).

Relocatable Site R-37 is on top of a slope above Poker Creek, which also eventually drains into the Yukon River. Relocatable Sites R-36 and R-38 would be on flat terrain or at the bottom of slopes. Although these locations would not be adjacent to surface waters, they would be in areas with permafrost or a high water table. Relocatable Site R-41 is near the toe of the Mystery Hills in the Mystery Creek watershed, which drains approximately 117 $km^2$ of the Kenai Peninsula, eventually draining into Chickaloon Creek. All surface waters at or near the proposed NEON Relocatable Sites meet their designated uses and none are included on the Alaska CWA Section 303(d) list of impaired waters (Alaska Division of Water Quality, 2008).

#### *Environmental Consequences*

There would be no potential for direct impacts to water quality during construction of NEON infrastructure. However, negligible short-term indirect impacts to water quality could occur from stormwater runoff during construction. STREON experiments could cause long-term moderate impacts to water quality in Caribou Creek. Any such impacts would be localized, however, so there would be no potential for cumulative impacts to occur.

**TABLE 3.5.19.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Towers and Aquatic Arrays—Domain 19, Taiga United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-55 | 5 | 0 | 0 | 0 | ND | ND |
| C-56 | 4 | 0 | 0 | 0 | ND | ND |
| C-57 | 5 | 1 | 1 | 0 | ND | ND |
| R-36 | 0 | 0 | 8 | 0 | ND | ND |
| R-37 | 7 | 0 | 0 | 0 | ND | ND |
| R-38 | 5 | 0 | 1 | 0 | ND | ND |
| R-41 | 4 | 0 | 9 | 0 | ND | ND |
| S-46 | 4 | 1 | 0 | 0 | ND | ND |

ND = No Data
Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009b.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand. At any proposed NEON location, the amount of disturbance would be small (less than 0.01 ha) and the amount of new impervious area would be less than 35 $m^2$. Any indirect impacts would be temporary and negligible and the potential for impacts to water quality from construction would end following the stabilization and revegetation of disturbed soils. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality as a result of erosion and sedimentation from disturbed soils. A similar potential for temporary direct and indirect impacts to water quality would be expected at the time of site closure. Measures discussed above that would be implemented to prevent permafrost thaw also would contribute to minimizing the potential for water quality impacts.

Elevation of $NH_4NO_3$ or $H_3PO_4$ concentrations in Caribou Creek to 5 times ambient concentrations for a 10-year period could result in long-term impairment of water quality in this stream. However, due to the cold temperatures that prevail in the stream, biological activity may not increase greatly, allowing more nutrients to be transferred downstream. Any increased growth would likely be limited to periphyton. There also could be periodic die-offs of periphyton biomass, which could lead to oxygen depletion in the stream from aerobic decomposition. Oxygen depletion could in turn result in changes to vertebrate and invertebrate communities in the immediate area (Hauer and Lamberti, 2006). Impacts would likely be long-term and moderate. No impacts would be expected from the recirculation tracer experiments.

Because Caribou Creek joins the larger Poker Creek a short distance downstream of the proposed STREON location and because there is no development in the watershed, no cumulative impacts would be expected.

There would be a potential for in-stream monitoring equipment to be washed downstream during flood events and it is unlikely that equipment would be recovered if washed away. Aquatic monitoring devices are small and would create negligible impacts to water quality if they were to be lost because there are no environmentally harmful components associated with this monitoring equipment. NEON, Inc. would secure STREON infrastructure to withstand expected flood levels and thus minimize the potential for damage. If sufficient advance warning of flood events is received, NEON, Inc. would temporarily remove equipment from the STREON Site to prevent damage or loss.

### Wetlands

#### *Affected Environment*

There are no NWI maps for the proposed Core Site area and the majority of the proposed Core Site lacks mapped soils. However, the presence of permafrost and hydric vegetation would result in wetlands being near most proposed NEON infrastructure locations. The location of Relocatable Site R-37, which is on a side slope, is the only proposed location where nearby wetlands would be unlikely. USFWS NWI maps indicate that the proposed location for R-41 would be in an area with numerous wetlands.

#### *Environmental Consequences*

Minor direct and indirect impacts to wetlands are likely during construction of proposed NEON towers, fencing around towers, and boardwalks. No additional impacts to wetlands would be expected from operation of NEON infrastructure. Because NEON sites would be separated spatially and have small, if any, localized impacts, no cumulative impacts to wetlands would be expected.

To the extent practicable, NEON, Inc. would place towers and equipment pads outside of wetlands, and would select construction sites either outside of wetlands and permafrost areas or in areas of stable permafrost where deep melting would not occur. Boardwalks would be installed on all permafrost and across any wetland areas to minimize impacts from access for construction, maintenance, or data collection. The Toolik Lake Research Station has established construction methods for boardwalks, tower pads, and fencing on permafrost and NEON, Inc. would follow these methods to avoid and minimize impacts to wetlands and permafrost to the extent practicable. Boardwalks also would be used to attach conduits to extend electric power and communications from portals to infrastructure locations. Transport of construction materials to proposed project sites would take place when soils are protected by snow to limit incidental disturbance to wetlands as a result of site access for construction. If wetlands and/or permafrost are present, temporary minor impacts would also be expected at the time of site closure. However, site closure would result in removal of the NEON tower and boardwalk from the wetland, which would then be a long-term benefit to the wetland as the area would be returned to its pre-construction condition.

NEON, Inc. also would implement appropriate BMPs, as described in Section 2.2.2, to minimize the potential for direct and indirect wetland impacts. NEON would obtain all appropriate permits (see Section 5.19) prior to conducting any land disturbing activities in wetlands. NEON would comply with all conditions of any issued permits.

### Floodplains

#### *Affected Environment*

Streams and channels within the Core Site have been mapped by FEMA to establish floodplains and flood prone areas. The proposed Core Site towers (C-55, C-56, and C-57) would be placed outside of any mapped floodplain. The proposed STREON Site (S-46) on Caribou Creek just upstream of its confluence with Little Poker Creek is not identified as within the floodplain according to FEMA maps. However, this area would be subject to overbank events from Caribou Creek.

The proposed Relocatable Sites (R-36, R-37, R-38, and R-41) would be in areas that have not been mapped by FEMA. However, Relocatable Sites R-36 and R-38 would be in lowlands near streams. R-37 would be on a slope and would not be subject to flood events. The proposed location of R-41 is not near a stream, but high surface water would be likely during snowmelt or following heavy growing season precipitation events.

#### *Environmental Consequences*

No flooding would be expected at the Core Site towers or Relocatable Site R-37 due to the topographic position of the proposed tower locations. Proposed Relocatable Sites R-36 and R-38 would likely be in areas subject to flooding based on their lowland locations near creek and river systems. Relocatable Site R-41 would likely be subject to elevated surface water conditions at certain times of the year. The proposed STREON Site (S-46) would be in an area subject to flooding from Caribou Creek.

None of the proposed NEON projects would be expected to increase flood elevations. Any changes in flood storage capacity and flood conveyance as a result of proposed NEON infrastructure would be negligible. There is the potential for equipment to be damaged during flood events. NEON, Inc. would design infrastructure in floodplains to withstand expected flood levels and thus minimize the potential for damage, but these designs are not expected to increase impacts to floodplains and flood prone areas. If sufficient advance warning of flood events is received, NEON, Inc. would temporarily remove equipment from flood prone areas to prevent flood damage or loss.

### Common Vegetation and Plant Communities

#### *Affected Environment*

Within the Taiga Domain, vegetation is dominated by slow growing spruce interspersed with occasionally dense, well-developed forest stands and treeless bogs. On the warmest, well-drained sites, such as south-facing slopes, closed forests of spruce-hardwood are the dominant plant community. The overstory at these sites typically is composed of white spruce, paper birch, and quaking aspen (Jorgenson et al., 2001). The composition changes to balsam poplar and white spruce along floodplains. On poorly drained sites, including those underlain by permafrost, black spruce dominates. Bog vegetation may range from sedge-dominated types to oligotrophic sphagnum bogs. Sedge-tussock meadows, with co-dominant low and dwarf shrubs, are widespread in the domain as well.

The vegetation structure within the proposed Core Site and STREON Site on the CPCRW is typical of interior Alaska. The major vegetation groups are closed and open coniferous forest, coniferous woodland, open and closed deciduous forest, closed mixed forest, closed tall shrub, shrub tundra, and tussock tundra (Jones et al., 2008). The majority of coniferous forest habitat is composed of black spruce. Scattered white spruce occurs on south-facing slopes with drier soils. Approximately one-third of the vegetation on the CPCRW, where the Core Site and STREON Site would be located, is black spruce forest, primarily on north-facing slopes (Jones et al., 2008). The majority of the area is dominated by birch and quaking aspen forests with areas of green alder. The level areas adjacent to streams are occupied by communities of tussock tundra dominated by stair-step moss, Schreber's feather moss, and sphagnum mosses.

Relocatable Sites R-36 and R-38 are proposed for generally level, low elevation sites. R-37 is proposed for a northeast facing slope overlooking Poker Creek. The vegetation at Relocatable Sites R-36 and R-38 would be similar, consisting of approximately equal amounts of lowland gravelly dry broadleaf forest and lowland gravelly needleleaf forest. The lowland gravelly dry broadleaf forest consists of quaking aspen and balsam poplar, with a lesser component of black spruce. The lowland gravelly needleleaf forest consists of black spruce, white spruce, and northern mountain cranberry with extensive ground cover of snow lichen and stair-step moss. These dominant vegetation types are interspersed with areas of lowland gravelly moist low scrub that is dominated by birch dwarf birch, northern mountain cranberry, and quaking aspen with extensive cover of snow lichen (Jones et al., 2008). The area surrounding R-41 is typical of interior boreal forests with a combination of black spruce, whites spruce, quaking aspen, and paper birch (Klein et al., 2005). Although the dominant tree of the Kenai Peninsula lowlands is black spruce, the R-41 site is in a transition area between lowlands and mountains and between coastal and boreal forests.

#### *Environmental Consequences*

There would be minor long-term impacts to vegetation and plant communities at tower pads, IHs, and along boardwalks. Because impacts would be localized, there would be no potential for interaction with other projects and no cumulative impacts to vegetation would be expected.

Minor clearing of vegetation would occur during construction to prepare for tower pads, fencing, IHs, and boardwalks. Vegetation in areas cleared for tower pads, fencing, and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site, and recovery following removal of NEON infrastructure would be extended due to the short growing season in this region.

Trenching would not be used to extend utility lines. All utility lines would be attached to boardwalks. The use of boardwalks would avoid long-term impacts to vegetation from trampling during maintenance and data collection visits. Limited removal of trees along the boardwalk routes may be necessary and these routes would remain free of trees until NEON project completion.

### Common Fauna

#### *Affected Environment*

Shrews and voles are common at all proposed NEON locations in Domain 19. Conifers occur at all proposed locations and provide nesting habitat for yellow-rumped warbler, blackpoll warbler, and Townsend's warbler. Arctic warblers occur in open black spruce forests (Ring et al., 2005) and nest in dry open areas with grasses and few trees. Red squirrels are common in areas with an adequate source of spruce cones. Several species of grouse, woodpeckers, and owls are common in the habitats present at the proposed NEON locations. R-41 would be within a Wildlife Refuge where moose, brown bear, grouse, lynx, caribou, snowshoe hare, and salmon would be relatively common. Wildlife that would occur in deciduous woodlands and alder and willow thickets near water include moose, yellow warbler, and Wilson's warbler. Caribou and bears range over wide areas and could occur at the proposed NEON locations occasionally.

### *Environmental Consequences*

Minor direct impacts to wildlife would occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife would result from loss of habitat. No population-level impacts would be expected and there would be no potential for cumulative impacts.

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction and materials would be brought in by hand. The proposed sites have adequate habitat surrounding the proposed locations, which could provide refuge during construction. Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding would be expected.

Fencing around towers would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

There would be a long-term loss of habitat at towers and IHs. Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. The area of lost habitat would be negligible relative to the total habitat available near proposed project areas. Overall, impacts to wildlife would be negligible.

Towers and guy wires would pose a minimal risk to common birds. Towers and guy wires would be within the forest canopy, except for the upper 10 m of the tower. Collisions with the tower or wires would be unlikely and any impacts would likely be negligible from a population standpoint. This potential risk to birds would be eliminated at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Alaska Department of Fish and Game Division of Wildlife Conservation prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because the proposed NEON sites would be in open terrain or areas with low and sparse forest vegetation, animals may startle at the approach of the plane during AOP overflights and move a short distance. Any impacts would likely be negligible. The response would likely be greater for flights that are proposed at 150 m above the canopy.

Because impacts would be separated in space and time, no potential for interaction among proposed NEON projects and other projects would be expected.

Large animals, such as moose and brown bear, tend to use vertical objects as scratching posts. These animals would likely use towers and guy wires for scratching and could topple towers or pull guy wires loose through continued use. Towers would be secured with fencing to prevent such impacts. Should it be necessary to anchor guy wires outside of fencing, these wires would be secured to concrete anchors. Routine maintenance checks would determine whether anchors would need repair or replacement.

### Sensitive Species

#### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 19 (Table 3.5.19.3-2). However, there are known occurrences of state protected species within 5 km of the proposed Relocatable Site (R-36 and R-38) locations. In addition, potentially suitable habitat for state protected species is present at or adjacent to all of the proposed NEON locations, excluding Core Site locations (C-55 and C-56) and Relocatable Site (R-37) (Table 3.5.19.3-2). The following sections discuss the species with potential to occur at or adjacent to proposed NEON sites in Domain 19.

### U.S. Fish and Wildlife Protected Species

No USFWS listed species are known to occur near proposed NEON sites in Domain 19. In addition, the habitats near the proposed NEON sites in Domain 19 are generally unsuitable for federally listed species known to occur in the regions near proposed NEON locations.

### BLM and State Protected Species

No species considered species of concern by BLM are known to occur near proposed NEON locations in Domain 19 (Lentz, 2009). Alaska has no laws protecting sensitive species other than those protected under federal law. Eight species considered rare in Alaska and tracked by the AKNHP are known to occur near the proposed NEON locations (Table 3.5.19.3-2) (Lentz, 2009). These species are described in Table D-19 (Appendix B). Those species likely to occur in the vicinity of proposed NEON locations are discussed below.

Woolly cinquefoil has less than 20 known occurrences in Alaska (Lentz, 2009). It grows on dry sites and is known to occur within 5 km of the proposed location for R-36.

Slender cliff-brake grows in shaded crevices on calcareous rocks with dripping water (Hulten, 1968). It has been documented on Fort Greeley, near the proposed location of R-36 in fine moist sand on an old embankment in the shade of tall alder scrub (Racine et al., 2001).

**TABLE 3.5.19.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 19, Taiga
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-55 | 0 | 0 | 0 | 0 | 0 | 0 |
| C-56 | 0 | 0 | 0 | 0 | 0 | 0 |
| C-57 | 0 | 0 | 0 | 0 | 0 | 2 |
| R-36 | 0 | 0 | 0 | 1 | 0 | 3 |
| R-37 | 0 | 0 | 0 | 0 | 0 | 0 |
| R-38 | 0 | 0 | 0 | 1 | 0 | 1 |
| R-41 | 0 | 0 | 0 | 0 | 0 | 2 |
| S-46 | 0 | 0 | 0 | 0 | 0 | 2 |

Source: Appendix B Domain 19

Gorman's douglasii occurs within 5 km of the proposed location of R-38. It grows at low elevations in mountains up to 200 m (Hulten 1968).

Crawford sedge has been documented on Fort Greeley, near the proposed location of R-36, on dry sites and roadsides in the Jarvis Creek Lowlands (Racine et al., 2001). This species also is known to occur within 5 km of proposed Core Site Tower C-57 and the proposed STREON Site (S-46).

Alaskan brook lamprey may occur in waters near the location of proposed Core Site Tower C-57 and the proposed STREON Site. It occurs in freshwater streams and lakes, but specific habitat requirements or associations are not known.

No protected species are known to occur near the proposed location of R-41. However, the Kenai Wildlife Refuge contains suitable habitat for the little brown myotis and wood frog and several species of migratory warblers (Alaska Natural Heritage Program, 2009).

### Environmental Consequences

Because there are no sensitive species known to occur at proposed NEON locations in Domain 19 and because NEON, Inc. would coordinate with site managers in advance of construction, no direct impacts to sensitive species would be expected. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for indirect impacts to sensitive aquatic species from sedimentation as a result of stormwater runoff.

NEON would work with property site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity and infrastructure locations would be adjusted slightly to avoid such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that a sensitive species occurs in the proposed impact area, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat.

There is the potential to disturb sensitive terrestrial wildlife of the area during construction activities. All of the proposed construction sites are surrounded by large amounts of similar habitat and it is expected that any sensitive wildlife species disturbed by construction activity would relocate a short distance to suitable habitat nearby during construction. Upon completion of construction, any displaced sensitive species would be expected to return to their former use patterns.

Towers and guy wires would pose a minimal collision risk to migratory birds. Any impacts would likely be negligible from a population standpoint. This potential risk would be removed at site closure.

Small mammal trapping would be conducted by local researchers and would follow established protocols and regulations for animal handling to minimize incidental trap mortality. Trap grids would be moved among FSUs to minimize the potential for predators to learn trap patterns. Appropriate permits for trapping would be obtained from the Alaska Department of Fish and Game Division of Wildlife Conservation prior to any small mammal trapping. A site-specific animal welfare plan would be prepared and implemented prior to conducting small mammal trapping at any location. Any sensitive species inadvertently captured would be released unharmed. No impacts to sensitive species would be expected.

### Cultural Resources

#### *Affected Environment*

The majority of the proposed NEON locations for Domain 19 are in the interior of Alaska. The Core Site and Relocatable Site R-37 would be near Caribou Creek on Poker Flats and in proximity to Old Chatanika, a gold mining boom town from the mid-1800s. Relocatable Site R-36 would be adjacent to Fort Greely Military Reservation, approximately 160 km south of Fairbanks near Delta Junction, Alaska. Relocatable Site R-38 would be near Eight Mile Lake in Denali Borough near Healy, Alaska. Relocatable Site R-41 would be in the southern part of the state in the Kenai National Wildlife Refuge near Sterling, Alaska. All proposed locations are in undeveloped to relatively undeveloped areas.

### Prehistoric Context

Among the unique factors in Alaskan archaeology is the continuing contact between prehistoric Alaskans and the prehistoric peoples of northeast Asia. Techniques, trade items, such as iron, and people moved across the Bering Strait between Alaska and Siberia until well into the 19th Century when Siberian raiders still frequently landed on the Seward Peninsula (NPS, 2004a). The earliest migrations from Asia into Alaska are generally believed to have taken place as early as 20,000 years ago (Cole, 2009). The Paleoindian Tradition, which is characterized by the Clovis, Folsom, and other archaeological traditions, is found throughout the continental U.S. and also appears in small pockets in Alaska. Current thought suggests the Clovis culture, a big game hunting tradition which focused on now-extinct megafauna, evolved south of the continental ice sheets during the late Pleistocene and moved north as the glaciers retreated. Fluted points associated with these hunting traditions have been found in Alaska but are not well dated (NPS, 2004a).

### *Interior Alaska*

The Paleoarctic Tradition, also referred to as the Denali Tradition, dates from approximately 8,000 to 10,000 years ago. This tradition is characterized by a core and blade technology that featured microblades, microcores, and burins. Within the tundra and northern taiga, people of this tradition lived in small mobile groups. The earliest peoples who lived along the northern areas of Alaska may have coexisting Northern Paleoindian and Paleoarctic traditions (Lobdell, 1999).

The Northern Archaic Tradition appears in Alaskan prehistory around 6,000 years ago. This culture seems to be related to the Archaic cultures of the boreal forest in southern and eastern Alaska. Some sites dated to this period exhibit the earlier microblade technology, but the culture appears to be a predominantly interior tradition (Bacon, 1986). Approximately 6,000 years ago, the interior of Alaska appears to have been settled by groups, culturally and ethnographically distinct from their coastal neighbors. Researchers proposed several hypotheses, including the “Three Wave” hypothesis, which puts forth the idea that the Athabaskans were genetically and culturally distinct from other groups who had migrated into Alaska. Other ideas postulate that Athabaskan culture began in the northern Interior due to major environmental change and the resulting adaptations (NPS, 2004c).

The Arctic Small Tool Tradition (AST) is one of the most widespread Arctic cultural traditions and dates from approximately 4,000 years ago. This tradition has been found within the boreal forests of Alaska, as well as along the coasts. The AST is characterized by very small and finely flaked stone tools. Subsistence was generally based upon the hunting of caribou and fishing. Fiber tempered and linear stamped pottery appears to be imported from Asia around 3,000 years ago. Projectile points became larger, and oil lamps and slate tools appeared. Some researchers propose that the AST encompasses a number of phases, including the Choris, Norton, and Ipiutak phases, which follow the Denbigh Flint complex, and lasts until approximately 1,000 years ago (NPS, 2004b). Bacon proposes that similar transitions of the AST occurred in the Interior, with Ipiutak directly replacing the Boreal Choris culture (Bacon, 1976).

Few chronologies have been proposed for the Athabaskan culture. One includes the Little Arm Phase, dating from 8,000 to 4,500 years ago, the Taye Lake Phase dating from approximately 4,500 to 1,800 years ago, and the Aishihik Phase, which dates from 1,600 years ago to European contact. The Little Arm Phase correlates with the Paleoarctic and Paleoindian cultures of the north in that tool kits and relative mobility were similar. The Taye Lake Phase correlates with the Northern Archaic Tradition along the coast. Again, tool kits and adaptations are similar. The last phase is the Bennett Lake Phase, which describes the protohistoric Athabaskan (NPS, 2004c).

### *Southeast Alaska*

The Paleomarine Tradition is a core and blade tradition, which developed along the coasts of northwest Canada and southeast Alaska. Microblades, burins, and bone or antler tools are part of the overall toolkit. This mobile hunter and gatherer tradition appeared in southeastern Alaska by 9500 BP. Settlement patterns and technology shifted between 6500 and 5000 BP, presumably in response to a changing environment. This Transition Phase is characterized by a prevalence of groundstone tools and decreased mobility. The Northwest Developmental Stage is generally divided into three phases: early, middle, and late. During the Early Phase, which dates from approximately 5000 to 3000 BP, people became more sedentary, settling in the winter near the shores and utilizing intertidal resources. During the Middle Phase, which dates from approximately 3000 to 1300 BP, use of marine resources intensified and expanded. Settlements appear to be seasonal and related to exploitation of seasonally available resources. Sedentism increased during the Late Phase, and wintertime villages become larger. Procurement camps related to seasonally available resources were still utilized. Continued ground stone use during the Late Phase is evident in the archaeological record. Advances in technology, including copper tools, stone bowls, new harpoon types, drift iron, and oil lamps, were utilized. The Late Phase dates from approximately A.D. 1000 to A.D. 1750 (NPS, 2004d).

### *European Contact*

Although Europeans did move into Alaska in the 1700s and 1800s, much of the native population within the state remained unaffected for many years after these initial forays. Many of the Native American sites that exhibit the effects of European contact and expansion on native populations are more recent than those found in the continental U.S. and are often part of a remembered past. Another unique aspect of Alaskan archaeology is the continued subsistence hunting by Native American peoples throughout rural Alaska. Many traditional lifeways from historic times have continued into the present out of necessity, providing insight into past cultures that is not visible elsewhere in the United States (NPS, 2004a). At the time of European contact and during the historic period, the area of Domain 19 was populated by the Athabaskans, a generally forest dwelling group, who depended upon a hunting and gathering lifestyle. The Dena'ina, one of the Athabaskan groups in Alaska, were living in southeast Alaska, including along the shores of Cook Inlet and in the interior of the Kenai Peninsula.

## Historic Context

Early Russian explorers sent by Peter the Great reached the North Pacific in the early 1700s. The first European explorer known to reach Alaska was Georg Steller, who landed on Kayak Island in 1741. The first permanent Russian settlement was established in 1772, at Unalaska by Russian fur trappers (Borneman, 2003). Other European explorers, including Juan Perez, James Cook, and George Vancouver, found their way to Alaska in the late 1700s. Throughout the 1700s, Russian fur trappers continued to move into Alaska and created several other permanent settlements. In 1821, the Russians prohibited trading in Alaska waters by other nations. The Hudson's Bay Company established Fort Yukon in 1847 and American whalers entered the Arctic Ocean the following year. The first gold discoveries were made on the Russian River that same year and oil was discovered in Cook Inlet 5 years later. In 1867, William Seward, the U.S. Secretary of State, bought Alaska from Russia for $7.2 million, less than 5 cents per ha.

Critics labeled the purchase Seward's Folly and Seward's Icebox (Cole, 2009; Borneman, 2003). The decades following this purchase were characterized by an influx of prospectors and fortune hunters as several large gold strikes and the first staked oil claims made national news in the continental U.S.

The early decades of the 1900s saw the expansion of gold production and start of copper production in Alaska. In 1912, Alaska gained territorial status. Almost immediately, the push for statehood began. The Alaska Railroad was completed in 1923. During World War II, the U.S. military built its presence in Alaska, particularly after the bombing of Dutch Harbor and the occupation of two of the Aleutian Islands by the Japanese. The first overland highway connecting Alaska to the continental U.S. was completed during World War II to provide better military access and remains the sole land link between Alaska and the continental U.S. today. Following the war, the U.S. Air Force began planning the Alaskan radar air defenses to protect the Alaskan mainland and North America from the threat of a Soviet attack from Siberian air bases during the Cold War (Argonne, undated). Alaska finally achieved statehood in January of 1959. The late 1960s saw the discovery of the massive oil reserves on the Northern Slope at Prudhoe Bay and during the 1970s the Trans-Alaska pipeline was constructed across Alaska extending from Prudhoe Bay on the northern coast to Valdez on the southern coast of Alaska. Oil from the Slope was transported through the pipeline to Valdez and then to Puget Sound, Washington, via oil tankers. The last decades of the 1900s are characterized by oil field development and improvements to travel and communication within Alaska (Cole, 2009). Tourists began to travel to Alaska during these decades to visit Alaska's millions of hectares of national forest and reserves. Tourism continues to be an important industry in the state.

### Archival Literature Search

To assess potential impacts to cultural resources, a prehistoric and historic records and literature search was conducted for all proposed NEON locations in Domain 19, within a defined study area that extended 1.6 km from each proposed location. This search consisted of a review of the files of the Alaska Heritage Resources Survey (AHRS), at the Office of History and Archaeology (OHA) in Anchorage, Alaska. The AHRS is an inventory of all reported historic and prehistoric sites within the State of Alaska and is maintained by the OHA. The inventory includes objects, structures, buildings, sites, districts, and trails, with a general provision that they be over 50 years old. To date, over 36,000 resources have been reported within Alaska, but only a small percentage of the state has been surveyed for resources. In addition to reviewing the AHRS database, hard copies of all pertinent USGS topographic quadrangle maps maintained by the OHA were reviewed, as not all recorded sites have been entered into the AHRS database. The NATREG Excel file, also maintained by the OHA, was checked for all pertinent quadrangle maps as well. This file contains all recorded resources considered eligible for or listed on the NRHP in the State of Alaska. In addition, the following archaeologists were contacted for additional information regarding resources within the proposed NEON locations: William Hedman of the Fairbanks BLM, Aaron Robertson of Fort Greely, and Debra Corbett of USFWS. One historic map was reviewed: the Map of the Davidson Ditch, ca 1927.

No proposed NEON locations in Domain 19 have been systematically surveyed for cultural resources (Table 3.5.19.3-3). A total of three surveys or site investigations have been conducted previously within 1.6 km of Relocatable Site R-36. No other surveys have been previously conducted within the vicinity of the remaining proposed NEON locations.

No sites are located within the areas of disturbance for any of the proposed NEON locations within Domain 19. The study areas for the NEON locations in the Poker Flats area significantly overlap due to the proximity of the proposed Core Site tower locations

**TABLE 3.5.19.3-3**
Literature Search Results–Domain 19, Taiga
*National Ecological Observatory Network (NEON) EA*

| | | Number of Archaeological Resources Present | | Number of Historic Resources, including Architecture Present | | | |
|---|---|---|---|---|---|---|---|
| **NEON Site Number** | **Previously Surveyed** | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | Within Area of Direct Impact of Proposed NEON location | Within 1.6-km Study Area | **Number Evaluated** | **Number Eligible** |
| C-55 | No | 0 | 1 | 0 | 0 | 1 | 0 |
| C-56 | No | 0 | 1 | 0 | 0 | 1 | 0 |
| C-57 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R-36 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R-37 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| R-41 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| A-45 | No | 0 | 0 | 0 | 0 | 0 | n/a |
| S-46 | No | 0 | 1 | 0 | 0 | 1 | 0 |

Source: Alaska Heritage Resources Survey (AHRS)

C-55, C-56, and C-57 and the proposed STREON Site S-46. Only one site, a historic cabin and refuse determined ineligible for the NRHP, is documented within 1.6 km of the proposed NEON locations in Domain 19. The Trans-Alaska Pipeline is within 1.6 km of the proposed location of R-36. The pipeline, although not yet 50 years old, is significant to the development of modern Alaska and personnel at the Alaska SHPO advised that the pipeline is considered historically and culturally significant. None of the remaining proposed locations have any known historic properties located within the surrounding 1.6 km.

### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 19 did not identify any significant known historic properties and there are no known NRHP eligible historic properties located within the study areas (Table 3.5.19.9-3).

A portion of the Trans-Alaska Pipeline is within 1.6 of the proposed location of R-36, but the area of disturbance the proposed NEON infrastructure is outside of the pipeline corridor and would not directly impact the pipeline.

A single historic cabin has been documented within 1.6 km of the proposed locations of C-55, C-56, and S-46. This historic resource has been evaluated and was determined not eligible for listing on the NRHP or any other register.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 19, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF's Section 106 compliance can be carried out.

### Utilities

#### *Affected Environment*

The proposed Core site is approximately 3.7 km from trunk line electric power service. Relocatable Site R-36 would be near the Fort Greely Military Reservation and electric service could be extended from there. Relocatable R-38 would be near Healey, Alaska and utility service could be extended from the town. Relocatable Site R-37 would connect to utility service from the proposed Core Site, which is approximately 2 km away. The proposed location for R-41 is approximately 2 km north of the Sterling Highway. Electric power and telecommunications are available along the highway.

#### *Environmental Consequences*

Power would be extended from the grid terminus with overhead lines placed along existing roads or trails to the point nearest proposed tower locations. A portal would be placed at the point where overhead transmission would no longer be possible and would extend power to proposed NEON sites through boardwalks fitted with surface conduits. No trenching would be done. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for impacts to soils, permafrost, and surface waters.

### Transportation

#### *Affected Environment*

The Core Site, Relocatable Site 37, and STREON Site would be on the CPCRW, which is adjacent to the Steese Highway. Access to CPCRW is through a Bailey bridge, which is gated and kept locked, across the Chatanika River. There is a gravel road network within CPCRW that is passable by four-wheel drive vehicles for approximately 15 km and by ATVs in the remainder of the watershed.

Relocatable Site R-36 is within 4 km of the Richardson Highway and is accessible by an unpaved road. Relocatable Site R-38 is north of Stampede Road, which connects to the Parks Highway east of the proposed R-38 site. Relocatable Site R-41 is accessible from the Sterling Highway (US-1) via the unpaved Mystery Creek Road. Mystery Creek Roads is gated and closed to wheeled traffic during winter, but remains heavily used by snow machines during winter.

### *Environmental Consequences*

Negligible impacts to transportation and traffic flow would be likely during construction and operation of NEON infrastructure. Because traffic associated with NEON would be minimal, no potential for interaction with other projects would likely result. No cumulative traffic impacts would be expected.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

Existing field roads may be improved to facilitate year-round access, but no new roads would be constructed. Improvements could include addition of gravel in some locations. Construction materials would be hauled to proposed sites by sled or skis in winter to avoid impacts to the tundra.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would be negligible.

## Recreation

### *Affected Environment*

Recreation is not restricted on any of the proposed Core and Relocatable Sites for Domain 19. Relocatable Site R-41 is expected to receive the greatest amount of recreational use because it is within the Kenai National Wildlife Refuge in an area with lakes, streams, campgrounds, and outfitters. The area is used frequently by hunters and recreational snow machine drivers.

There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 19.

### *Environmental Consequences*

Construction would be done outside of hunting seasons and the NEON infrastructure would not interfere with recreational uses following construction. Any impacts to recreation would likely be negligible.

## Human Health and Safety

### *Affected Environment*

The proposed Core Site, STREON Site, and Relocatable Site R-36 are on government land with restricted access. Direct access to CPCRW is through a locked Bailey bridge over the Chatanika River. Access to these proposed locations would be limited to researches and agents of the land management agency.

Relocatable Sites R-37, R-38, and R-41 would be generally accessible by the public. Areas surrounding these proposed locations may be used for hunting, bird watching, or other recreational purposes, but there is nothing to specifically attract people to the sites.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities.

#### *Environmental Consequences*

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, during cold weather, and around electrical hazards would be implemented to minimize risk of injury.

The proposed NEON locations are remote and would not receive routine visits from the public. Towers would be secured with fencing and locked gates to deter unauthorized access. Guy wires would be clearly marked and flagged to reduce the potential for accidental collision.

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**Figure 3.D19-1** Domain 19 Proposed Site Locations

**Figure 3.D19-2** Domain 19 Proposed Site Locations

**Figure 3.D19-3** Domain 19 Proposed Site Locations

**Figure 3.D19-4** Domain 19 Proposed Site Locations

## 3.5.20 Domain 20 Pacific Neotropical

### 3.5.20.1 Introduction

Domain 20 consists of the Hawaiʻian Islands in the Pacific Ocean. The Hawaiʻian Islands are approximately 3,700 km from the coast of California. The Islands were formed as volcanoes rose from the Pacific Ocean floor. At least one primary volcano makes up each island (HCV, 2009). All proposed Domain 20 NEON sites would be located on the island of Hawaiʻi, commonly referred to as the Big Island of Hawaiʻi. The island of Hawaiʻi is the largest and most southern of all of the Hawaiʻian Islands.

Advanced Tower C-58 (Figure 3.D20-1) would be in the Laupāhoehoe Natural Area Reserve in the Laupāhoehoe Section of the Hawaiʻi Experimental Tropical Forest (LETF). The Core Site would be near the proposed location of the Pacific Southwest Research Station – Institute of Pacific Islands Forestry Laupāhoehoe Research and Education Center (LREC). Both Relocatable Sites (R-39 and R-40, Figure 3.D20-2) would be in the Puʻu Waʻawaʻa section of the Hawaiʻi Experimental Tropical Forest (PWETF), which includes the Puʻu Waʻawaʻa Forest Bird Sanctuary and the Puʻu Waʻawaʻa Forest Reserve.

### 3.5.20.2 Resource Areas Considered But Not Addressed for Domain 20

Preliminary analysis indicated that there would be no potential to significantly impact six resource areas based on site locations. These resource areas and the reasons they were not addressed further in the analysis are provided below:

- Wetlands: None of the proposed NEON locations are within or adjacent to wetlands. There would be no potential for direct impacts to wetlands. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to minimize the potential for indirect impacts to wetlands.
- Floodplains: None of the proposed NEON infrastructure would be placed within floodplains or flood prone areas. There would be no potential for impacts to floodplains.
- Environmental Justice: The proposed NEON sites would be located in areas with limited vehicular access. All potential impacts would be confined to the immediate areas and there would be no potential to disproportionately impact minority or low-income populations.
- Protection of Children: The proposed NEON sites would be placed in areas that are not routinely visited by children and placement of the NEON infrastructure would not attract children to these sites. All potential impacts would be confined to the immediate areas and no environmental health and safety risks to children would be created.

### 3.5.20.3 Resource Areas Considered in Detail

The following sections describe the affected environment and anticipated environmental consequences for resource areas in Domain 20 where site-specific conditions would influence the anticipated environmental consequences.

### *Geology/Seismicity*

### *Affected Environment*

There are five major volcanoes on the island of Hawai'i: Mauna Kea and Kohala, which are dormant or extinct; and Hualalai, Mauna Loa, and Kilauea, which are considered active (USGS, 2009a, 2009b, 2009c, 2009d, 2009e).

At 4,205 m, Mauna Kea is Hawai'i's tallest volcano (USGS, 2009a). It is classified by the USGS as dormant but is likely to erupt again (USGS, 2009a). The proposed Core Site (Advanced Tower C-58) would be on the northeastern slopes of the Mauna Kea Volcano, approximately 20 km from the summit.

Kohala is an extinct volcano that emerged from the sea approximately 500,000 years ago, making it Hawai'i's oldest volcano (USGS, 2009b). It is approximately 46 km northwest of the LETF and 40 km north-northeast of PWETF.

Hualalai is Hawai'i's third most active and third youngest volcano (USGS, 2009c). It is considered a dangerous volcano because of its likelihood to erupt in the next 100 years (USGS, 2009c). The PWETF is located on the northern flank of Hualalai. The proposed Relocatable Site locations in the PWETF (R-39, R-40) would be approximately 3 to 5 km from the summit of Hualalai.

Mauna Loa covers half of the island of Hawai'i, making it the biggest volcano on earth (USGS, 2009d). Mauna Loa is considered a fairly active volcano, and its last eruption occurred in 1984 (USGS, 2009d). Because of the likelihood of future eruptions, it is carefully monitored by the USGS. Mauna Loa is approximately 50 km south-southwest of the LETF and 38 km southeast of PWETF.

Due to its continuous eruptions, Kilauea is considered one of the most active volcanoes on earth (USGS, 2009e). It is the most southeastern volcano on the island of Hawai'i. Kilauea's magma system extends more than 60 km into the earth (USGS, 2009e). It is more than 50 km from the LETF and PWETF proposed locations.

The probability of seismic activity, both for long and short wave motion, is relatively high for the island of Hawai'i. Within the areas proposed for NEON infrastructure, the maximum % pga with a 2 percent probability of occurrence in 50 years ranges from 40% pga to 60% pga for long wave motion and 125% pga to 150% pga for short wave motion (USGS, 1998a, 1998b).

### *Environmental Consequences*

The proposed Domain 20 sites were selected by NEON, Inc. based on the topographic, geologic, and seismic diversity found in Hawai'i. These areas are prone to seismic activity and are located near active volcanoes; however, the proposed structures would not influence surface activity and NEON activities would not impact subsurface geological features. Additional maintenance may be required after a seismic event and proper precautions would be used if an indication of potential eruption is observed.

## Soils

### *Affected Environment*

There are three main soil types surrounding the proposed location for Advanced Tower C-58. Within the immediate vicinity of the proposed tower location, Honokaa silty clay loam is dominant (NRCS, 2009a). Slope percentages average from 10 to 20 percent within this soil type (NRCS, 2009a). In the areas surrounding the proposed site, Maile silt loam with 6 to 20 percent slopes and Akaka soils occur (NRCS, 2009a).

There are two main soil types and two land classifications within the vicinity of proposed Relocatable Site R-39 (NRCS, 2009b). Puukala is the most prevalent and occurs at the proposed site location. Puukala is an extremely stony silt loam with 6 to 12 percent slopes (NRCS, 2009b). Manahaa occurs to the west of the proposed site and is also an extremely stony silt loam with slightly steeper slopes of 6 to 20 percent (NRCS, 2009b). There are also areas of rough broken land and very stony land approximately 600 m from the proposed site (NRCS, 2009b).

The proposed location for Relocatable Site R-40 is on the border of Manahaa soils and very stony land (NRCS, 2009c). To the east there are large pockets of Mawae soils, which are extremely stony muck with slopes of 6 to 20 percent (NRCS, 2009c).

### *Environmental Consequences*

There would be no direct impacts to native soils from placement of the concrete casing for utility lines beneath the road. The road would be trenched to place the lines and then restored to predisturbance conditions. There would be no soil impacts from placement of surface conduit from the road to the IH for C-58. Utilities would be extended from the IH to the Advanced Tower in conduit attached to a boardwalk. Construction of the boardwalk would cause minimal soil disturbance as a result of placing support poles in the ground. Appropriate BMPs, as described in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to soils from stormwater runoff.

During construction, soils would be disturbed as a result of clearing and grading to place the Core Tower pad and two Relocatable Site pads, as well as installation of fencing around the core tower and IHs. There would be potential for erosion and sedimentation to occur prior to covering or revegetating disturbed areas. None of the soils that would be disturbed are prone to erosion. NEON, Inc. would require implementation of BMPs, as described in Section 2.2.2, to minimize the potential for soil erosion and indirect impacts to surface waters from transport of eroded materials into nearby water bodies.

### *Climate*

### *Affected Environment*

The PWETF and the LETF are located within the high mountainous climatic regions of Hawaiʻi. These areas are generally at elevations greater than 610 to 915 m, where rainfall rapidly decreases as the elevation increases (WRCC, 2009). Skies are typically clear and humidity is low, and some of the lowest temperatures in Hawaiʻi occur in these areas (WRCC, 2009).

The average annual precipitation at the LETF is approximately 175 cm (HETF, 2009a). The mean annual temperature ranges from 26 to 28°C during the daytime to 17 to 21°C at night in the lower areas (USFS, 2009). Temperatures can be nearly 13°C cooler in the higher elevations (USFS, 2009). The windward lowlands region affects the north to northeast sides of the island in areas that are generally below 610 m (WRCC, 2009). Sections of the LETF are within the windward lowlands region. In this region, trade wind showers are common and temperatures are uniform and milder than in other regions (WRCC, 2009).

The PWETF is located within a climatic region known as the Kona Coast of Hawai'i. It is the only region that receives more rain during the late spring and summer months than the winter months (WRCC, 2009). Conditions are warmer and drier here, with well-developed land and sea breezes occurring, especially in the summer (WRCC, 2009). At PWETF, the mean temperature is warmest (22°C) during September and coolest (5.4°C) in February, when an occasional winter frost occurs in the higher elevations (Giffin, 2003). With an annual precipitation of approximately 56 cm, the climate at PWETF is relatively dry compared to other climatic regions, (Giffin, 2003; HETF, 2009b). The rainy season is from March through July, with peak rainfall occurring in May (Giffin, 2003).

#### *Environmental Consequences*

Implementation of NEON would not impact the regional climate. Due to the potential for seasonal storms, Advanced Tower C-58 would be designed and secured to minimize the risk of loss from high winds. Instrument huts would be constructed with a low profile and placed in areas sheltered from the wind.

### *Air Quality*

#### *Affected Environment*

The LETF and PWETF are located in rural areas. There are no areas of nonattainment in the State of Hawai'i (USEPA, 2009a). There are two Class I Wilderness Areas in the state and both are within 160 km of the proposed NEON sites. Hawai'i Volcanoes National Park is located in the southeast region of the island of Hawai'i; and Haleakala National Park is located in the eastern region of the island of Maui (USEPA, 2009b). Hawai'i Volcanoes National Park is located approximately 44 km south-southwest of the proposed Core Site and 37 km southeast of the proposed PWETF Relocatable Sites. Haleakala National Park is approximately 112 km northwest of the proposed Core Site and 104 km north-northwest of PWETF.

#### *Environmental Consequences*

Construction of the proposed infrastructure would have short-term, negligible impacts on air quality. The amount of ground disturbance would be less than 0.01 ha at any proposed location and no large earthmoving equipment would be used. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented during construction to reduce or eliminate fugitive dust emissions.

A comparable potential for short-term air quality impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would likely be negligible.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality.

During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

The NEON project would not contribute to regional haze and would not impact visibility or contribute to the deterioration of air quality at the Hawaiʻi Volcanoes or Haleakala National Parks.

### *Airspace*

### *Affected Environment*

There is an area of restricted airspace approximately 13 km east of proposed Relocatable Sites (R-39, R-40) (FAA,2009). This is the only known restricted airspace on the island of Hawaiʻi. Once operational, the proposed LREC would have a helipad for medical evacuations and emergencies.

### *Environmental Consequences*

The AOP flights would be planned to the extent practicable to avoid the restricted airspace area. Flight schedules and flight plans would be provided to the FAA prior to any NEON activities. Should it be necessary to cross the restricted airspace, NEON, Inc. would coordinate with FAA to obtain authorization for flights. No impacts are anticipated with regard to restricted airspace. NEON, Inc. would coordinate with HETF and DLNR-DOFAW staff regarding the implementation of AOP flights.

### *Noise*

### *Affected Environment*

The noise environments at the LETF and PWETF would be similar. Both are located in rural areas with low populations in surrounding areas. There are no residential areas near the proposed sites. Existing noise levels at all three locations would likely be approximately 40 dBA (USEPA, 1974).

### *Environmental Consequences*

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. Equipment and materials would be brought in by hand with as little impact as possible. No new roads would be constructed. During construction, noise levels would be elevated periodically during daytime from minor clearing, leveling, and other construction activities. Onsite persons at each location would be aware of the operation of equipment during construction and could experience interference with outdoor conversations depending on proximity to the construction area. However, elevated noise levels would be temporary and site noise conditions would revert to background levels following construction. Nearby recreational visitors may hear the construction noise, but this would be a minor nuisance.

There are no residential areas near the proposed NEON locations. There would be no noise impacts to residents.

Wildlife in the immediate construction area would be exposed to the elevated noise and would be expected to relocate from the construction area, but would likely resume normal activity following construction. Any construction-related noise impacts would be temporary and minor.

During operations, it is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. Vehicle noise during trips for maintenance and data collection would result in intermittent negligible noise increases throughout the duration of NEON activities (30 years at Core Site tower locations and up to 5 years at Relocatable Sites).

It is unlikely that noise from the AOP would impact residents on the island of Hawaiʻi due to the remote locations of the proposed Domain 20 sites. No potential sensitive receptors live near the Core Site and the PWETF Relocatable Sites (R-39 and R-40) are nearly 10 km east of any significantly populated areas. AOP flights at 1,000 m above the canopy would be expected to have no impact on residents. AOP flights at 150 m above the canopy would be a short-term nuisance, but any impacts to residents would be negligible. The potential for AOP flights to disturb wildlife is discussed below.

A comparable potential for noise impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would be negligible.

### *Water Quality*

### *Affected Environment*

The LETF extends across parts of nine watersheds: Maulua, Paeohe, Kepehu Camp, Pahale, Haakoa, Kaiwilahilahi, Kilau, Laupāhoehoe, and Kaʻawaliʻi, ranging in elevation from sea level to upwards of 2,400 m. Parts of the Waipunalei, Manowaiopae, Kuwaikahi, and Kihalani watersheds, which are outside the boundary of the forest unit, also are within 2.5 km of the proposed NEON locations.

Headwaters of several streams are present in the LETF (Table 3.5.20.3-1), including Kaʻawaliʻi Stream, Laupāhoehoe Stream, Kilau Stream, Kaiwilahiahi Stream, Haʻakoa Stream, and Pahale Stream (USDA, 2007). The streams are characterized by flashy flows following a rainfall event (Poff et al., 2008). Only two of the streams are perennial and consistently contain aquatic organisms (Poff et al., 2008).

**TABLE 3.5.20.3-1**
Streams, Ponds, and NWI Wetlands Occurring at or Near Proposed NEON Locations and Aquatic Arrays—Domain 20, Pacific Tropical United States
*National Ecological Observatory Network (NEON) EA*

| NEON Facility Number | Streams | | Ponds | | Wetlands | |
|---|---|---|---|---|---|---|
| | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array | Within 5 km of Proposed Tower/Array | At or adjacent to Proposed Tower/Array |
| C-58 | 5 | 0 | 6 | 0 | 0 | 0 |
| R-39 | 0 | 0 | 0 | 0 | 0 | 0 |
| R-40 | 1 | 0 | 3 | 0 | 0 | 0 |

Sources: USFWS, 2008-2009; USGS, 2008-2009; USGS, 2009f.

The streams flow into the Pacific Ocean, and the outlets of the streams are considered Class A waters as set forth in Hawaiʻi Administrative Rules, Title 11, Chapter 54. Class A waters are protected for recreational purposes and aesthetic enjoyment. Other permitted uses must be compatible with protection and propagation of fish, wildlife, and recreation. Discharges to Class A waters must receive the highest degree of treatment or control compatible with the criteria established.

Prior to the designation of the LETF as an experimental forest, no streams in this area had been surveyed (Poff et al., 2008). Several small lakes are located south and east of the proposed location of C-58 (Table 3.5.20.3-1), but these lakes would not receive runoff from proposed NEON locations. The proposed NEON location is more than 0.5 km from a mainstem stream channel.

The PWETF is within the Kiholo watershed, which extends from sea level to within 1.6 km of Hualalai's summit. The Kiholo watershed is bounded on the west by the Waiaha, Honokohau, and Keahole watersheds, and on the east by the Pohakuloa watershed. There are no perennial streams within the forest unit (Giffin, 2003; USGS, 2008). PWETF is located on porous lava flows and contains three man-made reservoirs and few other bodies of standing water (Table 3.5.20.3-1) (Giffin, 2003). The larger freshwater reservoir near the PWETF ranch headquarters (1,188 to 1,207 m in elevation) contains approximately 19,000 $m^3$ of water and is the single most important habitat feature at Puʻu Waʻawaʻa for the Hawaiʻian goose or nene, which is the State bird of Hawaiʻi. This impoundment is supplied with water from a private well (Giffin, 2003).

All waters near the proposed Core Site or the proposed Relocatable Sites meet their designated uses and none are on the Hawaiʻi CWA Section 303(d) list of impaired waters (Hawaiʻi Department of Health Water Quality Management Program, 2008).

### *Environmental Consequences*

There would be no direct impacts to water quality from placement of the concrete casing for utility lines beneath the road. The road would be trenched to place the lines and then restored to predisturbance conditions. Construction of the boardwalk from the IH to C-58 and excavation of the open trench to bury the utility lines would cause minimal soils disturbance. As a result, there would be limited potential for stormwater runoff to carry sediment to downslope waters. Appropriate BMPs, as described in Section 2.2.2, would be implemented to minimize the potential for indirect impacts to water quality in downslope waters as a result of stormwater runoff during utility line construction.

The distance between the proposed Advanced Tower (C-58) at the LETF and a lake or stream is more than 0.5 km. Lakes and streams are unlikely to be directly impacted by either construction or long-term operational activities at the Core Site. The weather stations that would be placed at R-39 and R-40 in the PWETF would not impact waters. If stream tributaries or drainages are noted in proximity to a construction site, BMPs (as discussed in Section 2.2.2) would be used to prevent movement of any sediment into the stream network. The three manmade reservoirs at PWETF are within 2.5 km of the proposed Relocatable Sites, but are unlikely to be impacted by activities at the sites.

### *Common Vegetation and Plant Communities*

### *Affected Environment*

The proposed tower location (C-58) in the LETF is in the Koa-'Ohi'a Wet Forest. C-58 would be in Koa-'Ohi'a Montane Wet Forest.

Koa-'Ohi'a Montane Wet Forest occurs in areas from approximately 914-m to 1,372-m elevations. The koa (*Acacia koa*) and 'ohi'a (*Metrosideros polymorpha*) trees grow to approximately 30 m tall and form a mixture of closed and open canopy. This community type differs from the Koa-'Ohi'a Lowland Wet Forest in the species composition of the subcanopy. Trees in the secondary tree layer include a well-developed subcanopy of tree ferns (*Cibotium glaucum, C. chamissoi*, and *C. Hawai'iense*) as well as 'olapa (*Cheirodendron trigynum* ssp. *trigynum*), kawa'u (*Ilex anomala*), kolea (*Myrsine lessertiana*), and pilo (*Coprosma rhynchocarpa* and *C. pubens*). The understory consists of native shrubs such as 'ohelo kau la'au (*Vaccinium calycinum*), 'akala (*Rubus Hawai'insis*), *Cyrtandra* spp., *Clermontia parviflora*, mamaki (*Pipturus albidus*), manono, as well as saplings of 'olapa (*Cheirodendron trigynum* ssp. *trigynum*), 'ohi'a (*Metrosideros polymorpha*), pilo, and kawa'u. Ferns, including *Asplenium* spp., *Dryopteris wallichiana*, 'akolea (*Athyrium microphyllum*), *Ophioglossum pendulum* var. *falcatum*, and *Pleopeltis thunbergiana* are also prevalent. Mosses appear in areas with limited damage by feral pigs.

'Ohi'a-hapu'u Montane Wet Forest occurs on the east side of the Laupāhoehoe unit from approximately 1,067-m to 1,372-m elevation. This vegetation type bisects the upper portion of the Koa-'Ohi'a Montane Wet Forest. The canopy, dominated by 'ohi'a, is open to scattered and is approximately 24 m tall. A secondary layer of native trees such as olomea (*Perrottetia sandwicensis*), mehame (*Antidesma platyphyllum* var. *platyphyllum*), 'olapa, and pilo, grow over a layer of tree ferns of various heights composed mostly of hapu'u (*Cibotium glaucum*). Beneath the hapu'u is a mixture of native shrubs such as manono, young 'olapa, pilo, *Cyrtandra* spp., and *Clermontia parviflora* and ferns such as ho'i'o (*Athyrium sandwichianum*), *Asplenium* spp., *Vandenboschia davallioides*, wahine noho mauna (*Adenophorus spp*.), *Elaphoglossum* spp., and *Pleopeltis thunbergiana*.

The mid-elevation area (between 1,220 m and 1,370 m) in the Laupāhoehoe unit contains several low-lying, poorly drained montane wet grassland communities that are dominated almost exclusively by *Carex alligata*. In some areas this community type contains a few species from the surrounding community such as 'ohi'a, 'olapa, and 'ohelo kau la'au.

Koa-'Ohi'a montane forest occurs above approximately 1,650 m and occupies the areas of lower rainfall (100 to 190 cm) in the Laupāhoehoe unit. The canopy is an open to scattered layer of 35-m tall koa above 25-m tall 'ohi'a. The taller trees are most prevalent along ridges. Open areas and swales are dominated by patches of 1- to 2-m tall ʻakala (*Rubus Hawaiʻiensis*). The understory tree layer is similar to the Koa-ʼOhiʻa wet forest without the presence of hapuʻu (*Cibotium glaucum*). Common species include olomea, mehame, ʻolapa, and pilo with no single species being dominant. Other species found in the understory include *Cheirodendron trigynum*, *Coprosma* spp., *Ehrharta stipoides*, *Hedyotis terminalis*, *Holcus lanatus*, *Ilex anomala*, *Myoporum sandwicense*, *Myrsine lessertiana*, *Nothocestrum breviflorum*, *Pelea* spp., *Pittosporum* spp., *Ranunculus Hawaiʻiensis*, *Sophora chrysophylla*, *Leptechophylla tameiameiae*, and ʻohelo (*Vaccinium* sp.). Patches of non-native species occur and include banana poka (*Passiflora mollissima*), non-native pasture grass, and herb species, as well as a prominent stand of tropical ash (*Fraxinus uhdei*).

There are five major vegetation cover types within the PWETF: ʻOhiʻa Subalpine Forest, ʻOhiʻa Montane Dry Woodlands, Koa-ʼOhiʻa Montane Mesic Forest, Lowland Dry Forest, and Coastal. Montane Dry Woodlands dominate the eastern side of Puʻu Waʻawaʻa, while moister Montane Mesic Forests occur on the western side. Native shrublands and open grasslands/pasture cover the majority of the area (USDA, 2007).

The Relocatable Sites at Puʻu Waʻawaʻa are located within the Koa-ʼOhiʻa Montane Mesic Forest in the State Wildlife Sanctuary (Forest Bird Sanctuary). Within 2.5 km of the proposed Relocatable Sites are areas of subalpine forest and shrublands, montane dry forest, and open canopied ʼohiʻa-mamane woodlands.

Ohiʻa Subalpine Forest occurs above 1,829-m elevation on Hualalai. The conditions are dry and temperatures fluctuate greatly over the day, with temperatures often falling below freezing at night. The subalpine forest at Puʻu Waʻawaʻa is composed of open, low stature ʼohiʻa trees and scattered stands of native shrubs and grasses. Dominant understory species include pukiawe (*Leptechophylla tameiameiae*), ʻohelo (*Vaccinium calycinum* and *V. reticulatum*), ʻaʻaliʻi (*Dodonaea viscosa*), sedges, and rushes. Native mints (*Stenogyne* spp.), lilies (*Astelia menziesiana*), and ferns occur in shaded areas such as lava tube openings (Giffin, 2003).

Montane forests at Puʻu Waʻawaʻa are located from elevations between 762 and 1,829 m and are divided into dry and mesic montane forest. ʻOhiʻa montane dry forest occurs below the subalpine forest, on the east side of the Puʻu Waʻawaʻa Unit. Vegetation damage by feral ungulates, particularly goats and sheep, is widespread throughout the montane zone, and the dry forest understories have been largely replaced by invasive plant species such as fountain grass (*Pennisetum setaceum*) and kikuyu grass (*Pennisetum clandestinum*) (Giffin, 2003). The dry montane forest is composed primarily of ʼohiʻa, naio (*Myoporum sandwicense*), and *Dodonaea viscosa*. Scattered stands of mamane (*Sophora chrysophylla*), sandalwood (*Santalum paniculatum*), and ʻakoko (*Chamaesyce* sp.) are also present in the dry montane forests at Puʻu Waʻawaʻa.

Koa-ʼOhiʻa montane mesic forest occurs on the western side of Puʻu Waʻawaʻa in the montane forest zone. This forest type has a high diversity of plant species, and is best developed in the State Wildlife (Forest Bird) Sanctuary. The two Relocatable Sites (R-39 and R-40) are within this forest type. Koa and ʼohiʻa are the dominant tree species in the overstory, kolea (*Myrsine lessertiana*) dominates the mid-story, and native short-stature trees and shrubs occur in the understory. Invasive grasses such as kikuyu (*Pennisetum clandestinum*) and native ferns such as the shuttlecock-shaped laukahi (*Dryopteris* spp.) make up the ground layer in forest gaps. Ferns such as hoʻiʻo (*Athyrium sandwichianum*),

ʻakolea (*Athyrium microphyllum*), and palapalai (*Microlepia setosa*) occur in wetter shaded areas within the mesic montane forest. Tree ferns (hapuʻu; *Cibotium glaucum*) are scattered throughout the forest, but do not make up a distinctive canopy layer.

At about 1,280-m elevation, the montane mesic forest at Puʻu Waʻawaʻa transitions from a Koa-ʻOhiʻa dominated forest to an open canopied ʻohiʻa-mamane woodland. The ʻohiʻa-mamane woodland descends to about 914-m elevation and connects the montane mesic forests to the lowland dry forests. The ʻohiʻa-mamane woodland is biologically diverse and many rare and unique plants occur there. Tree species in the ʻohiʻa-mamane woodland include koa, ʻakoko (*Chamaesyce* sp.), ʻiliahi (*Santalum paniculatum*), kopiko (*Psychotria Hawaiʻiensis*), papala (*Charpentiera obovata*), papala kepau (*Pisonia brunoniana*), poʻola (*Claoxylon sandwicense*), aʻiaʻi (*Streblus pendulinus*), olopua (*Nestegis sandwicensis*), and hoʻawa (*Pittosporum hosmeri*). The understory is dominated by non-native pasture grasses, with scattered patches of kuluʻi (*Nototrichium sandwicense*), mint (*Stenogyne rugosa*), and ferns (*Dryopteris, Pteris, Asplenium*).

Lowland dry forest occurs below montane forest, beginning at about 914-m elevation. Although they have been greatly disturbed by fire and feral ungulates over the past years, dry forests are among the most diverse in Hawaiʻi, with many rare and endangered species (USDA, 2007). Dominant tree species include lama (*Diospyros sandwicensis*) and ʻohiʻa. Trees such as alaheʻe (*Psydrax odoratum*), wiliwili (*Erythrina sandwicensis*), ʻohe makai (*Reynoldsia sandwicensis*), and kauila (*Colubrina oppositifolia*) also occur in the dry forest.

#### *Environmental Consequences*

There would be no impacts to vegetation from placement of the concrete casing for utility lines beneath the road. The road would be trenched to place the lines and then restored to predisturbance conditions. There would be no vegetation impacts from extending utility lines from the road to the IH through surface conduits. Limited clearing of common vegetation would result during construction of the boardwalk from the edge of the road to C-58.

Minor clearing of vegetation would occur during construction to prepare for the tower pad, two small Relocatable Site pads, fencing, and IHs. Vegetation in areas cleared for the tower pad, two Relocatable Site pads, fencing, and IHs would be lost for the duration of the NEON project, up to 5 years at Relocatable Sites and 30 years at the Core Site. Natural revegetation would be enhanced by using propagules of native species collected from within 2.5 km of the proposed NEON infrastructure. Active weed control efforts would be undertaken by NEON, Inc. until the native vegetation becomes established. Any weed control efforts would be coordinated with DLNR-DOFAW.

Non-native species are a major source of habitat degradation and the subsequent decline of native species throughout the Hawaiʻian Islands. Appropriate BMPs would be used to minimize the potential for transport of non-native species during construction, maintenance, and data gathering. BMPs that would be implemented could include inspection and offsite washing of vehicles, research equipment, shoes, and clothing; prohibition of the use of fill material known to contain non-native species; and the prompt eradication of new introductions identified by NEON, Inc. In addition to initial prevention measures, scientists and technicians would note whether non-native species begin to encroach along access routes or at tower locations during the life of NEON projects (up to 5 years at Relocatable Sites and 30 years at the Core Site). Any new occurrences of non-native species would be promptly controlled using accepted measures.

### *Common Fauna*

### *Affected Environment*

Hawai'i is known for its endemic bird, snail, and insect species. However, there is little information available on the invertebrate communities at the LETF. A survey of the Laupāhoehoe Natural Area Reserve (LNAR) was conducted in 1988 by the State Department of Land and Natural Resources (DLNR) (DLNR, 2007). Native invertebrates, including several guilds of insects, spiders, and snails, have been observed in the LETF, but a list of species has not been compiled. Arthropod collections taken from 'ohi'a trees within the LETF between 1996 and 2001 suggest that diversity is high, with at least 20 spider species and 188 insect species (Gruner, 2004). It should be noted that this survey was restricted to 'ohi'a trees and largely ignored some large arthropod groups, such as Lepidoptera (moths and butterflies).

Native birds at LEFT include five honeycreepers ('akiapola'au [*Hemignathus munroi*], 'amakihi [*Hemignathus virens*], 'apapane [*Himatione sanguinea*], 'i'iwi [*Vestiaria coccinea*], and Hawai'i creeper [*Oreomystis mana*]); one monarchine flycatcher ('elepaio [*Chasiempis sandwichensis sandwichensis*]); one Hawai'ian solitaire (Hawai'i thrush or 'oma'o [*Myadestes obscurus*]), two raptors ('io or Hawai'ian hawk [*Buteo solitarius*], and pueo [Hawai'ian short-eared owl, *Asio flammeus sandwichensis*]); and a duck (Hawai'ian duck, Koloa Maoli [*Anas wyvilliana*]). While not protected on the island of Hawai'i, the pueo is protected on O'ahu and is a species of significant concern. The 'io or Hawai'ian hawk and Hawai'i creeper are federally endangered species and are further discussed in the Sensitive Species section. There are at least 12 species of non-native birds found at the LETF, including gamebirds such as pheasants and turkeys, and introduced passerines that are common throughout the islands such as Japanese white-eye (*Zosterops japonicus*), house finch (*Carpodacus mexicanus*), northern cardinal (*Cardinalis cardinalis*), Hwamei (*Garrulax canorus*), and red-billed leiothrix (*Leiothrix lutea*) (USDA, 2007).

In the past, PWETF had a rich land snail fauna, with more than 30 species in nine families collected there. The majority of these land snail taxa are now extinct, and native land snails still extant at Pu'u Wa'awa'a occur mainly in upper elevations, primarily in the forest bird sanctuary (Giffin, 2003).

Native arthropod diversity at PWETF is high, with the greatest diversity seen in the Lepidoptera, followed by Heteroptera and Coleoptera (Giffin, 2003). Some of the more showy species include giant dragonflies (*Anax strenuus*), Kamehameha butterflies (*Vanessa tameamea*), hawk moths (*Hyles* and *Manudca* spp.), koa bugs (*Coleotichus blackburniae*), long-horned beetles (*Plagithmysus* spp.), lacewings (*Anomalochrysa* spp.), and predatory Ichneumonid wasps. Most have limited distributions, secretive habits, or are rare (Giffin, 2003). Common species include the damsel bugs (Nabidae), mirid leaf bugs (Miridae), Lygaeid seed bugs (Lygaeidae), planthoppers (Cixiidae and Delphacidae), leafhoppers (Cicadellidae), and spiders (Aranae) (Giffin, 2003).

Native birds currently found at PWETF include five honeycreepers ('amakihi [*Hemignathus virens*], 'apapane [*Himatione sanguinea*], 'i'iwi [*Vestiaria coccinea*], Hawai'i

ʻakepa [*Loxops coccineus*], and Hawaiʻi creeper [*Oreomystis mana*]); one monarchine flycatcher (ʻelepaio [*Chasiempis sandwichensis sandwichensis*]); two raptors (ʻio or Hawaiʻian hawk [*Buteo solitarius*], and pueo [*Asio flammeus sandwichensis*]); and a goose (nene [*Branta sandvicensis*]). The Hawaiʻian ʻakepa, Hawaiʻi creeper, ʻio or Hawaiʻian hawk, and nene are federally endangered species and are further discussed in the Sensitive Species section. There are 38 species of non-native birds at PWETF, including gamebirds such as francolins, pheasants and quails, and introduced passerines that are common throughout the islands. The most abundant non-native species in the forest bird sanctuary are Japanese white-eye (*Zosterops japonicus*), house finch (*Carpodacus mexicanus*), northern cardinal (*Cardinalis cardinalis*) and red-billed leiothrix (*Leiothrix lutea*) (Giffin, 2003).

The federally endangered ʻopeʻapeʻa or Hawaiʻian hoary bat (*Lasiurus cinereus semotus*) is Hawaiʻi's only native land mammal. Habitat needs and distribution of the bat are discussed below. The Hawaiʻian hoary bat has been detected in the LETF between 760- and 950-m elevation and at Puʻu Waʻawaʻa between 931- and 1,402-m elevation, in the Forest Bird Sanctuary (Giffin, 2003). The Hawaiʻian hoary bat is also federally endangered and is further discussed in the Sensitive Species section. The bat could occur at or adjacent to proposed locations in the LETF and the PWETF.

### *Environmental Consequences*

During construction activities, there would be the potential to disturb and displace wildlife. However, construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day. No large equipment would be used during construction. All of the proposed construction sites are surrounded by similar habitat and it is expected that any common wildlife species disturbed by construction activity would relocate a short distance to suitable habitat nearby during construction. Upon completion of construction, any displaced animals would likely return to their former use patterns.

Any construction near nesting, breeding, or rearing areas would be timed to avoid sensitive periods to the extent practicable. No disruption of wildlife breeding would be expected.

The tower and guy wires would be a potential collision risk for birds. Guy wires would be equipped with daytime visual markers or bird flight diverters to minimize the risk of collision by common bird species. Petrels are known to breed on the island and could collide with guy wires and the tower at night. Any impacts would likely be negligible from a population standpoint. This potential risk would be removed at site closure.

There would be a long-term loss of habitat at the tower and IHs. The area of lost habitat would be negligible relative to the total habitat available in the proposed project areas. Overall impacts to wildlife would likely be negligible.

Fencing around the tower would prevent large terrestrial wildlife from entering the immediate tower area. The fenced areas would be small and no impact to wildlife populations would be expected.

Scientists accessing the site and research activities have the potential to disturb nearby sensitive animal species. Any impacts would be minor and temporary. These intermittent disturbances would continue for the duration of the NEON project.

Wildlife species react to fixed-wing aircraft overflights, with the type and magnitude of response varying among species and with the specific conditions of the overflight. The response is thought to be a result of both visual and auditory stimuli (Ward, 1984). Because flights would be conducted under full canopy conditions, visual stimuli would be minimal and the closed canopy could reduce airplane noise. Animals may startle at the noise of the plane, but no energy-consuming flight response would be expected due to the lack of visual stimuli and the relatively low volume and constant nature of the noise. The response would likely be greater for flights that are proposed at 150 m above the canopy, but impacts would still likely be negligible due to the closed canopy screening the wildlife from the flight. Any impacts from additional overflights at either 1,000 m or 150 m for the AOP would likely be negligible.

### *Sensitive Ecological Communities*

### *Affected Environment*

Critical habitat has been designated for eight plant species in the LETF and proposed Core Site tower would be within designated critical habitat for eight species. These include *Clermontia lindseyana, Clermontia peleana, Clermontia pyrularia, Cyanea platyphylla, Cyrtandra giffardii, Cyrtandra tintinnabula, Phyllostegia racemosa*, and *Phyllostegia warshaueri*. Four species may occur within 2.5 km of the proposed Core Site (C-58), and the other four may occur within 5 km of these sites. Habitat descriptions are provided below. There is no designated critical habitat for wildlife species within the LETF.

Critical habitat has been designated for 12 plant species in the PWETF, 9 of which are within 5 km of proposed Relocatable Sites (R-39 and R-40). These nine species include *Argyroxiphium kauense, Colubrina oppositifolia, Delissea undulata* ssp. *undulata, Hibiscadelphus hualalaiensis, Kokia drynarioides, Neraudia ovata, Northocestrum brevifolium, Solanum incompletum*, and *Zanthoxylum dipetalum* var. *tomentosum*. Of the species with critical habitat within 5 km of the Relocatable Sites, two (*Argyroxiphium kauense* and *Neraudia ovata*) are not known to occur within PWETF and these two species are not further discussed. The Relocatable Sites would be within designated critical habitat for one animal species, the Blackburn hawk moth (*Manduca blackburni*). Habitat descriptions are provided below.

### *Environmental Consequences*

Any impacts to sensitive habitats would likely be negligible. Critical habitat for federally protected species occurs at both the LETF and PWETF. Prior to any habitat disturbance or construction in designated critical habitat, consultation with USFWS would be necessary to receive authorization for modification or alteration of designated critical habitat. NEON, Inc. would implement any RPMs or other mitigation actions specified through the consultation process prior to or concurrent with construction. Any RPMs or other mitigation specified for operation of the NEON projects would be implemented by NEON, Inc., as appropriate throughout the duration of the NEON experiments.

Further, NEON, Inc. would work with USFWS, DLNR-DOFAW, and property site managers to minimize temporary disturbance of sensitive habitat. Specific resources, such as obligate host plants for sensitive invertebrate species, would be avoided in construction of NEON infrastructure. Appropriate BMPs, as discussed in Section 2.2.2, would be implemented to further minimize disturbance of sensitive habitats. Disturbed areas would be promptly revegetated with native species. Any impacts would be temporary and, with implementation of RPMs and other mitigation measures, would be unlikely to affect the long-term viability of these sensitive habitats.

### *Sensitive Species*

### *Affected Environment*

Review of available data indicates that there are no known occurrences of protected species at or adjacent to the proposed NEON locations in Domain 20 (Table 3.5.20.3-2). However, there are known occurrences of federal and state protected species within 5 km of all the proposed NEON locations. In addition, potentially suitable habitat for protected species is present at or adjacent to all of the proposed NEON locations (Table 3.5.20.3-2).

**TABLE 3.5.20.3-2**
Protected Species Known to Occur at or Near Proposed NEON Infrastructure—Domain 20, Pacific Neotropical
*National Ecological Observatory Network (NEON) EA*

| | Number of Federal Protected Species Potentially Occurring | | | Number of State Protected Species Potentially Occurring | | |
|---|---|---|---|---|---|---|
| **NEON Facility Number** | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower | Within 5 km of Proposed Tower | At or adjacent to Proposed Tower | Potentially Suitable habitat occurs at or adjacent to Proposed Tower |
| C-58 | 7-ESA | 0 | 22-ESA | 1 | 0 | 9 |
| R-39 | 23-ESA | 0 | 33-ESA | 14 | 0 | 24 |
| R-40 | 23-ESA | 0 | 33-ESA | 14 | 0 | 24 |

Source: Appendix B Domain 20

All sensitive species identified as having potential to occur on or near the LETF and PWETF are identified in Table Domain 20 (Appendix B), along with their legal status and preferred habitat types. The following discussion is limited to those species which may occur in or near the proposed project locations. There are no additional state-protected species beyond those identified as federally listed.

### State and Federally Protected Species

### *Laupāhoehoe Experimental Tropical Forest*

### *Vegetation*

*Clermontia lindseyana* (`oha wai) is a federally endangered terrestrial shrub that grows to 6 m (Wagner et al., 1990). It occurs in wet and moist forests at 1,220- to 1,825-m elevation. The only known populations occur on the slopes of Haleakala on Maui and the slopes of Mauna Loa and Mauna Kea on Hawai'i. Currently there are only 10 known occurrences. Although the total number of individuals is not known, it is believed that there are fewer than 1,000 plants, possibly as few as 200 to 250 individuals (NatureServe, 2008). Critical habitat for *Clermontia lindseyana* has been designated within 5 km of the proposed location of C-60.

The federally endangered *Clermontia peleana* (`oha wai or Pele Clermontia), is an epiphytic shrub or tree that grows on koa, 'ohi'a, 'olapa, and ama'u (Wagner et al., 1990). This species is distinguished from other *Clermontia* by its epiphytic growth habit. Historically, *Clermontia peleana* has been found only on Mauna Loa and Mauna Kea on the island of Hawaiʻi. It occurs in montane wet forests between 530- and 1,160-m elevations. This species has only six known populations consisting of eight total individuals. The known distribution extends over a distance of about 19.3 km to 8 km near Waiakaumalo Stream, by the Wailuku River, near Saddle Road, and between the towns of Glenwood and Volcano (DLNR, 2006a). It is unknown whether any individuals occur at or adjacent to the proposed Core Site tower locations, but the Core Site is within designated critical habitat for this species.

*Clermontia pyrularia* (`oha wai) is a tree that grows to 4 m and is endemic to the island of Hawaiʻi (Wagner et al., 1990). *Clermontia pyrularia* is listed as federally endangered. Historically, *Clermontia pyrularia* occurred only on Mauna Loa, Mauna Kea, and the saddle area between the two mountains. It typically occurs in montane wet forests and subalpine dry forests on old lava flows and old cinder cones between 910- and 2,130-m elevations. Currently this species is only known from one wild population and two outplanted populations in the LETF and Hakalau Forest NWR (DLNR, 2006b). The known locations are not at the proposed NEON sites.

*Cyanea platyphylla* (haha) is an unbranched palm-like shrub that grows to 3 m (Wagner et al., 1990). *Cyanea platyphylla* is listed as federally endangered and is endemic to the island of Hawaiʻi. *Cyanea platyphylla* typically occurs in Koa-ʻOhiʻa dominated lowland and montane wet forests on volcanic slopes and gulch sides. There are 6 known populations totaling fewer than 100 plants. The two populations known from the LETF were last confirmed in 1982 and the current status of these populations is unknown (DLNR, 2006c). It is unknown whether any individuals occur at or adjacent to the proposed Laupāhoehoe unit NEON location, but designated critical habitat for this species occurs within 5 km of the proposed Core Site.

The federally endangered *Cyrtandra giffardii* (Giffard's cyrtandra) is a shrubby tree that grows to 6 m (Wagner et al., 1990). It is endemic to the Hawaiʻian islands and has been previously observed in Koa-'Ohiʻa Lowland Wet Forest habitat (USDA, 2007). This species is known from only three collections between 940- and 1,500-m elevations at Kilauea, Kulani, and Laupāhoehoe (Wagner et al., 1990). There are approximately 245 individuals within the LETF (USFWS, 2003). It is unknown whether any individuals occur at or adjacent to the proposed Core Site, but the proposed Core Site is within the designated critical habitat for this species.

*Cyrtandra tintinnabula* is a shrub that grows to 3 m and is endemic to the eastern slope of Mauna Kea (Wagner et al., 1990). *Cyrtandra tintinnabula* is listed as federally endangered and occurs in the Koa-'Ohiʻa Lowland Wet Forest and the Koa-'Ohiʻa Montane Wet Forest at 730- to 1,040-m elevations. It is known to occur in only three places within the LETF and the Hilo Forest Reserve and fewer than 20 plants are known (USFWS, 2003). It is unknown whether any individuals occur at or adjacent to the proposed Core Site, but the proposed Core Site is within the designated critical habitat for this species.

*Gardenia remyi* (Remy's gardenia) is a candidate for listing under the ESA. This species is a tree in the Madder family (Rubiaceae) that prefers moist and wet forests on ridges and gulch slopes (NatureServe, 2009b). Known threats include pigs, goats, deer, and alien plants (NatureServe, 2009b). It is unknown whether any individuals occur at or adjacent to the proposed Relocatable Sites.

*Huperzia mannii*, or wawaeʻiole, is a federally endangered pendant epiphyte endemic to the Hawaiʻian Islands. This member of the club moss family typically grows on plants such as koa or ʼohiʻa. It occurs in the Koa-ʻOhiʻa Montane Wet Forest and Ohiʻa- hapuʻu Montane Wet Forest from 900- to 1,600-m elevations. Currently this species has only six known populations consisting of 35 individuals. On the island of Hawaiʻi this species occurs in the LETF (DLNR, 2006d). It is unknown whether any individuals occur at or adjacent to proposed NEON Core Site.

The federally endangered *Phyllostegia racemosa* (kiponapona) is a climbing vine that is a member of the mint family. It occurs in mesic to wet forests at 700 to 1,650 m on the eastern slopes on Mauna Kea and Mauna Loa (Wagner et al., 1990). Currently there are four known populations, with a total of less than 50 plants (DLNR, 2006e). None of the four known populations is at or adjacent to the proposed Core Site.

*Phyllostegia warshaueri* (Laupāhoehoe phyllostegia) is a climbing or ground growing liana that usually reaches 3 m in length (Wagner et al., 1990). *Phyllostegia warshaueri* is a federally endangered species. It has been collected in the LETF and from the Kohala Ditch trail in the wet forests between 720 and 1,150 m elevation (Wagner et al., 1990). It occurs in Ohiʻa- hapuʻu Montane Wet Forest. There are only two known occurrences, both in the Kohala Mountains, with fewer than 20 plants total (DLNR, 2006f). It is unknown whether any individuals occur at or adjacent to the proposed Relocatable Sites, but proposed tower C-58 would be within the designated critical habitat for this species.

*Platydesma remyi*, or Hawaiʻi pilo kea, is a candidate for listing under the ESA and occurs in the same habitat as ʻoha. It is unknown whether any individuals of this species occur at or adjacent to the proposed Relocatable Sites.

#### *Wildlife*

Listed endangered wildlife species that occur or may occur at the LETF include one mammal, and six bird species; however, it is likely that two listed picture wing fly species occur at Hakalau and the nearby the LETF (Table 3.5.20.3-2). The two species are picture-wing flies: the endangered *Drosophila heteroneura* and the threatened *Drosophila mulli* (Howarth et al., 2003).

The federally endangered Hawaiʻian hoary bat [ʻopeʻapeʻa (*Lasiurus cinereus semotus*)] once occurred on all the main Hawaiʻian Islands, but now is thought to be limited to Hawaiʻi, Kauaʻi, and Maui. It is the only land mammal native to Hawaiʻi. ʻOpeʻapeʻa have been observed from sea level to 4,115 m on Hawaiʻi, and use a variety of both native and non-native vegetation types (DLNR, 2005a; Frasher et al., 2007). While ʻOpeʻapeʻa typically roost alone in foliage, it has also been observed in lava tubes, man-made structures, and rock crevices (Frasher et al., 2007). ʻOpeʻapeʻa migrate and their densities in high elevation areas are thought to be highest during December through March (Menard, 2001; Menard, 2008). ʻOpeʻapeʻa have been detected in the LNAR between 760 - 950 m using echolocation (Gorresen et al., 2008), and the species is likely to occur in both Koa-ʼOhiʻa lowland wet forest (up to 914 m) and Koa-ʼOhiʻa montane wet forest (above 914 m). It is unknown whether this species occurs at or adjacent to proposed NEON locations; however, suitable habitat is present. Therefore, this species could occur at or adjacent to proposed NEON locations.

ʻIo (*Buteo solitarius*) are territorial, monogamous raptors that feed on birds, mammals, insects, and spiders (Scott et al., 1986). They occur from sea level to approximately 2,600 m on the island of Hawaiʻi and are known to utilize a broad range of forest habitats while avoiding cleared areas. The species is most abundant in native forests (Klavitter et al., 2003). Surveys indicate that ʻio populations are stable, and the species may be a candidate for down-listing or removal from Endangered Species Act protection (Klavitter et al., 2003). It is unknown whether this species occurs at or adjacent to proposed NEON locations; however, suitable habitat is present. Therefore, this species could occur at or adjacent to proposed NEON locations.

Hawaiʻi ʻakepa (*Loxops coccineus coccineus*) are small insectivorous birds that feed mainly on ʼohiʻa and koa leaves and seed pods, where they use their bill to pry open leaf and flower buds in search of small arthropods (DLNR, 2005c). Hawaiʻi ʻakepa often forage in mixed-species flocks, particularly those with Hawaiʻi creepers (*Oreomystis mana*) (DLNR, 2005c). ʻAkepa are obligate cavity nesters, with most nests placed in cavities in old-growth ʼohiʻa and koa trees (DLNR, 2005c). Hawaiʻi ʻakepa populations occur on the upper slopes of Mauna Kea, Mauna Loa, and Hualalai (Giffin 2003). At the LETF, high quality ʻakepa habitat exists in the upper elevations (DLNR, 2005c). It is unknown whether this species occurs at or adjacent to proposed NEON locations; however, suitable habitat is present. Therefore, this species could occur at or adjacent to proposed NEON locations.

Hawaiʻi creeper (*Oreomystis mana*) are small, inconspicuous, insectivores that glean insects, spiders, and other invertebrates from the trunks, branches, and leaves of ʼohiʻa and koa trees (DLNR, 2005d). They often join mixed-species flocks in the non-breeding season. Hawaiʻi creeper occur most commonly in mesic and wet forests above 1,493 m that are dominated by ʼohiʻa and koa, with a subcanopy of ʻolapa (*Cheirodendron trigynum*), pukiawe (*Leptechophylla tameiameiae*), ʻohelo (Vaccinium spp.), ʻakala (*Rubus Hawaiʻiensis*), kolea (*Myrsine* spp.), kawaʻu (*Ilex anomala*), and hapuʻu tree ferns (*Cibotium* spp.) (Scott et al., 1986; DLNR, 2005c). Habitat conditions vary across the species' range, with much of the habitat degraded by ungulates, especially feral pigs (*Sus scrofa*). Hawaiʻi creeper occur on all major Hawaiʻi Island volcanoes except Kohala Mountain. It has been found at the LETF in the past and could occur at the proposed tower locations. It is unknown whether this species occurs at or adjacent to proposed NEON locations; however, suitable habitat is present. Therefore, the species could occur at or adjacent to proposed NEON locations.

The federally threatened Hawaiʻian shearwater (*Puffinus newelli*) breeds at elevations of 160 to 1,200 m and small colonies possibly exist on Oʼahu in the Hawaiʻian islands (Birdlife International, 2009). It is unknown if individuals occur at or adjacent to the proposed Relocatable Sites, but suitable nesting habitat is present. Therefore the species could occur at or adjacent to proposed NEON locations while traveling from nesting areas to the sea.

Petrel species are considered extirpated from the LETF (Giffin, 2009). However, the dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*) is known to breed on the island historically (The Birds of North America, 2009). It is unknown if individuals occur at or adjacent to the proposed Core Site, but suitable habitat is present and the species could occur at or adjacent to proposed NEON locations while traveling from nesting areas to the sea.

The endangered picture-wing pomace fly (*Drosophila heteroneura*) occurs in mesic to wet forest on the island of Hawaiʻi. The primary host plants for this species are *Clermontia*, *Cheirodendron*, and *Delissea undulata* (USFWS, 2006a, 2006b). Two of the host plant genera, *Clermontia* and *Cheirodendron,* occur at the LETF. It is unknown whether any potential host plants occur within 5 km of the proposed NEON locations.

*Drosophila mulli* is a federally threatened picture wing fly with no common name that occurs in montane wet forest, primarily on *Pritchardia beccariana* trees between 985 and 1,220 m elevation. Very few individuals have been observed, with most of the sightings occurring at Olaa Forest Reserve at approximately 985-m elevation and Upper Waiakea Reserve at approximately 1,219 m elevation (USFWS, 2006b). It is unknown whether any potential host plants occur within 5 km of the proposed NEON locations.

Another picture-wing fly with no common name (*Drosophila digressa*) is a candidate species endemic to the island of Hawaiʻi. It feeds only upon species of *Charpentiera*, and was originally known from five populations and may now be limited to as few as one or two sites (USFWS, 2007). Little information is available on this species. It is unknown whether any potential host plants occur within 5 km of the proposed NEON locations.

### *Pu'u Wa'awa'a Experimental Tropical Forest*

### *Vegetation*

Botanical records for PWETF date to 1909 (Giffin, 2003). Puʻu Waʻawaʻa forests were considered among the most biologically diverse in the Hawaiʻian Islands (Giffin, 2003). Although the Puʻu Waʻawaʻa forests have been greatly disturbed over the last 100 years by livestock grazing, tree clearing for pasture improvement, harvest of koa and other native trees, introduction of non-native plants and animals, and wildfires, significant remnants of the native communities remain, and there are a large number of protected species, several of which occur nowhere else in the Hawaiʻian Islands (Giffin, 2003).

The federally endangered *Asplenium fragile* (diamond spleenwort) is a fern found in scattered populations on Hawaiʻi Island between 1,600 and 2,380 m elevation, including Hawaiʻi Volcanoes National Park, Hilo, Puʻu Hualalai, Puʻu Waʻawaʻa, 1823 lava flow, Hualalai summit, Keauhou Ranch, Puʻu Huluhulu, Kapapala Forest Reserve, and Puʻu Moana and Pohakuloa Training Area (Shaw, 1997; USFWS, 1998). The species was previously found on Mauna Kea as high as 2,926 m (Hartt and Neal, 1940) and it occurs at Puʻu Waʻawaʻa within the montane dry forest. It is unknown whether this species occurs at or adjacent to the proposed Relocatable Sites.

*Colubrina oppositifolia* (kauila) is a federally endangered tree reaching 13 m that occurs in dry to mesic forest, 240-920 m elevation in leeward Hawaiʻi and in the Waiʻanae Mountains, Oʻahu. It has a very hard wood that was used in the place of metals by ancient Hawaiʻians (Wagner et al., 1990). Critical habitat for *Colubrina oppositifolia* has been designated at Puʻu Waʻawaʻa between 396 and 762 m elevation, and contains several hundred individuals (USFWS, 2003). A portion of the critical habitat designated for this species is within 5 km of proposed Relocatable Site R-39. It is considered unlikely that individuals will occur in the immediate vicinity of the Relocatable Sites, but it is unknown whether this species occurs at or adjacent to the proposed Relocatable Sites.

*Cyanea stictophylla*, or haha, is a federally endangered shrub or small tree that occurs in mesic to wet forest from 1,400 – 1,950 m elevation on the Kona Coast and Kaʻu District, Hawai'i. Few individuals of this species have been observed in the wild since its discovery (Wagner et al., 1990) and less than 10 individual plants are known to exist in the wild, one of which is at Pu'u Wa'awa'a in the Forest Bird Sanctuary at 1,658 m elevation (Giffin, 2003). It is unknown if additional individuals occur at or adjacent to the proposed Relocatable Sites. Outplanting of seedlings has occurred within fenced enclosures at Pu'u Wa'awa'a and Ka'u Forest Reserve (DLNR, 2006g). It is unlikely that individuals occur in the immediate vicinity of the Relocatable Sites.

The federally endangered *Delissea undulata* ssp. *undulata* is an unbranched palm-like Hawai'ian lobelioid that can reach up to 10 m tall (Wagner et al., 1990). *Delissea undulata* ssp. *undulata* formerly occurred on Mauna Loa and on Hualalai at Pu'u Wa'awa'a cone (914 m elevation) and in Waihou Forest (914 - 1,067 m elevation), where they were abundant historically (Giffin, 2003). It was thought to be extinct in 1971, but a single plant was discovered in 1992 at Pu'u Wa'awa'a in the montane dry forest near Poohohoo cinder cone at 1,073 m elevation (Giffin, 2003). Fruits were collected from the plant and germinated at Lyon Arboretum and at the State Tree Nursery in Kamuela, Hawai'i. Seedlings were outplanted beginning in 1993 as part of a restoration program for this species. Two areas of critical habitat have been designated for this species at Pu'u Wa'awa'a, in lowland dry forest and montane mesic forest. The critical habitat in the mesic montane forest is within 2.5 km of the proposed Relocatable Sites. There is one individual of *Delissea undulata* ssp. *undulata* in the critical habitat at Pu'u Wa'awa'a (USFWS, 2003), but it is unknown whether this plant is at or adjacent to a proposed NEON location.

The federally endangered *Hibiscadelphus hualalaiensis*, or hau kuahiwi, is a tree reaching 7 m that formerly occurred in dry to mesic forest and lava flows of Hualalai and Waihou (Wagner et al., 1990). The last known wild tree died in Pu'u Wa'awa'a in 1992. Since then 12 cultivated trees have been planted within a fenced area in Pu'u Wa'awa'a (DLNR, 2006h). Critical habitat that extends from lowland dry forest (at approximately 610 m) into mesic montane forest (approximately 1,128 m) has been designated for *Hibiscadelphus hualalaiensis* within 5 km of the proposed Relocatable Sites at Pu'u Wa'awa'a, and contains the 12 outplanted individuals (USFWS, 2003). It is unlikely that individuals will occur at or adjacent to the proposed Relocatable Sites.

*Kokia drynarioides* (koki'o) is a federally endangered tree reaching 8 m that occurs in dry forests in leeward Hawai'i, on rough lava with thin, well drained soils from 455 – 1,915 m (Wagner et al., 1990). There are only six individuals known to exist in the wild, although an outplanting program is underway (DLNR, 2006i). Critical habitat for *Kokia drynarioides* has been designated in Pu'u Wa'awa'a within 5 km of the proposed Relocatable Sites, but it is unknown whether any individuals occur at or adjacent to the proposed NEON locations.

Federally endangered *Nothocestrum breviflorum*, or 'aiea, is a stout tree reaching 10-12 m in height in dry to mesic forests from 550 – 1,830 m elevation (Wagner et al., 1990). It has been recorded at Laupāhoehoe in Koa-'Ohi'a montane forest (USDA, 2007). It occurs primarily in the Ka'u District north to Waimea, Kohala District, and is most common at Pu'u Wa'awa'a (Wagner et al., 1990). 'Aiea is locally common on ranch pastures at about 1,067 m elevation (Giffin, 2003). Critical habitat for *Northocestrum brevifolium* has been designated between approximately 396 – 1,158 m elevation in the lower mesic montane forest and lowland dry forest at Pu'u Wa'awa'a, and is within 5 km of the proposed

Relocatable Sites. More than 165 individuals are present in the designated critical habitat (USFWS, 2003). It is unknown whether this species occurs at or adjacent to the proposed Relocatable Sites.

*Phyllostegia velutina* is a federally endangered climbing, non-aromatic vine in the mint family, found in low densities in mesic to wet forest, and from 1,460 – 1,920 m in elevation in limited distribution (Kilauea to Pu'ukipu; Na'alehu; Waipi'o, upper Hamakua ditch) on the island of Hawai'i (Wagner et al., 1990). At Pu'u Wa'awa'a they occur in the montane mesic forest and are often found in cave openings (Giffin, 2003). It is unknown whether any individuals occur at or adjacent to the proposed NEON locations.

The federally endangered *Plantago Hawai'insis*, or laukahi kuahiwi, is a perennial herb with leathery leaves found in mesic to dry shrublands between 1,800 to 1,950 m elevation on the leeward side of Hawai'i (Wagner et al., 1990). This species occurs in the subalpine zone at Pu'u Wa'awa'a near the upper boundary of the forest bird sanctuary (Giffin, 2003). It is unknown whether any individuals occur at or adjacent to the proposed NEON locations.

*Portulaca sclerocarpa*, or po'e, is a federally endangered perennial herb that occurs in dry habitats such as subalpine woodlands, bare cinders, and near steam vents, and between 1,030 – 1,630 m on Hawai'i (Wagner et al., 1990). At Pu'u Wa'awa'a it occurs on the 1859 lava flow (Giffin, 2003). It is unknown whether any individuals occur at or adjacent to the proposed Relocatable Sites.

*Sicyos macrophyllus* ('anunu) is a candidate for listing under ESA. This species is a perennial vine primarily that occurs in wet and subalpine forest at 1,200 – 2,000 m on the windward slopes of the Kohala Mountains, Mauna Kea, and the Mauna Loa-mauna Kea saddle (Wagner et al., 1990). A few individuals of this species occur at Pu'u Wa'awa'a, within the lower montane mesic forest (Giffin, 2003). It is unknown whether any individuals occur at or adjacent to the proposed NEON locations.

*Solanum incompletum*, or popolo ku mai, is a federally endangered woody shrub in the nightshade family that grows up to 3 m in height. It historically occurred in dry to mesic and subalpine forest, and from 600 – 2,020 m elevation, on Kaua'i, Moloka'i, Lanai, Maui, and Hawai'i (Wagner et al., 1990), but was thought to be extinct until recently (DLNR, 2006j). Ten individuals of *Solanum incompletum* were discovered in Pu'u Wa'awa'a in 2007, and over 200 individuals have been outplanted at Pu'u Wa'awa'a over the last several years (USFWS, 2008). Critical habitat for *Solanum incompletum* exists in the Koa-'Ohi'a montane mesic forest within 2.5 km of the proposed Relocatable Sites. It is unknown whether any individuals occur at or adjacent to the proposed NEON locations.

The federally endangered *Stenogyne angustifolia* is a vine in the mint family that formerly occurred in dry subalpine shrublands from 1,550 – 2,150 m elevation on Moloka'i, Maui, and Hawai'i, but is currently restricted to the island of Hawai'i, primarily at Pohakuloa Training Area (Wagner et al., 1990). A few individuals of this species occur at Pu'u Wa'awa'a on a'ā lava flows near the 1859 lava flow (Giffin, 2003). It is unknown whether any individuals occur at or adjacent to proposed NEON locations.

*Vicia menziesii*, or Hawai'ian vetch, is a federally endangered tree-climbing vine in the pea family that occurs only in mesic to wet forests in Keauhou-Kilauea area and at Pu'u

Waʻawaʻa (Wagner et al., 1990). Vicia was the first Hawaiʻian plant to be listed as endangered. This species was thought to be restricted to Mauna Kea and Mauna Loa until it was discovered at Puʻu Waʻawaʻa in 1985 (Giffin, 2003). A *Vicia menziesii* colony occurs in the Halepiula mauka Waimea paddock at 1,600 m elevation in a forest opening of approximately 348 $m^2$ (Giffin, 2003). It is unknown whether any individuals occur at or adjacent to proposed NEON locations.

The federally endangered *Zanthoxylum dipetalum* var. *tomentosum*, or kawaʻu, is a tree reaching 15 m in height that occurs in dry to mesic forests and lava fields at Puʻu Waʻawaʻa (Wagner et al., 1990). There are approximately 24 individuals found at Puʻu Waʻawaʻa (DLNR, 2006k). The species is dioecious (separate male and female trees) and does not grow in dense patches; therefore, reproduction is limited (Giffin, 2003). Critical habitat for *Zanthoxylum dipetalum* var. *tomentosum* has been designated in montane mesic and lowland dry forest, within 2 km of the proposed Relocatable Sites, and is currently occupied by approximately ten individuals (USFWS, 2003). It is unknown whether this species occurs at or adjacent to the proposed Relocatable Sites.

*Zanthoxylum Hawaiʻiense*, or aʻe, is a federally endangered small to medium sized tree that occurs in dry forest and occasionally in mesic forest on lava flows, from 550 – 1,740 m on Molokaʻi, Lanai, Maui, and Hawaiʻi (Wagner et al., 1990). A small number of *Zanthoxylum Hawaiʻiense* trees occur on aʻa lava flows in the montane dry forest zone at Puʻu Waʻawaʻa (Giffin, 2003). It is unknown whether any individuals are at or adjacent to the proposed Relocatable Sites.

#### *Wildlife*

Puʻu Waʻawaʻa provides habitat for nine federally listed threatened and endangered animal species, including one mammal, six birds, and two insects (Table 3.5.20.3-2).

Small numbers of Hawaiʻian hoary bats (up to 3 individuals) are commonly observed at PWETF, particularly in the Forest Bird Sanctuary (Giffin, 2003). This species can occur at Puʻu Waʻawaʻa almost any time of year, but are most commonly encountered in August (Giffin, 2003). It is unknown if individuals of this species occur at or adjacent to the Relocatable Sites, but suitable habitat is present. Therefore, this species could occur at or adjacent to the proposed Relocatable Sites.

ʻIo (*Buteo solitarius*) is relatively common at PWETF within in the Forest Bird Sanctuary and adjacent pasturelands (Giffin, 2003). The best ʻio breeding habitat at Puʻu Waʻawaʻa is restricted to a narrow band of dry montane forest near the lower boundary of the Forest Bird Sanctuary, from 957 – 1,402 m elevation, where nests have been observed in kolea, ʼohiʻa, and koa trees (Giffin, 2003). It is unknown if individuals of this species occur at or adjacent to the proposed Relocatable Sites (R-39, R-40), but suitable habitat is present. Therefore, this species could occur at or adjacent to the proposed Relocatable Sites.

The nene (*Branta sandvicensis*) is the only remaining species of goose in the Hawaiʻian Islands from the seven or more species that existed prior to the arrival of Polynesians (Olson and James, 1982). Nene historically inhabited grasslands, grassy shrublands, and dryland forest, from sea level to the subalpine and alpine zones and likely inhabited high-elevation sites during the non-breeding season (USFWS, 2004). Nene feed on leaves, buds, flowers and seeds of grasses and herbs, and the fruits of ʻohelo (*Vaccinium* *reticulatum*), ʻaiakenene (*Coprosma ernodeoides*), and other plants (Scott et al., 1986). Nene populations are small and may suffer from inbreeding depression; they are sustained by a captive breeding program (USFWS, 2004). Their present distribution reflects locations of release sites of captive-bred birds (USFWS, 2004). On the island of Hawaiʻi, nene occur from sea level to 2,400 m, with population centers at PWETF area including Pua Lani and Puʻu Anahulu (USFWS, 2004). At PWETF, nene nests are confined to the Puʻu Anahulu ridge and homesteads area, from 487 to 701 m in elevation, but birds have been observed up to 975 m (Giffin, 2003). In 1991, 46 nene were counted at Puʻu Waʻawaʻa Ranch. The most important habitat feature for nene at Puʻu Waʻawaʻa is a freshwater reservoir situated at 931 m elevation near the ranch headquarters. Nene in the area fly to the reservoir in the morning and evening to drink water and graze along the shore. Because of the forested conditions, nene are unlikely to occur at the proposed Relocatable Sites, but they may be encountered along access routes.

The greatest concentration of Hawaiʻi ʻakepa (*Loxops coccineus coccineus*) in Kona is centered on the northern side of Hualalai with the majority of birds occurring in the Koa-ʻOhiʻa forest at Puʻu Waʻawaʻa, within the Forest Bird Sanctuary between 1,402 and 1,706 m (Scott et al., 1986; Giffin, 2003). Habitat requirements include old growth Koa-ʻOhiʻa forests with ground ferns and other native vegetation (Giffin, 2003). It is unknown if individuals of this species occur at or adjacent to the proposed Relocatable Sites, but suitable habitat is present. Therefore, the species could occur at or adjacent to the proposed Relocatable Sites.

Most (94%) Hawaiʻi creeper (*Oreomystis mana*) within PWETF occur between 1,493 – 1,767 m, although birds have been observed between 1,219 – 1,920 m (Giffin, 2003). The habitat for this species was described above. It is unknown if individuals of this species occur at or adjacent to the proposed Relocatable Sites, but suitable habitat is present. Therefore, the species could occur at or adjacent to the proposed Relocatable Sites.

The federally threatened Hawaiʻian shearwater (*Puffinus newelli*) breeds at elevations of 160 to 1,200 m and small colonies may exist on O'ahu (Birdlife International, 2009). It is unknown if individuals occur at or adjacent to the proposed Relocatable Sites, but suitable nesting habitat is present. Therefore, the species could occur at or adjacent to proposed NEON locations while traveling from nesting areas to the sea.

Petrel species are considered extirpated from PWETF (Giffin, 2009). However, the dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*) is known to breed on the island historically (The Birds of North America, 2009). It is unknown if individuals occur at or adjacent to the proposed Relocatable Sites, but suitable nesting habitat is present. Therefore, the species could occur at or adjacent to proposed NEON locations while traveling from nesting areas to the sea.

The picture-wing pomace fly, *Drosophila heteroneura* has not been recorded at Puʻu Waʻawaʻa since 1969 (Giffin, 2003), but was observed nearby on private land on Hualalai in 1993 (USFWS, 2006a, 2006b). All three host plants for this species occur in the Puʻu Waʻawaʻa but are widely scattered and in decline due to slugs, rats, non-native insects, feral ungulates, and competition from invasive weeds (Giffin, 2003). It is unknown whether any individuals would occur at or adjacent to the proposed Relocatable Sites.

The endangered Blackburn's sphinx moth (*Manduca blackburni*) is one of Hawaiʻi's largest native insects, with a wingspan of up to 12 cm (USFWS, 2005). Vegetation that supports Blackburn's sphinx moth includes dry to mesic shrub land and forest from sea level to approximately 1,300 m (USFWS, 2005). Host plants for Blackburn's sphinx moth caterpillars include plants in the nightshade family (Solanaceae), such as native trees in the genus *Nothocestrum* and non-native solanacious plants such as commercial tobacco (*Nicotiana tabacum*), tree tobacco (*Nicotiana glauca*), eggplant (*Solanum melongena*), tomato (*Lycopersicon esculentum*), and Jimson weed (*Datura stramonium*). Adults feed on the nectar of koaliawa (*Ipomea indica*), and are likely to take nectar from other species of *Ipomea*, maiapilo (*Capparis sandwichiana*), and 'ilie'e (*Plumbago zeylancia*) (DLNR, 2005f). This species was considered extirpated from the island of Hawai'i until 1998 when it was observed in the dry forest at PWETF at 548 m elevation (Giffin, 2003). It was observed again in 2001 in the Forest Bird Sanctuary at 1,219 m elevation (Giffin, 2003). On Hawai'i, it was known from Hilo, Pahala, Kalaoa, Kona, and Hamakua (USFWS, 2005). No information is available on the current distribution or abundance of *Manduca blackburni*. It appears that numbers may be increasing due to the recent invasion of tree tobacco, a favored food plant.

### *Environmental Consequences*

Proposed NEON construction activities would not be expected to impact sensitive aquatic species. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2 to minimize the potential for indirect impacts to sensitive aquatic species from sedimentation as a result of stormwater runoff.

NEON, Inc. would work with property site managers to avoid conducting ground-disturbing or vegetation-clearing activities in areas where sensitive plant or animal species are known to occur. Each proposed area of disturbance would be investigated prior to initiating construction activity, with appropriate protocol surveys conducted for potentially occurring sensitive species. Infrastructure locations would be adjusted slightly to avoid any such disturbance while retaining the scientific merit of the location. In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat.

Prior to construction, consultation with USFWS on potential impacts to protected species and designated critical habitat would be required. Through consultation, NEON, Inc. would avoid disturbance to host trees and roost sites and to otherwise minimize disturbance within designated critical habitat. Any RPMs or other mitigation specified through consultation would be implemented by NEON, Inc. prior to or concurrent with construction. Any RPMs or other mitigation specified for operation of the NEON projects would be implemented by NEON, Inc., as appropriate throughout the duration of the NEON experiments. Should obligate plant hosts for protected invertebrate species be found within an area to be disturbed, the proposed tower location would be shifted to avoid impacting these plants. Nest surveys for avian species and roost surveys for the Hawai'ian hoary bat would be conducted within the immediate vicinity proposed for tower placement and other areas where vegetation would be removed. Vegetation clearing or tower placement activities would be postponed until bats vacate the area or until chicks fledge and leave the nest.

The Core and Relocatable Sites in Domain 20 occur within habitats for several sensitive bird species and an endangered bat species. The tower and guy wires would pose a minimal collision risk to birds and the bat. Because the tower and wires would be stationary, they would be detectable and flying bats would be able to avoid them. Bird strikes could occur, but guy wires would be equipped with daytime visual markers or bird flight diverters to minimize the risk of collision by protected bird species. Federally endangered petrels are known to breed on the island and could collide with the guy wires and tower at night. Any impacts would likely be negligible from a population standpoint. This potential risk would be removed at site closure.

Appropriate permits for collecting invertebrates would be obtained from the Hawaiʻi Department of Land and Natural Resources prior to any collection. Should researchers need to capture other animals or birds, the appropriate permits would be obtained prior to collection. No impacts to sensitive species would be expected.

MBTA listed birds would have the potential to be disturbed during construction and operation of the NEON sites. Should nesting bird species protected by the MBTA occur in or adjacent to an area that would be cleared or be subject to a high level of human activity during construction, work would be delayed until after the young have fledged if the site could not be relocated.

### *Cultural Resources*

### *Affected Environment*

The proposed NEON locations for Domain 20 are located in the Pacific Neotropical Laupāhoehoe and Puʻu Waʻawaʻa Forest Units of the Hawaiʻi Experimental Tropical Forest on the island of Hawaiʻi. A cultural resource study that included archival research and limited field survey cultural resources study was completed for Domain 20 (Kailihiwa et al., 2009).

#### Archival Literature Search

To assess potential impacts to cultural resources a prehistoric and historic records and literature search was conducted for all proposed NEON facility locations in Domain 20. The proposed locations plus all land within a 1.6 km radius around each proposed location defined the study area. Archival research included visits to the State Historic Preservation Division (SHPD) library in Kapolei, the Department of Accounting and General Services Land Survey Division, the Hawai`i State Archives, the Bishop Museum Archives and various public libraries. Based upon previous experience with consultations in Hawaiʻi, it was determined to conduct field investigations of proposed NEON Locations. Consultation with Native Hawaiʻian entities typically requires a site investigation. Field survey was limited to inspections of the proposed Laupāhoehoe Core Site.

Archival research identified three prior archaeological studies conducted in Laupāhoehoe Ahupua`a. Previous archaeological studies conducted within Pu`uwa`awa`a focused on the coastal portion of the ahupua`a and no studies of the uplands in Pu`uwa`awa`a were located during archival research. However, several studies in uplands of the adjacent ahupua`a to the north, Pu`u Anahulu, have been conducted.

The Laupāhoehoe Core Site would be situated between approximately 305 m and 1,400 m elevation on the northeastern slopes of Mauna Kea. Based on previous archaeological work and historical documentary research, expected traditional Hawaiʻian site types potentially include trails and temporary habitation sites associated with upland travel and resource exploitation. Historic records attest to the cultural importance of project area forests, which provided logs for canoes, feathers for chiefly regalia, and other valued plant resources. Cattle were hunted in the forest and above it. Potential historic features consist of trails, bullock pits, temporary camps, and sugarcane plantation-related infrastructure including water diversion structures, flumes, ditches, and roads.

The Relocatable Sites at Pu`uwa`awa`a would be situated between approximately 1,555 m and 1,645 m elevation on the upper northern slopes of Hualalai. Potential traditional Hawaiʻian site types in this zone include trails and temporary habitation sites associated with upland travel and resource exploitation. The area was an important source for plant resources, stone tool raw material, and birds for food and feathers. Historic sites potentially would consist of trails, bullock pits, and temporary camps.

The combined factors of heavy rainfall, rapidly growing dense vegetation, and ground disturbance by pigs greatly reduce the likelihood of identifying intact cultural resources and the cultural resources sensitivity for all NEON facilities in Domain 20 is considered low.

#### *Laupāhoehoe Field Visit*

An archaeological inspection of the three proposed NEON Core Site tower locations in Laupāhoehoe was conducted on February 10, 2009 by Haun & Associates accompanied by USFS agent Cheyenne Perry. The locations were identified through the use of Global Positioning System (GPS) receivers. The Core Site inspections focused on an approximately 50 to 60 m diameter area surrounding the GPS located center-point coordinates for each proposed tower location. The areas were systematically examined for the presence of historic properties. No archaeological sites were identified at the sites or along the main unpaved road through the forest unit used to access the area. All of the proposed Core Site tower locations (C-58, C-59, and C-60) exhibited evidence of disturbance by feral pigs, which could have destroyed or compromised the integrity of any sites that may have been there.

#### *Environmental Consequences*

The literature review of the proposed NEON locations in Domain 20 did not identify any significant known historic properties within the proposed areas of disturbance for any of the proposed NEON facilities. There are no known NRHP eligible historic properties located within the study areas.

Field inspection of the Laupāhoehoe Core Site did not encounter any cultural remains. The absence of traditional Hawaiʻian artifacts is expected because the area would have had a very low site density. Furthermore, archaeological evidence for such sites, primarily temporary camps and trails, would be minimal and consist of food remains and artifacts. The combined factors of heavy rainfall, rapidly growing dense vegetation, and ground disturbance by pigs in the area greatly reduce the likelihood of identifying such sites.

Based on a review of all cultural resources information collected and analyzed for NEON facilities in Domain 20, no known historic properties of significance exist in the site-specific footprints. Because NSF is using a phased approach to identify historic properties pursuant to 36 CFR Section 800.4(b)(2), further investigation of the potential for significant historic properties, as appropriate, will occur at the micro-siting stage. At that point, any remaining steps to conclude NSF’s Section 106 compliance can be carried out.

### *Utilities*

### *Affected Environment*

There are no existing electric power or telecommunications utilities available in the LETF. Lines would have to be extended through the LETF to provide electric power and communications to the tower.

Existing utilities near the proposed Relocatable Sites (R-39, R-40) within the PWETF are located down a dirt road approximately 5.2 km from the furthest proposed Relocatable Site.

### *Environmental Consequences*

NEON, Inc. would extend power and telecommunication lines from the existing grid terminus through concrete-encased conduit buried in the road to as near the proposed location of C-58 as possible. A portal would be placed at the point where the road would no longer be used and electric power and telecommunications would be extended beneath a new boardwalk to C-58. The weather stations placed at the proposed Relocatable Sites would be solar powered and no utility lines would be extended to these sites. Erosion control BMPs, as discussed in Section 2.2.2 would be implemented to minimize the potential for environmental impacts.

NEON, Inc. would coordinate with Hawaiʻi Electric Light Company regarding extension of utility lines to C-58.

### *Transportation*

### *Affected Environment*

The LETF can be accessed from an unimproved road. Existing field roads that are near the proposed NEON locations in the LETF may require improvement for researchers to safely access the areas throughout the year. Should improvements be determined to be necessary, NEON, Inc. would prepare a road grading plan in advance of any road work. Materials and equipment would be hand carried from the nearest point on the road.

PWETF also is accessible from paved surface roads. From the end of the public road, PWETF service roads extend to within 0.6 km of the proposed location of R-39 and 1.0 km of the proposed location of R-40. Materials and equipment would be hand carried from the nearest point on the road.

### *Environmental Consequences*

There would be a negligible increase in traffic to local roads during construction. Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. All work would be completed during the day and equipment and materials would be brought in by hand.

Existing roads and field roads on the LETF and PWETF would be utilized as much as possible to bring in the materials for construction. No new roads would be constructed. Improved trails may be required to transport materials from the nearest field road to the proposed tower location. Materials would be transported by hand from the field road to the tower location. NEON, Inc. would not make any new roads or trails. Workers and researchers would use dispersed movement to access the sites to minimize the potential for impact to vegetation, wildlife, sensitive habitats, and sensitive species.

Because of the level of disturbance to the road from trenching to place buried lines, NEON, Inc. would prepare a road improvement plan prior to conducting road work. The road improvement plan would be submitted to the Hawai'i Department of Land and Natural Resources and USFS in advance of any work.

Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. Workers would travel to the sites in carpools or vanpools to minimize the amount of vehicle emissions. Vehicle emissions during construction would be a minor temporary impact on local air quality. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites and vehicle trips associated with implementation of the proposed NEON, Inc. activities would not cause substantial changes in air quality from the baseline conditions.

A comparable potential for transportation impacts would result at the end of the NEON projects. Similar equipment would be used to remove NEON infrastructure and implement site restoration activities. Any impacts at site closure would be negligible.

### *Recreation*

### *Affected Environment*

The proposed NEON sites on the LETF and PWETF would be on land used by the public for hunting. These areas are known as hunting units (HU). The Core Site at the LETF would be in Hunting Unit K, which allows public access year-round (DLNR, 2003). PWETF is in Hunting Unit J, which is typically open year-round; however, hunting season is subject to change depending on climate and species population (DLNR, 2003). Hiking groups of 10 or less are also permitted in the HETF.

There are no NSTs or NHTs within 10 km of proposed NEON locations in Domain 20.

### *Environmental Consequences*

While the areas around proposed NEON locations are open to public access, there would be nothing at the NEON sites to attract typical visitors to the area. Researchers would be required to obtain approval through the HETF permitting process and visitors could be notified when data collection would occur. Recreational visitors to the forest could use other parts of the forest while activities were being conducted by NEON, Inc., if the NEON activities would detract from recreation in the immediate area The tower would be secured with fencing and locked gates to deter unauthorized access, but there would be no other restrictions placed on public access.

Construction and site closure activities could disrupt recreational activities near the proposed NEON locations at the LETF and PWETF, depending on the timing of the work. Any impacts would be short–term. Hunting and hiking activities could occur in other parts of the HU. Any impacts would be negligible.

Intense sampling events, when up to 25 researchers would be accessing the site, also could disrupt nearby recreational activities. Any impacts would be short–term. Hunting and hiking activities could occur in other parts of the forest if the NEON activities would detract from recreation in the immediate area Any impacts would be negligible.

The tower and guy wires could be visible to recreational users in the immediate project area. However, the forest vegetation would screen the infrastructure from most visitors. Any impacts would be minor and limited to the immediate area.

### *Human Health and Safety*

### *Affected Environment*

The proposed tower at the LETF and the proposed weather stations at PWETF would be in an area where passive recreation and hunting activities may occur. Access to the C-58 tower and the weather stations would be limited to employees and researchers. Construction would be completed in approximately 6 months by a crew of up to 10 contractors plus oversight personnel from NEON, Inc. All work would be done during the day. Workers would travel to the sites in carpools or vanpools to minimize the number of vehicle trips. During operations, a maximum of 25 scientists and technicians would be onsite daily for a 6-week period during maximum sampling efforts. During other times, it is expected that an average of three people would visit each site twice per week. Scientists and technicians would carpool or vanpool to the sites to minimize the number of vehicle trips associated with data collection activities. Construction workers would bring materials in by hand from the nearest road.

### *Environmental Consequences*

There would be minor potential for injuries to workers during construction and a long-term negligible risk of injury to site users for the duration of NEON. Any potential health and safety risks associated with NEON would end at site closure. No cumulative health or safety impacts would result.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. However, appropriate safety practices for working at heights, near fall hazards, and around electrical hazards would be implemented to minimize risk of injury. Workers would wear bright orange safety vests to minimize risk.

While the public would be able to access the proposed NEON sites, no health and safety risks to the public would be likely. Typical visitors to these areas would not be drawn to the NEON infrastructure, as the NEON infrastructure would not contribute to their planned activities. The tower would be fenced and secured to deter unauthorized access. The weather stations would not create a safety hazard for visitors. No human safety risks would be anticipated.

#### *Aesthetics and Visual Resources*

#### *Affected Environment*

Proposed NEON locations in Domain 20 are in areas where public recreation may occur. Both the LETF and PWEFT are visited for their aesthetic and scenic values. The LETF is a tropical rainforest, which offers visitors many scenic views, including views of wildlife. The PWEFT offers scenic views of volcanoes and includes a bird sanctuary where visitors may observe endemic Hawai'ian species.

#### *Environmental Consequences*

There would be no overhead power lines associated with NEON and only the Core Site Advanced Tower would be potentially visible to visitors. The forest canopy would obscure the tower from ground observation, although viewers from afar could observe the tower from some vantage-points. Implementation of NEON would not likely substantially reduce the aesthetic and visual quality of the proposed locations. Any impacts would likely be minor.

### 3.5.20.4 Hawai'i State Environmental Policy Act

The Hawai'i Environmental Policy Act of 1974 (Hawai'i Revised Statutes 343, HEPA) requires analysis for any action that proposes to use state lands. Because of the national scope of the proposed NEON project, the analysis prepared in this document to meet the requirements of the National Environmental Policy Act of 1969 (NEPA) may not fully satisfy the requirements of HEPA with regard to state concerns. This NEPA analysis may be used to supplement the HEPA process.

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**Figure 3.D20-1** Domain 20 Proposed Site Locations

**Figure 3.D20-2** Domain 20 Proposed Site Locations

# 4.0 CONCLUSIONS

This EA analyzed the potential environmental and socioeconomic impacts that would result from implementation of NEON. The analysis examined construction and installation of proposed NEON infrastructure and subsequent operation of NEON by NEON, Inc. for 30 years at Core Sites and 5 years at initial Relocatable Sites. The analysis also considered potential impacts that would result from decommissioning NEON infrastructure at the close of the project.

Analysis indicated that NEON would have no effect on land use, topography, hydrogeology and groundwater, demographics, and community resources in any of the 20 domains. It also was determined that, even though NEON would not result in a change in demographics, there would be minor short-term and long-term beneficial impacts to the local economy of the areas where infrastructure would be placed through secondary spending by construction crews, maintenance technicians, and researchers.

NEON would have similar negligible adverse impacts on hydrology and hazardous and toxic substances across all 20 domains. NEON, Inc. would develop and implement spill prevention, control, and countermeasures (SPCC) plans at all sites where hazardous and toxic materials or fuel would be stored to minimize the potential for adverse impacts. NEON, Inc. also would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for hydrologic impacts. With the implementation of appropriate BMPs and project design features, impacts to hydrology and hazardous and toxic substances would be less than significant.

While NEON would have no impact on the underlying geology in any domain, there are areas where NEON, Inc. would have to account for karst terrain or potential seismic activity in design and construction of NEON infrastructure. Where NEON infrastructure would be placed in karst terrain, NEON, Inc. would design to avoid sites prone to sinkhole development and would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for indirect impacts to water quality from runoff entering karst systems. NEON, Inc. would implement designs for infrastructure in Domain 18 that would minimize the potential for impacts to permafrost and that would not contribute to permafrost thawing. In areas where the potential for strong earthquakes is present, NEON, Inc. would design infrastructure to withstand greater stresses from movement of the earth. Long-term maintenance would be more extensive in these regions. With the implementation of appropriate BMPs and project design features, impacts related to geology would be minor and less than significant.

Implementation of NEON would have minor temporary adverse impacts on soils. Less than 0.01 ha would be disturbed at any one location and upon completion of NEON, infrastructure would be removed and the area restored. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for soil impacts. Prior to revegetation in areas where soils are susceptible to erosion, BMPs would be implemented to minimize the erosive forces to which disturbed soils would be subject. In areas with sensitive soils (wetlands and arid regions with biological soil crusts), NEON, Inc. would incorporate boardwalks into site design to minimize the potential for impacts during construction and subsequent long-term impacts as a result of data collection and maintenance. In permafrost areas, construction and transport of materials would be done during the time of year when the ground is covered with snow to avoid damage to the sensitive permafrost soils. With the implementation of appropriate BMPs and other project design features, impacts to soils would be less than significant.

Proposed NEON, Inc. activities would have no potential to impact climate, but there are areas where NEON, Inc. would have to account for extreme climatic conditions in design and construction of NEON infrastructure. In areas of extreme cold, NEON infrastructure would have to be capable of withstanding the severe winter conditions. In addition, fuel for the two primary generators in Domain 18 would have to remain functional at extremely cold temperatures. In permafrost areas, construction and transport of materials would be done during the time of year when the ground is covered with snow to avoid damage to the sensitive permafrost soils. In areas subject to oceanic storm surge, design would avoid placing NEON infrastructure where storm surge would be likely. Where extreme lightning events are common, appropriate grounding of equipment and transmission lines would be used to minimize the potential for damage. With the implementation of appropriate project design features and the anticipation of potential extreme weather-related events, climate-related impacts to NEON infrastructure would be less than significant.

NEON would have minor adverse temporary impacts on air quality in all domains from equipment and vehicle emissions and generation of fugitive dust during construction and operation. During peak sampling periods, up to seven vehicle trips per day would be expected at each site, with four or fewer trips per day anticipated at other times, including construction. This small number of vehicle trips would have a negligible impact on air quality. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for fugitive dust generation during construction. Routine maintenance throughout the duration of NEON would keep the three primary and one standby generators running efficiently and minimize emissions during operation. The operation of primary generators would produce the most emissions during operation, but the amount of emissions at any given location would be minimal. Where required, NEON, Inc. would obtain necessary permits to install and operate primary and standby generators and would comply with all conditions of those permits. No deterioration of air quality would be expected. Therefore, implementation of NEON would not adversely impact air quality or contribute to deterioration of visibility at any designated mandatory Class I Wilderness Area. With the implementation of appropriate BMPs and other project design features, impacts to air quality would be less than significant.

Where NEON infrastructure would be near Federal Aviation Administration (FAA)-regulated airfields, NEON, Inc. would coordinate with FAA in design of infrastructure to be compliant with all applicable FAA regulations and guidance. NEON, Inc. also would obtain any permits or approvals required by FAA in advance of construction. NEON, Inc. would coordinate timing and routes of Airborne Observation Platform (AOP) overflights with the FAA and any military installations or other secure air facilities. No impacts on airspace would result.

There would be short-term negligible direct noise impacts to onsite workers and minor direct noise impacts to wildlife from construction of NEON infrastructure. These impacts would also occur during removal of NEON infrastructure: after 5 years at Relocatable Sites and 30 years at Core Sites. During the operation of NEON, long-term minor impacts to wildlife could result from the noise created by the one standby and three primary generators and vehicles used to access sites for data collection. AOP overflights may be a nuisance to residents where such overflights would include populated areas. Any impacts from noise would be less than significant.

Construction of NEON infrastructure would have the potential to impact water quality during construction from sedimentation or transport of nutrients or other pollutants into receiving waters. During operation of NEON, spills of fuel or chemicals associated with NEON operations would have the potential to introduce contaminants to receiving waters. NEON, Inc. would develop and implement SPCC plans at all sites where fuel or chemicals would be stored to minimize the potential for adverse impacts. NEON, Inc. also would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for indirect impacts to water quality during construction. STREON experiments would add small concentrations of nitrogen and phosphorus to streams for up to 10 years at a given site. Typically, this would result in moderate long-term impacts to water quality in streams and would have potential for contributing to downstream eutrophication. However, because STREON experiments would be conducted on relatively small streams (first and second order), the greater assimilative capacity of larger streams would prevent further impacts to downstream water quality. NEON, Inc. would obtain any necessary permits in advance of construction or STREON experiments, and would comply with all permit conditions during construction and STREON experiments. With the implementation of appropriate BMPs and other project design features, impacts to water quality would be less than significant.

During the final design stage, NEON, Inc. would plan sites to avoid placing infrastructure in wetlands except where necessary to meet scientific goals (data collection from within a wetland) or where unavoidable (crossing a wetland necessary to reach instrument location for access or power). During construction, NEON would make site-specific adjustments to further minimize any unavoidable encroachment into wetlands. Further, NEON, Inc. would minimize the size of proposed infrastructure within wetlands by placing support infrastructure (such as the three primary and one standby generators and IH) outside of wetlands and only placing necessary data collection infrastructure within a wetland. NEON, Inc. would develop and implement SPCC plans at all sites where fuel or chemicals would be stored adjacent to or upslope from a wetland to minimize the potential for adverse impacts from accidental spills. NEON, Inc. also would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for direct and indirect impacts to wetlands during construction. Where routine access across wetlands is necessary, NEON, Inc. would construct boardwalks to minimize disturbance to wetland soils and vegetation from data collection and maintenance activities. All infrastructure placed in wetlands would be removed at project closure and the disturbed areas would be restored. No additional mitigation actions would be necessary, unless required by permit. While impacts to wetlands would be minimized to the extent practicable, there would be unavoidable minor impacts to wetlands as a result of NEON infrastructure construction and operation. NEON, Inc. would obtain any necessary permits in advance of construction, and would comply with all permit conditions. With the implementation of appropriate

BMPs and other project design features and compliance with all permit conditions, impacts to wetlands would be less than significant.

During the final design stage, NEON, Inc. would plan sites to avoid placing infrastructure in floodplains and other flood prone areas except where necessary to meet scientific goals (data collection from within a stream or site within a floodplain) or where unavoidable (access across a floodplains and other flood prone areas necessary to reach instrument location for access or power). During construction, NEON would make site-specific adjustments to further minimize any unavoidable encroachment into floodplains and flood prone areas. Further, NEON, Inc. would minimize the size of proposed infrastructure within floodplains and other flood prone areas by placing support infrastructure (such as the three primary and one standby generators and IH) outside of these areas and only placing necessary data collection infrastructure within floodplains and other flood prone areas. NEON, Inc. would develop and implement SPCC plans at all sites where fuel or chemicals would be stored adjacent to or upslope from floodplains and other flood prone areas to minimize the potential for adverse impacts from accidental spills. NEON, Inc. also would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for direct and indirect impacts to floodplains and other flood prone areas during construction. Where routine access across regularly flooded areas is necessary, NEON, Inc. would construct boardwalks to facilitate access for data collection and maintenance activities. Equipment that must be placed in floodplains and other flood prone areas would be secured to prevent washing away or would be temporarily removed in advance of flood events. All infrastructure placed in floodplains and flood prone areas would be removed at project closure and the disturbed areas would be restored. While impacts to floodplains and other flood prone areas would be minimized to the extent practicable, there would be unavoidable minor impacts to wetlands as a result of NEON construction and operation. NEON, Inc. would obtain any necessary permits in advance of construction, and would comply with all permit conditions. With the implementation of appropriate BMPs and other project design features and compliance with all permit conditions, impacts to wetlands would be less than significant.

Construction, access, and consumptive sampling would have the potential to impact common vegetation and plant communities. Minor clearing of common vegetation would occur to place towers and instrument pads, IHs, utility lines, and boardwalks. These impacts would be long-term, lasting until the NEON closure, when infrastructure would be removed and vegetation restored. No population-level impacts would result. Woody vegetation would not be allowed to regrow along utility lines installed to reach NEON locations until after the lines were removed. NEON, Inc. would develop and implement SPCC plans at all sites where fuel or chemicals would be stored to minimize the potential for adverse impacts from accidental spills. NEON, Inc. also would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for direct and indirect impacts to common vegetation and plant communities during construction. With the implementation of appropriate BMPs and other project design features, impacts to vegetation would be long-term, but less than significant.

Minor direct impacts to wildlife could occur from construction and operation of NEON infrastructure. Negligible indirect impacts to wildlife could result from loss of habitat. During construction wildlife would likely be displaced from construction areas and immediately adjacent areas. Animals would likely return to the area following construction. No disruption of wildlife breeding is expected. No population-level impacts would occur. Construction would result in the loss of less than 0.01 ha of potential wildlife habitat at each proposed location. There is abundant suitable habitat in the surrounding areas to provide refuge and any impacts would be negligible. Towers and guy wires would pose a minimal risk to common birds and flying mammals, but any impacts would likely be negligible from a population standpoint. This risk to birds and flying mammals would be eliminated at site closure. Disturbances from the operation of the three primary and one standby generators would occur, as noted in the discussion of noise. Animals may startle at the noise or approach of the plane during AOP overflights, but flight responses would likely be uncommon. NEON, Inc. would develop and implement SPCC plans at all sites where fuel or chemicals would be stored to minimize the potential for adverse impacts from accidental spills. NEON, Inc. also would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for indirect impacts to common fauna during construction. With the implementation of appropriate BMPs and other project design features, impacts to common fauna would be less than significant.

Impacts to sensitive ecological communities would only occur when NEON infrastructure would be placed within a sensitive community specifically to collect data on that community type or when NEON infrastructure is placed within a larger area designated as critical habitat for a species listed under the Endangered Species Act (ESA). Compliance with the ESA requires that NEON, Inc. consult with the U.S. Fish and Wildlife Service (USFWS) prior to any disturbance or alteration of designated critical habitat. Less than 0.01 ha would be disturbed at any location and upon completion of NEON, infrastructure would be removed and the area restored. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for indirect impacts to sensitive ecological communities. In wetlands, arid regions with biological soil crusts, and permafrost areas, NEON, Inc. would incorporate boardwalks into site design to minimize the potential for impacts during construction and subsequent long-term impacts as a result of data collection and maintenance. Also, in permafrost areas, construction and transport of materials would be done during the time of year when the ground is covered with snow to avoid damage to the sensitive permafrost vegetation. With the implementation of appropriate BMPs and other project design features and consultation with USFWS where appropriate, impacts to sensitive ecological communities would be less than significant.

Impacts to sensitive species would be similar to those described for common vegetation and fauna. No population-level impacts to sensitive species would occur. NEON, Inc. would implement appropriate BMPs, as discussed in Section 2.2.2, to reduce the potential for indirect impacts to sensitive species. If potential impacts to state listed species could not be avoided at a proposed site, NEON, Inc. would coordinate with the appropriate state agency prior to any action at that site. If potential impacts to a sensitive species designated by the land management agency could not be avoided at a proposed site, NEON, Inc. would coordinate with the land management agency prior to any action at that site. If potential impacts to federally protected species could not be avoided at a proposed site, NEON, Inc. would consult with USFWS prior to any action at that site. If necessary, NEON, Inc. would move infrastructure short distances to avoid impacts to sensitive species. With the implementation of appropriate BMPs, other project design features, and agency coordination and consultation where appropriate, impacts to sensitive species would be less than significant.

NEON, Inc. worked with property managers and examined archival records for geomorphologic history, settlement history, and cartographic review within the study areas to determine if NEON would have a significant impact on known cultural resources. The final position of infrastructure at a site would be selected by NSF to avoid adverse effects on significant cultural resources. If infrastructure positioning is unable to avoid impacts to significant cultural resources, mitigation, as required by the SHPO, would be implemented to ensure the magnitude of any impact would be less than significant. Through implementation of infrastructure positioning to avoid impacts and implementation of any required mitigation where impacts could not be avoided, impacts to cultural resources would be less than significant.

NEON would not overly burden the electric power or telecommunications systems in any domain. Where there is insufficient existing electrical power infrastructure at the proposed Relocatable Tower in the Moab Desert of Domain 13, the Toolik Lake Core Sites (Domain 18), and the Relocatable Tower (R-35) in Domain 18, NEON, Inc. would install and operate generators to provide a full-time power supply. NEON would extend existing transmission lines to provide service at the proposed locations. The impacts to other resources that would result from extension of utility service has already been addressed. Any impacts to utilities would be less than significant.

Construction would be completed in approximately 6 months with a crew of up to 10 workers plus oversight personnel from NEON, Inc. Workers would carpool and construction-related vehicle trips would not be expected to exceed four trips per day. Construction vehicle trips would have a negligible impact on traffic at any proposed NEON location. Similar impacts would be expected at site closure. Minor improvements to field roads would not impact transportation in the region. No new roads would be constructed.

It is expected that a maximum of 25 scientists and technicians would visit the site during peak sampling when researchers would access the site daily for up to 6 weeks for bird surveys and small mammal trapping events. During peak sampling, crews would be spread across multiple FSUs and would not concentrate in a single area. During other times, it is expected that a maximum of 10 persons would be onsite at any time. Researchers and technicians would carpool and no more than seven vehicle trips per day would be expected during peak sampling and no more than three vehicle trips per day at other times. These trips for maintenance and data collection would have a negligible impact on transportation. Any impacts to transportation would be less than significant.

There would be the potential for construction and maintenance workers to injure themselves, which would pose a minor, short-term impact to health and safety. As appropriate, NEON, Inc. would require workers follow standard safety practices for the type of work being performed, and would require that workers adopt suitable safety measures, as appropriate, for working at heights, near fall hazards, during cold or hot weather, and around electrical hazards to minimize risk of injury. NEON, Inc. would develop site-specific safety policies, procedures, and plans to address unique hazardous conditions at different locations. Typically, the proposed NEON locations are remote and would not receive routine visits from the public. Even where proposed NEON sites would be accessible to the public, towers would be secured with fencing and locked gates to deter unauthorized access. Guy wires would be clearly marked and flagged to reduce the potential for accidental collision. With implementation of appropriate project design features, any impacts to human health and safety would be less than significant.

Construction and operation of NEON infrastructure would not disproportionately impact minority or low-income populations. All direct impacts would be confined to the proposed locations, where minority or low-income populations do not occur. While there would be limited loss of areas for subsistence hunting and fishing due to NEON, the total area made unavailable would be small at any given location and the impact on subsistence hunting and fishing would be negligible. Any Environmental Justice impacts would be less than significant.

Where NEON towers would be placed in areas with easy access by unsupervised children, there could a temptation to try to climb the tower. However, access to the tower would be restricted with secure fencing and locked gates. As a result, no pathway for direct exposure to an environmental health or safety risk would be available to children. No impacts to the environmental health and safety of children would occur. Any impacts related to creating environmental health or safety risks to children would be less than significant.

Recreational opportunities at and adjacent to NEON construction sites would be constrained for the duration of construction. After construction, recreational activities would not occur on NEON tower sites. However, the area that would be withdrawn from potential recreational use would be small in any one area and the impact on recreation would be negligible. Any impacts to recreation would be less than significant.

Implementation of NEON would not cause impacts to aesthetics or visual resources in most locations. Towers and powerlines would be the most prominent features added to the visual landscape. Infrastructure typically would be placed in areas that are not routinely viewed for aesthetic quality or in urban lands where aesthetic quality is impaired. Where NEON infrastructure is proposed near national parks or other areas where aesthetic and visual resources are important, NEON, Inc. would work with the land manager to eliminate or limit the potential for adverse impacts on visual quality through location of infrastructure and to further reduce impacts by painting infrastructure to blend with the background. Where possible, infrastructure would be located in areas where it would not be visible from usual scenic viewing areas. Where avoidance would not be possible, the locations were selected such that NEON infrastructure would not be a dominant feature of the view from usual scenic viewing areas or co-located with other anthropogenic features, such as along roadways. Any impacts to aesthetic and visual resources would be no more than minor in any domain. Impacts to aesthetic and visual resources would be less than significant.

Because NEON would be spread across a very large area and would occur over a 30-year period, there is limited potential for NEON to interact with other past, present, or reasonably foreseeable future projects to create adverse cumulative impacts. Where NEON would be co-located with existing projects, such as research stations, LTER sites, and the Canopy Crane, NEON would be compatible with the existing projects and the co-location would result in a reduction of impacts through shared resources. No adverse cumulative impacts would occur during the operation of NEON.

This EA identifies project design features and BMPs that would be implemented to eliminate or minimize impacts. NEON, Inc. would obtain all necessary permits and authorizations prior to construction, conducting destructive (harvest) sampling, and implementing manipulative experiments on waterways. Further, NEON, Inc. would comply with all permit conditions. Where additional site-specific data are needed to determine the extent of impacts, NEON, Inc. would coordinate with appropriate regulatory agencies, collect any needed data, and implement any specified mitigation required by agencies.

Based on the analysis in this EA, NSF has determined that implementation of NEON, with the condition that appropriate project design features and BMPs would be implemented as needed and additional agency coordination would be completed where necessary, would result in no significant adverse impacts to the natural or human environment. The NSF held two public meetings, one in Arlington, Virginia, and the other in Boulder, Colorado, to provide public participation opportunities with respect to this EA. The Preliminary Final EA was made available to the public for comment for a period of 30 days. At the end of the 30-day public review period, the NSF considered all comments submitted by individuals, agencies, or organizations. A Matrix of Public Comments and Responses to Comments is provided in Addendum A. The NSF determined that implementation would not result in significant impacts and is executing a Finding of No Significant Impact and will proceed with implementation of the Proposed Action.

# 5.0 PERMITTING REQUIREMENTS

The following are discussions of the permits and approvals that could be required for proposed NEON, Inc. activities. Each domain is discussed separately. The discussion of air permitting is limited to proposed NEON locations that would be within areas designated as in non-attainment for one or more criteria pollutants. Because U.S. regulatory limits are expressed in English units of measure, English units are used throughout this section.

There are 10 domains where STREON experiments would release nutrients into waters of the U.S. over multiple years. These releases generally represent small but discrete point discharges that may be regulated under either federal (Puerto Rico) or state programs, where these states have primacy for NPDES under the CWA. Alaska is currently transitioning to assume primacy and will administer the NPDES program for domestic discharges (individual and general permits), log storage and transfer facilities, seafood processing facilities (individual and general permits), and hatcheries when the transition is complete. The federal government would retain primacy for STREON-type experiments. Texas has primacy for NPDES permits with the exception of activities associated with oil or gas development. Available information for each of the affected states within each domain is summarized below.

In situations where NEON sampling would involve animal trapping or collection, individual researchers would develop an animal handling plan that would be approved by the institution with which the researcher is affiliated. After obtaining this approval, the animal handling plan would be submitted to the land management agency where the work is proposed as part of the permitting process to authorize the research. No animal trapping or collection would occur prior to obtaining all necessary approvals of the animal handling plan.

Where NEON facilities would connect with existing electrical power or telecommunications infrastructure, NEON, Inc. would coordinate with existing providers for authorization of extensions and connections.

## Domain 1

**Clean Water Act Nationwide Permit -** The USACE New England District has revoked all CWA Nationwide Permits (NWPs) within its boundaries (USACE, 2007). All actions that are subject to USACE jurisdiction would have to be authorized under appropriate state-specific Programmatic General Permits (PGPs). Authorization under a USACE General Permit would not be valid until the receipt of a CWA Section 401 water quality certification from the Massachusetts Department of Environmental Protection (MDEP), as well as any authorization under local permitting agencies (USACE, 2006).

Placement of the tower and associated infrastructure in Black Gum Swamp would be authorized under PGP 1, which would not require reporting to USACE, as long as the amount of fill for all associated NEON activities related to Black Gum Swamp was less than 5,000 square feet ($ft^2$) (USACE, 2006). Should the fill from all proposed NEON, Inc. activities associated with Black Gum Swamp (tower pad, guy wire anchors, utility lines, footbridges, etc.) exceed 5,000 $ft^2$, a PGP 2 would be required. Compliance with conditions of PGP 1 would require the filing of a Notice of Intent with the MDEP and the Petersham Conservation Commission.

Construction of a weir or flume to monitor flow in streams at Aquatic Array locations also would be authorized under PGP 1. Each of the proposed NEON locations would be considered separate and complete and each would require a separate permit.

**Scientific Collection Permit -** Prior to conducting any small mammal trapping in Massachusetts, NEON, Inc. would obtain an annual permit from the Commonwealth of Massachusetts Division of Fish and Wildlife. Separate applications would be submitted for each taxonomic group that would be trapped (Massachusetts Division of Fish and Wildlife, 2009). NEON, Inc. would obtain annual scientific permits from the New Hampshire Fish and Game Department for scientific and research purposes to allow small mammal trapping at the Bartlett Experimental Forest in New Hampshire (Justia U.S. Laws, 2009).

**General Construction Permit -** In Massachusetts and New Hampshire, a USEPA General Construction Permit is required for projects with land-disturbing activities between 1 and 5 acres (USEPA, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

**Special Use Permit** – A Special Use Permit from the USFS would be required to place proposed R-01 and associated infrastructure in the Bartlett Experimental Forest within the White Mountain National Forest.

# Domain 2

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a pre-construction notification (PCN) for any such structures that would entail placement of less than 25 cubic yards ($yd^3$) of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**Scientific Collection Permit -** In Maryland, an annual collection permit from the Maryland Department of Natural Resources would be obtained in advance of conducting small mammal trapping in any year (Maryland Department of Natural Resources, 2009). In Virginia, a 2-year collection permit would be obtained as needed from the Virginia Department of Game and Inland Fisheries to authorize small mammal trapping activities (Virginia Department of Game and Inland Fisheries, 2009).

**General Construction Permit -** In Maryland, ground-disturbing activities on greater than 5,000 $ft^2$ of land area and greater than 100 $yd^3$ of earth movement must have an erosion and sediment control plan approved by MDE prior to initiating work (MDE, 2004). A general permit for construction activities of 1 acre or more is required through MDE (MDE, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

In Virginia, projects disturbing over 1 acre of land must obtain a General Permit for discharges from construction activities through the Virginia Department of Conservation and Recreation (VDCR) and prepare a stormwater pollution prevention plan (VDCR, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

**NPDES Permit** - Baisman Run, the water body proposed for the STREON experiments, is not included on the list of impaired streams under S. 303(d) of the CWA. However, Baisman Run is a designated forested "Reference Reach" for the Baltimore area and may require special permitting consultation with the state for nutrient releases. Site-specific determination of appropriate permitting requirements will have to be made by the Maryland Department of the Environment and NEON, Inc. would have to obtain any required permits prior to implementing STREON nutrient manipulation experiments.

## Domain 3

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). In addition, in Florida the maximum size of the device may not exceed 1,000 $ft^2$. Structures not meeting these size limits would require permitting through the appropriate USACE District. Additionally, any structure in Florida would require authorization by the Florida Department of Environmental Protection (FDEP) and the appropriate Water Management District.

Construction of the proposed tower in Ashley Prairie would require authorization under the CWA through the USACE. Additionally, construction of this tower would require authorization by the FDEP and the appropriate Water Management District.

**Scientific Collection Permit –** In Georgia, an annual permit is required from the GADNR Wildlife Resources Division for collection of animals for scientific research (GADNR, 2009). This permit requires that any encounters with animals on the GADNR Natural Heritage Program Tracking List of Special Concern Animals be reported to the GADNR Natural Heritage Program within 7 days (GADNR, 2006).

In Florida, a scientific collection permit is required from the Florida Fish and Wildlife Conservation (FLFWC) Commission before any species may be collected for research purposes (FLFWC, 2009; FLFWC, 2004).

**General Construction Permit -** In Georgia, land-disturbing activities of 1 acre or more require a National Pollutant Discharge Elimination System (NPDES) General Permit through the Georgia Environmental Protection Division (GA EPD) (GA EPD, 2008). Projects that disturb less than 1 acre are not required to obtain a permit. A stream buffer variance through the GA EPD is required for projects within the designated 25-foot stream buffer that would result in clearing of vegetation or ground disturbance.

In Florida land-disturbing activities of 1 to 5 acres require a Phase II Generic Permit for Stormwater Discharge for small construction activities though the FDEP. A Phase I permit is required for land-disturbing activities greater than 5 acres (FDEP, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

## Domain 4

**General Construction Permit -** In Puerto Rico, a USEPA General Construction Permit is required for projects with land-disturbing activities between 1 and 5 acres (USEPA, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

**Clean Water Act Nationwide Permit -** Construction of the proposed NEON facility at Ponce Metro (R-08) could result in impacts to wetlands. If wetlands could not be avoided, NEON, Inc. would obtain appropriate authorization from USACE and the Commonwealth of Puerto Rico in advance of any disturbance. NEON, Inc. would comply with all permit conditions.

**NPDES Permit** - Rio Cupeyes, which is proposed for STREON experiments, is not included in list of impaired streams under S. 303(d) of the CWA. Site-specific determination of appropriate permitting requirements will have to be made by the USEPA, Region 2 and NEON, Inc. would have to obtain any required permits prior to implementing STREON nutrient manipulation experiments.

**Scientific Collection Permit –** In Puerto Rico, NEON, Inc would obtain an annual collection permit from the Puerto Rico Department of Natural Resources and Environment in advance of conducting small mammal trapping in any year.

## Domain 5

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**Cultural Resources Consultation** - As part of consultation for the purposes of completing Section 106 consultation, the PR SHPO and ICP will require a formal proponent application and request for review for the proposed NEON projects. The PR SHPO and ICP will include a comprehensive staff assessment of the undertaking and formal recommendations. NSF would implement the formal recommendations.

**Scientific Collection Permit -**An annual collector permit for fish, reptiles, amphibians, mollusks, or crustaceans would be obtained from the Michigan Department of Natural Resources (Michigan DNR) Fisheries Division prior to collecting specimens from these taxonomic groups. These permits require submission of an annual record of species collected to the Michigan DNR Fisheries Division.

Prior to trapping small mammals in Michigan, a Mammal Collection Permit would be obtained from the Michigan DNR Wildlife Division (Michigan DNR, 2009a; 2009b).

In Wisconsin, a Five-year Scientific Collectors Permit would be obtained from the Wisconsin Department of Natural Resources in advance of conducting small mammal trapping at Treehaven or Steigerwaldt (The State of Wisconsin, 2009).

**Michigan DNR Clearance -** Prior to initiating land-altering activities, a clearance would be obtained from the Lansing, Michigan DNR office indicating that the proposed activity would have "No Effect" on habitat for protected species. If Michigan DNR determines that there is no significant available habitat, the project would be cleared. However, if potential habitat exists in the proposed project area, then the applicant must provide either (1) a statement from a knowledgeable source stating that suitable habitat is or is not present and written justification for why the project would not impact species or habitats or (2) results from a complete and adequate survey by a knowledgeable source demonstrating whether protected species are present in the proposed project area. Guidelines for conducting complete and adequate surveys can be obtained from Michigan DNR (Michigan DNR, 2008).

**General Construction Permit -** In Michigan, ground-disturbing activities of 1 or more acres or that are within 500 feet of a water resource require a soil erosion and sedimentation control (SESC) permit through the Gogebic County SESC Program (Gogebic County SESC Program, 2009). Ground-disturbing activities of 1 to 5 acres are automatically covered under the Michigan Department of Environmental Quality (DEQ) Permit by Rule. If the project is over 5 acres, then a Notice of Coverage is required through DEQ in conjunction with a SESC permit (DEQ, 2009).

In Wisconsin, ground-disturbing activities of 1 acre or more require a Storm Water Runoff General Permit through the Wisconsin Department of Natural Resources (WI DNR, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

# Domain 6

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the USACE Regulatory Program.

**Scientific Collection Permit -** An annual permit would be required from the Kansas Department of Wildlife and Parks (KDWP) for collection of animals for scientific research. A record of all species collected would have to be submitted to KDWP annually. The permittee would be required to submit GPS coordinates for any observed threatened and endangered species (KDWP, 2009).

**General Construction Permit -** Land-disturbing activities of 1 acre or more require a construction stormwater General Permit through the Kansas Department of Health and Environment (KDHE) (KDHE, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

**NPDES Permit** - Kings Creek, which is proposed for the STREON experiments, is not included on the list of impaired streams under S. 303(d) of the CWA. Site-specific determination of appropriate permitting requirements will have to be made by the Kansas Department of Health and Environment and NEON, Inc. would have to obtain any required permits prior to implementing STREON nutrient manipulation experiments.

# Domain 7

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**NPS Scientific Research and Collecting Permit -** All infrastructure to be placed within GSMNP and all data and specimen collection activities would require an NPS Scientific and Research Collecting Permit. If sufficient detail is known in advance of construction, NPS could process the infrastructure and planned data collection and, as applicable, specimen collection activities under a single Scientific Research and Collecting Permit. Any subsequent changes to the planned activities would require new authorization by the NPS.

**NPS Director's Order 12** - NPS Director's Order 12 and the accompanying NPS handbook outline the procedures by which the NPS carries out its responsibilities under NEPA. To fully comply with NPS Director's Order 12, the NPS may require additional site-specific NEPA documentation of that portion of the action that would be constructed and operated in GSMNP.

**Scientific Collection Permit -** An annual permit would be required from the Tennessee Wildlife Resources Agency (TWRA) to collect animals for scientific research. A record of all species collected would be submitted to TWRA annually (TWRA, 2009).

A 2-year collection permit would be obtained as needed from the Virginia Department of Game and Inland Fisheries to authorize small mammal trapping activities (Virginia Department of Game and Inland Fisheries, 2009).

**General Construction Permit -** In Tennessee, ground-disturbing activities of 1 acre or more require an NPDES Storm Water Construction Permit through TDEC (TDEC, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

In Virginia, projects disturbing over 1 acre of land must obtain a General Permit for discharges from construction activities through the Virginia Department of Conservation and Recreation (VDCR) and prepare a stormwater pollution prevention plan (VDCR, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

**NPDES Permit** - Walker Branch, which is proposed for the STREON experiments, is not included on the list of impaired streams under S. 303(d) of the CWA. This stream is referred to by the state as "pristine" and classified for recreation and fish and other aquatic life. Implementation of STREON experiments on Walker Branch may require permitting consultation with the state. Site-specific determination of appropriate permitting requirements will have to be made by the Tennessee Department of Environment and Conservation and NEON, Inc. would have to obtain any required permits prior to implementing STREON nutrient manipulation experiments.

## Domain 8

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the USACE Regulatory Program.

**Special Use Permit -** Proposed NEON, Inc. activities at the Core Site within the Talladega National Forest, including infrastructure and data collection, would require a Special Use Permit from the USFS.

**Scientific Collection Permit -** An annual scientific collection permit would be obtained from the Alabama Department of Conservation and Natural Resources Heritage Program in advance of any small mammal trapping (Alabama Department of Conservation and Natural Resources Heritage Program, 2009). Following each year in which trapping is conducted, NEON, Inc. would submit the required annual collection report.

**General Construction Permit -** In Alabama, ground-disturbing activities of 1 acre or greater must be registered through the Alabama Department of Environmental Management (ADEM) (ADEM, 2009). Projects that disturb less than 1 acre are not required to be registered.

**NPDES Permit** - The tributary to South Sandy Creek that is proposed for the STREON experiments is not included on the list of impaired streams under S. 303(d) of the CWA. Site-specific determination of appropriate permitting requirements will have to be made by the Alabama Department of Environmental Management and NEON, Inc. would have to obtain any required permits prior to implementing STREON nutrient manipulation experiments.

## Domain 9

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**General Construction Permit –** Ground-disturbing activities greater than or equal to 1 acre require a general construction permit through the North Dakota Department of Health (NDDH) Stormwater Program (NDDH, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

**Scientific Collection Permit –** Small mammal trapping in North Dakota would require a scientific collection permit from the North Dakota Fish and Game Department.

## Domain 10

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**Scientific Collection Permit -** Possession of wildlife under the authority of a scientific collection permit is allowed under specific permit conditions and restrictions. A scientific collection permit from the Colorado Division of Wildlife would be obtained to authorize small mammal trapping and collection of other live specimens (Colorado Division of Wildlife, 2009). Project personnel would comply with all permit conditions.

**NPS Director's Order 12** - NPS Director's Order 12 and the accompanying NPS handbook outline the procedures by which the NPS carries out its responsibilities under NEPA. To fully comply with NPS Director's Order 12, the NPS may require additional site-specific NEPA documentation of that portion of the action that would be constructed and operated in RMNP.

**NPS Scientific Research and Collecting Permit –** All infrastructure placed within RMNP and all data and specimen collection activities would require an NPS Scientific Research and Collecting Permit. If sufficient detail is known in advance of construction, NPS could process the infrastructure and planned data and, as applicable, specimen collection activities under a single Scientific Research and Collecting Permit. Any subsequent changes to the planned activities would require new authorization by NPS.

**General Construction Permit -** Ground-disturbing activities in Colorado of at least 1 acre require a Stormwater Construction Permit through the CDPHE Water Quality Control Division's Stormwater Program (CDPHE, 2007). Projects that disturb less than 1 acre are not required to obtain a permit.

## Domain 11

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**Special Use Permit -** Proposed NEON, Inc. activities, including infrastructure and data collection, at the LBJ National Grasslands would require a Special Use Permit from the USFS.

**Scientific Collection Permit -** A permit would be required from the Texas Parks and Wildlife Department (TPWD) to collect animals for scientific research in Texas (TPWD, 2009). The TPWD permit is issued for a 5-year period. Each year, a collection report, including a record of all species collected, would be submitted to TPWD (TPWD, 2006). In Oklahoma a permit would be required from the Oklahoma Department of Wildlife Conservation.

**General Construction Permit -** In Texas, ground-disturbing activities greater than 1 acre require a General Permit through the Texas Commission on Environmental Quality (TCEQ) (TCEQ, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

**General Construction Permit –** Ground-disturbing activities in Oklahoma of 1 acre or more require a General Permit through the Oklahoma Department of Environmental Quality (ODEQ) (ODEQ, 2007). Projects that disturb less than 1 acre are not required to obtain a permit.

# Domain 12

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**NPS Director's Order 12** - NPS Director's Order 12 and the accompanying NPS handbook outline the procedures by which the NPS carries out its responsibilities under NEPA. To fully comply with NPS Director's Order 12, the NPS may require additional site-specific NEPA documentation of that portion of the action that would be constructed and operated in YNP.

**NPS Scientific Research and Collecting Permit –** All infrastructure placed within YNP and all data and specimen collection activities would require an NPS Scientific Research and Collecting Permit. If sufficient detail is known in advance of construction, NPS could process the infrastructure and planned data collection and, as applicable, specimen collection activities under a single Scientific Research and Collecting Permit. Any subsequent changes to the planned activities would require new authorization by NPS.

**Scientific Collection Permit -** Prior to implementing small mammal trapping at FSUs in Domain 12, an annual scientific collector permit would be obtained from either the Montana Fish, Wildlife, and Parks (MFWP) or the Wyoming Game and Fish Division (WGFD), depending on where trapping would be conducted. These permits would be obtained from each state at the beginning of each year in which trapping would be conducted. An annual collection report would be submitted to MFWP and/or WGFD at the end of each year in which a permit is obtained (MFWP, 2009; WGFD, 2009).

**General Construction Permit –** In Wyoming, for all ground-disturbing activities of 1 acre or more, a general stormwater permit must be obtained through the Wyoming Department of Environmental Quality (WDEQ) (WDEQ, 2006). Projects that disturb less than 1 acre are not required to obtain a permit.

Ground-disturbing activities in Montana of 1 acre or more require a General Permit through the Montana Department of Environmental Quality (DEQ) (Montana DEQ, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

## Domain 13

**Clean Water Act Nationwide Permit** - Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**Special Use Permit** - All proposed NEON sites in Domain 13 are on USFS lands. Proposed NEON, Inc. activities within the Roosevelt National Forest and the Arapaho National Forest, including infrastructure and data collection, would require a Special Use Permit from the USFS.

**Scientific Collection Permit** – Small mammal trapping in Colorado would require a scientific collection permit from the Colorado Division of Wildlife. In Utah a scientific collection permit would be required from the Utah Division of Wildlife Resources.

**Air Permitting** - In Utah, engines that emit less than 5 tons per year of particulate matter, sulfur dioxide, carbon monoxide, nitrogen oxides, and volatile organic compounds are exempt from permitting as long as the engine emits less than 500 pounds per year of any hazardous air pollutant, less than 2,000 pounds per year for any combination of hazardous air pollutants, less than 500 pounds per year of any air contaminant not listed above, and less than 2,000 pounds per year of any combination of air contaminants not listed above. New sources would be registered with the Utah Division of Air Quality (UDAQ) (UDAQ, 2009).

**General Construction Permit** – Ground-disturbing activities in Colorado of at least 1 acre require a Stormwater Construction Permit through the CDPHE Water Quality Control Division's Stormwater Program (CDPHE, 2007). Projects that disturb less than 1 acre are not required to obtain a permit.

In Utah, ground-disturbing activities of 1 acre or more are required to obtain a Utah Pollutant Discharge Elimination System (UPDES) Storm Water General Permit for Construction Activities through the Utah Department of Environmental Quality (UDEQ) (UDEQ, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

## Domain 14

**Clean Water Act Nationwide Permit** - Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**Scientific Collection Permit** - An annual scientific collection license would be obtained from the Arizona Game and Fish Department (AGFD) and/or the New Mexico Department of Game and Fish prior to conducting small mammal trapping in any year (AGFD, 2009).

**Special Use Permit** - Proposed NEON, Inc. activities at the Core Site in the Santa Rita Experimental Range, including infrastructure and data collection, would require a Special Use Permit from the USFS.

**Tower Registration** - AGFD may perform low elevation fixed-wing big game surveys within the footprint of the proposed project. Tower heights and GPS locations of all towers must be provided to the AGFD prior to construction (AGFD, 2008).

**NPDES Permit** - Sycamore Creek, which is proposed for the STREON experiments, is not included on the list of impaired streams under S. 303(d) of the CWA. Site-specific determination of appropriate permitting requirements will have to be made by the Arizona Department of Environmental Quality. NEON, Inc. would obtain any required permits prior to implementing STREON nutrient manipulation experiments.

**STREON Approval** - Water manipulation studies must be submitted to AGFD for review prior to implementation due to the potential to affect endemic populations of fish and amphibians through changes in water chemistry (AGFD, 2008).

**Air Permitting** - Pima County requires a permit through PDEQ for trenching over 300 feet to install utility lines (PDEQ, 2009).

The Pinal County Air Quality Control District (PCAQCD) requires that engines which operate for more than 72 hours per year be permitted. Additionally, the County must be notified of any new sources subject to the new source performance standards. Any activity disturbing 0.1 acre or more of ground must be permitted through the PCAQCD (Jain, personal communication, 2009).

The Maricopa County Air Quality Department in Arizona issues Dust Control Permits for activities that would disturb a surface area equal to or greater than 0.1 acre (MCAQD, 2009).

**General Construction Permit** - In Arizona, ground-disturbing activities of 1 acre or more require a Construction General Permit through the Arizona Department of Environmental Quality (ADEQ) (ADEQ, 2008). Projects that disturb less than 1 acre are not required to obtain a permit.

In New Mexico, a USEPA General Construction Permit is required for projects with land-disturbing activities between 1 and 5 acres (USEPA, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

## Domain 15

**Clean Water Act Nationwide Permit** - Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**BLM ROW Permit** - Proposed NEON infrastructure on the Onaqui-Benmore Experiment Station would require a right-of-way (ROW) permit from the Bureau of Land Management (BLM).

**Special Use Permit** - Proposed NEON, Inc. activities, including infrastructure and data collection, at Red Butte Canyon Research Natural Area (RNA) within the Wasatch-Cache National Forest would require a Special Use Permit from the USFS.

**Scientific Collection Permit** - Proposed NEON data collection activities would require two permits from the Utah Division of Wildlife Resources. Scientists conducting NEON data collection would need to obtain a permit for handling fish and a separate collection permit to conduct live-trapping of small mammals prior to conducting these activities.

**General Construction Permit** - In Utah, ground-disturbing activities of 1 acre or more are required to obtain a UPDES Storm Water General Permit for Construction Activities through the Utah Department of Environmental Quality (UDEQ) (UDEQ, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

# Domain 16

**Clean Water Act Nationwide Permit** - Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**Endangered Species Act Consultation**: Modification or alteration of designated critical habitat for the northern spotted owl would result from construction of Basic Towers and extension of utility services to those towers. Any modifications would require consultation with the USFWS.

**Scientific Collection Permit** - NEON, Inc. would obtain an annual scientific collection permit from the Washington Department of Fish and Wildlife (WDFW) in any year when small mammal trapping would be conducted. An annual collection report would be submitted each year, and would be required if the permit were to be renewed (WDFW, 2009). Additionally, NEON, Inc. would be required to obtain a permit through the Pacific Northwest Region 6 Research Station to collect in the Research Natural Area.

**Special Use Permit** - Proposed NEON, Inc. activities at the Core Sites, Relocatable Sites, and Aquatic Array within the Gifford Pinchot National Forest, including infrastructure and data collection, would require a Special Use Permit from the USFS.

Proposed NEON, Inc. activities at the STREON Site, including infrastructure and data collections, at the H.J. Andrews Experimental Forest, would require a Special Use Permit from the USFS.

**General Construction Permit** - In Washington, construction projects that disturb 1 or more of acres of land require a Construction Stormwater Permit through the Washington Department of Ecology (Washington Department of Ecology, 2009).

Ground-disturbing activities in Oregon of 1 acre or more require an NPDES 1200-C stormwater general permit through the Oregon Department of Environmental Quality (ODEQ) (ODEQ, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

**NPDES Permit** - The tributary to Lookout Creek that is proposed for the STREON experiments is not included on the list of impaired streams under S. 303(d) of the CWA. Further site-specific evaluation will be required and is likely to be section classified for use for resident fish and aquatic life, Salmonid fish rearing and spawning. Site-specific determination of appropriate permitting requirements will have to be made by the ODEQ and NEON, Inc. would have to obtain any required permits prior to implementing STREON nutrient manipulation experiments.

## Domain 17

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**Scientific Collection Permit -** An annual scientific collection permit would be obtained from the California Department of Fish and Game (CDFG) for collection of small mammals. In addition, a notice of intent to collect for scientific purposes would be submitted at least 24 hours before beginning any specific collection activity. Each year, a collection report would be submitted to the CDFG (CDFG, 2009).

**Special Use Permit -** Proposed NEON, Inc. activities at sites in Domain 17 within the Sierra National Forest, including infrastructure and data collection, would require a Special Use Permit from the USFS.

**Air Permitting -** Projects that would involve ground-disturbing activities of at least 1 acre, and where a Dust Control Plan is not required, must provide written notification to the San Joaquin Valley Air Pollution Control District at least 48 hours in advance of planned ground-disturbing activity (San Joaquin Valley Air, 2007).

**General Construction Permit -** Ground-disturbing activities of 1 or more acres of land require a Construction General Permit through the California Environmental Protection Agency (CA EPA) (CA EPA, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

**NPDES Permit -** Teakettle Creek, which is proposed for the STREON experiments, is not included on the list of impaired streams under S. 303(d) of the CWA. Site-specific determination of appropriate permitting requirements will have to be made by the California State Water Resources Control Board and NEON, Inc. would have to obtain any required permits prior to implementing STREON nutrient manipulation experiments.

## Domain 18

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE District.

**Scientific Collection Permit -** An annual scientific permit would be obtained from the Alaska Department of Fish and Game Division of Wildlife Conservation in advance of conducting any trapping for small mammals. After any year in which an annual scientific permit is obtained, an annual report of activities and collections must be filed by January 31 (Alaska Department of Fish and Game Division of Wildlife Conservation, 2008).

**General Construction Permit -** A USEPA General Construction Permit is required for projects with land-disturbing activities between 1 and 5 acres (USEPA, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

**NPDES Permit** - The Kuparuk River, which is proposed for the STREON experiments, has been classified as a Category 3 river, meaning that insufficient data are available to determine any limitations to releases into this waterbody. Site-specific determination of appropriate permitting requirements will have to be made by the USEPA and NEON, Inc. would have to obtain any required permits prior to implementing STREON nutrient manipulation experiments.

**BLM ROW Permit -** Proposed NEON infrastructure on BLM property would require a ROW permit from the BLM.

**Special Use Permit -** Proposed NEON, Inc. activities at sites in the Alaska State Forest, including infrastructure and data collection, would require a Special Use Permit from the USFS.

## Domain 19

**Clean Water Act Nationwide Permit -** Construction of a weir or flume to monitor flow in streams would be authorized under NWP 5 without filing a PCN for any such structures that would entail placement of less than 25 $yd^3$ of fill material in regulated waters (USACE, 2009). If a greater amount of fill material were needed, that activity would require permitting through the appropriate USACE Regulatory Program.

**Scientific Collection Permit -** An annual scientific permit would be obtained from the Alaska Department of Fish and Game Division of Wildlife Conservation in advance of any trapping for small mammals. After any year in which an annual scientific permit is obtained, an annual report of activities and collections must be filed by January 31 (Alaska Department of Fish and Game Division of Wildlife Conservation, 2008).

**General Construction Permit -** A USEPA General Construction Permit is required for projects with land-disturbing activities between 1 and 5 acres (USEPA, 2009). Projects that disturb less than 1 acre are not required to obtain a permit.

**NPDES Permit** - Caribou Creek, which is proposed for the STREON experiments, is not included on the list of impaired streams under S. 303(d) of the CWA. Site-specific determination of appropriate permitting requirements will have to be made by the USEPA and NEON, Inc. would have to obtain any required permits prior to implementing STREON nutrient manipulation experiments.

**BLM ROW Permit -** Proposed NEON infrastructure on BLM property would require a ROW permit from the BLM.

**Special Use Permit -** Proposed NEON, Inc. activities at Relocatable Sites in the Alaska State Forest, including infrastructure and data collection, would require a Special Use Permit from the USFS.

Proposed NEON, Inc. activities for sites in Kenai National Wildlife Refuge, including infrastructure and data collections, would require a Special Use Permit from the USFWS.

## Domain 20

**Special Use Permit** – Work within the HETF would require a Special Use Permit, which also incorporates Natural Area Reserves System Special Use Permit requirements. These permits are issued by the Hawai'i Department of Land and Natural Resources.

**General Construction Permit -** Ground-disturbing activities of 1 or more acres require an NPDES general permit from the Hawai'i Department of Health, Clean Water Branch (Hawai'i Department of Health, 2003). Projects that disturb less than 1 acre are not required to obtain a permit. DLNR-DOFAW staff would monitor construction activities within HETF.

**Construction Monitoring** – Construction of NEON, Inc. sites and infrastructure would be monitored by the Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR-DOFAW).

**Weed Control and Monitoring** – NEON, Inc. would be responsible for re-vegetation, collection of seeds, and weed control. NEON, Inc. would also be responsible for monitoring these activities and would report to the DLNR-DOFAW.

**Endangered Species Act Consultation**: Endangered species are known to occur in the Laupāhoehoe and Pu'u Wa'awa'a sections of the HETF outside of areas designated as critical habitat. Potential modification of habitat in these areas could result from site construction. Any modifications would require consultation with the USFWS and DLNR-DOFAW.

**Conservation District Use Permit** – Approval from the Board of Land and Natural Resources (BLNR) would be required for constructing and operating sites within the Conservation District. Any activity within the Natural Area Reserves would require Natural Area Reserves System Commission approval prior to BLNR approval.

**Hawai'i Department of Land and Natural Resources Permits** – BLNR requires permits for accessing DOFAW managed lands, collection of forest items, actions affecting any endangered, threatened, candidate or proposed species, and handling of invertebrates.

**Special Activity Permit** – Any research, educational, or management institution intending to collect aquatic life is required to obtain a Special Activity Permit through the Hawai'i Division of Aquatic Resources.

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# 7.0 ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| °C | degrees Centigrade |
| %g | percent of gravitational acceleration |
| % pga | peak ground acceleration |
| 15N | Isotopic nitrogen |
| AC | Advisory Circular |
| A.D. | Anno Domini |
| ADEQ | Arizona Department of Environmental Quality |
| AEF | H.J. Andrews Experimental Forest |
| AOP | Airborne Observation Platform |
| AP | Auxiliary Portal |
| ASU | Arizona State University |
| AT | Appalachian National Scenic Trail |
| ATBI | All Taxa Biodiversity Index |
| B.C. | Before Christ |
| BCDRP | Baltimore County Department of Recreation and Parks |
| BEF | Blandy Experimental Farm |
| BLM | Bureau of Land Management |
| BMP | Best Management Practice |
| BP | Before Present |
| CofA | Climate of the Appalachian |
| CAA | Clean Air Act |
| CAP | Central Arizona-Phoenix |
| CAPLTER | Central Arizona–Phoenix Long-Term Ecological Research |
| CBP | Chesapeake Bay Program |
| CEQ | Council on Environmental Quality |
| CFPCW | Caribou Flats-Poker Creek Watershed |
| CFR | *Code of Federal Regulations* |
| cm | Centimeter(s) |
| $CO_2$ | Carbon dioxide |
| CPCRW | Caribou-Poker Creeks Research Watershed |
| CPER | Central Plains Experimental Range |
| CRS | Canyonlands Research Station |
| CSRV | Cumberlands and Southern Ridge and Valley |

| | |
|---|---|
| CWA | Clean Water Act of 1977 |
| dBA | A-weighted Decibel |
| DCFS | Dakota Coteau Field School |
| DEQ | Department of Environmental Quality |
| DHR | Division of Historical Resources |
| DLNR-DOFAW | State of Hawaii Department of Land and Natural Resources Division of Forestry and Wildlife |
| DNR | Department of Natural Resources |
| DSL | Digital Subscriber Line |
| DSW | Desert Southwest |
| DWP | Disney Wilderness Preserve |
| EA | Environmental Assessment |
| EO | Executive order |
| EROS | Earth Research Observing and Science |
| ESA | Endangered Species Act of 1973 |
| ESU | Evolutionary Significant Unit |
| ETF | Experimental Tropical Forest |
| FAA | Federal Aviation Administration |
| FABLSP | Fort Abraham Lincoln State Park |
| FDEP | Florida Department of Environmental Protection |
| FEF | Fraser Experimental Forest |
| FEMA | Federal Emergency Management Agency |
| FHWA | Federal Highway Administration |
| FIDBH | Forest Interior Dwelling Bird Habitat |
| FIRM | Flood Insurance Rate Map |
| FIU | Fundamental Instrument Unit |
| FLFWC | Florida Fish and Wildlife Conservation |
| FNAI | Florida Natural Areas Inventory |
| FR | Federal Register |
| FSF | Forest Service Facility |
| FSMF | Florida State Master File |
| FSU | Fundamental Sentinel Unit |
| $ft^2$ | Square foot/feet |
| GADNR | Georgia Department of Natural Resources |
| GASF | Georgia Archaeological Site File |
| GDFR | Guánica Dry Forest Reserve |

| | |
|---|---|
| GPS | Global Positioning System |
| GSMNP | Great Smoky Mountains National Park |
| GVEA | Golden Valley Electric Association |
| GYE | Great Yellowstone Ecosystem |
| ha | Hectare |
| HETF | Hawaii Experimental Tropical Forest |
| HU | Hunting Unit |
| ICP | Instituto de Cultura Puertorriqueña |
| IH | Instrument Hut |
| IMU | Inertial Measurement Unit |
| JBLTER | Jornada Basin Long Term Ecological Research |
| KDWP | Kansas Department of Wildlife and Parks |
| kg | Kilogram(s) |
| km | Kilometer(s) |
| $km^2$ | Square kilometer |
| KPBS | Konza Prairie Biological Station |
| KREW | Kings River Experimental Watershed |
| KRRS | Klemme Range Research Station |
| kW | Kilowatt(s) |
| LAES | Lajas Agricultural Experiment Station |
| LBJ | Lyndon B. Johnson National Grasslands |
| LETF | Laupāhoehoe Experimental Tropical Forest |
| LiDAR | Light Detection and Ranging |
| LTER | Long Term Ecological Research |
| LUAP | Land Use Analysis Package |
| $\mu g$ | Microgram(s) |
| m | Meter(s) |
| $m^2$ | Square meter(s) |
| $m^3$ | Cubic meter(s) |
| $m^3sec^{-1}$ | Cubic meter(s) per second |
| MACRI | Massachusetts Cultural Resource Information System |
| MBTA | Migratory Bird Treaty Act |
| MDEQ | Montana Department of Environmental Quality |
| MDEP | Massachusetts Department of Environmental Protection |

| | |
|---|---|
| MDFW | Massachusetts Division of Fisheries and Wildlife |
| MDOE | Maryland Department of the Environment |
| MDP | Mobile Deployment Platform |
| MFWP | Montana Fish, Wildlife, and Parks |
| MHC | Massachusetts Historical Commission |
| MIC | Management Indicator Communities |
| MIS | Management Indicator Species |
| MLBS | Mountain Lake Biological Station |
| mm | Millimeter(s) |
| MRCC | Midwestern Regional Climate Center |
| MSF | Maricao State Forest (Bosque Estatal de Maricao) |
| NAAQS | National Ambient Air Quality Standards |
| NAHRGIS | Natural, Archaeological, and Historical Resources GIS |
| NALMS | North American Lake Management Society |
| NDDOH | North Dakota Department of Health |
| NDPRD | North Dakota Parks and Recreation Department |
| NDSU | North Dakota State University |
| NEON | National Ecological Observatory Network |
| NEPA | National Environmental Policy Act |
| NGPRL | Northern Great Plains Research Laboratory |
| NHNM | Natural Heritage New Mexico |
| NHP | Natural Heritage Program |
| NHPA | National Historic Preservation Act of 1966 |
| NHRP | National Register of Historic Places |
| NHT | National Historic Trail |
| NOAA | National Oceanic and Atmospheric Administration |
| $NO_x$ | Nitrogen Oxides |
| NPS | National Park Service |
| NRC | National Research Council |
| NRCS | Natural Resources Conservation Service |
| NRHP | National Register of Historic Places |
| NRIS | National Register Information System |
| NSF | National Science Foundation |
| NST | National Scenic Trail |
| NSU | Northern State University |
| NWI | National Wetland Inventory |

| | |
|---|---|
| NWP | Nationwide Permit |
| NWR | National Wildlife Refuge |
| NWT | Niwot Ridge |
| ONF | Ottawa National Forest |
| ORNC | Oregon Ridge Nature Center |
| ORNL | Oak Ridge National Laboratory |
| ORP | Oregon Ridge Park |
| ORR | Oak Ridge Reservation |
| OSBS | Ordway-Swisher Biological Station (University of Florida) |
| OSU | Oklahoma State University |
| PCBs | Polychlorinated Biphenyls |
| PCN | Pre-construction notification |
| PCS | Portal Container Set |
| PDF | Project Design Feature |
| PETS | Proposed, Endangered, Threatened, and Sensitive |
| PGP | Programmatic General Permit |
| ppm | Part(s) per million |
| PTES | Proposed, Threatened, Endangered, and Sensitive |
| PWETF | Pu'u Wa'awa'a Experimental Tropical Forest |
| RCW | Red-cockaded Woodpecker |
| RFI | Request for Information |
| RMNP | Rocky Mountain National Park |
| RNA | Research Natural Area |
| ROI | Region of Influence |
| ROW | Right-of-way |
| RPM | Reasonable and prudent Measure |
| SCRC | Smithsonian Conservation Research Center |
| SERC | Smithsonian Environmental Research Center |
| SFSU | San Francisco State University |
| SHPO | State Historic Preservation Office |
| SI | Système International |
| SJER | San Joaquin Experimental Range |
| SNZP | Smithsonian National Zoological Park |
| SPPC | Spill prevention, control, and countermeasures |
| SR | State Road |

| | |
|---|---|
| SRCC | Southern Regional Climate Center |
| SRER | Santa Rita Experimental Range |
| STREON | Stream Observatory Network |
| TDWR | Texas Department of Water Resources |
| TDEC | Tennessee Department of Environment and Conservation |
| TEF | Teakettle Experimental Forest |
| TFS | Toolik Field Station |
| TNF | Talladega National Forest |
| TPWD | Texas Parks and Wildlife Division |
| TWRA | Tennessee Wildlife Resources Agency |
| U.S. | United States |
| UND | University of Notre Dame |
| UNDERC | University of Notre Dame Environmental Research Center |
| UNESCO | United Nations Education, Scientific, and Cultural Organization |
| UO | University of Oklahoma |
| UOBS | University of Oklahoma Biological Station |
| UofA | University of Arizona |
| USACE | U.S. Army Corps of Engineers |
| USC | United States Code |
| USDA | United States Department of Agriculture |
| USEPA | United States Environmental Protection Agency |
| USFS | U.S. Forest Service |
| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geological Survey |
| UTEP | University of Texas at El Paso |
| UW | University of Wisconsin |
| UWEX | University of Wisconsin Extension Service |
| VDCR | Virginia Department of Conservation and Recreation |
| VDEQ | Virginia Department of Environmental Quality |
| VDGIF | Virginia Department of Game and Inland Fisheries |
| VDHR | Virginia Department of Historic Resources |
| VLR | Virginia Landmarks Register |
| VRM | Visual Resource Management |
| WDE | Washington Department of Ecology |
| WDFW | Washington Department of Fish and Wildlife |

| | |
|---|---|
| WDNR | Washington Department of Natural Resources |
| WFS | Woodworth Field Station |
| WGFD | Wyoming Game and Fish Division |
| WI DNR | Wisconsin Department of Natural Resources |
| WRCC | Western Regional Climate Center |
| WREF | Wind River Experimental Forest |
| WRRI | Water Resources Research Institute |
| WTPR | Welcome To Puerto Rico |
| $yd^3$ | Cubic yard(s) |
| YBSF | Yacolt Burn State Forest |
| YNP | Yellowstone National Park |
| YNR | Yellowstone Northern Range |

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# Appendix A
# Table for Converting SI Units to English Units

Length

| | |
|---|---|
| 1 Inch | 2.54 Centimeters |
| 1 Foot | 30.480 Centimeters |
| 1 Yard | 0.914 Meters |
| 1 Mile | 1.609 Kilometers |
| 1 Millimeter | 0.039 Inches |
| 1 Centimeter | 0.393 Inches |
| 1 Meter | 3.280 Feet |
| 1 Meter | 1.093 Yards |
| 1 Kilometer | 0.621 Miles |

Weight

| | |
|---|---|
| 1 Ounce | 28.350 Grams |
| 1 Pound | 0.453 Kilograms |
| 1 Gram | 0.035 Ounces |
| 1 Kilogram | 2.204 Pounds |

Volume

| | |
|---|---|
| 1 Fluid ounce | 29.573 Milliliters |
| 1 Pint | 0.473 Liters |
| 1 Quart | 0.946 Liters |
| 1 Gallon | 3.785 Liters |
| 1 Milliliter | 0.033 Fluid Ounces |
| 1 Cubic Inch | 0.01639 Liters |
| 1 Cubic Inch | 0.0043 Gallons |

Temperature

Celsius=(Fahrenheit-32)x.555
Fahrenheit=(Celsiusx1.8)+32

Area

| | |
|---|---|
| 1 Square mile | 639.99999999 Acres |
| 1 Hectare | 2.4710538147 Acres |
| 1 Square kilometer | 247.10538147 Acres |
| 1 Square foot | 0.00002295684139 Acres |
| 1 Square yard | 0.00020661157025 Acres |
| 1 million gallon | 3,785.412 m3 |

# Appendix B
# Sensitive Species Identified as Potentially Occurring Near Proposed NEON Locations in Each Domain

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 1 | | Domain Name: Northeast | | | |
| | | | | | |
| Core and Aquatic Site Name: A-1, C-1, C-2, and C-3 | | | Mgmt. Agency: Harvard University | | State: Massachusetts |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Ebony boghaunter (*Williamsonia fletcheri*) | SE | Wet sphagnum bogs and swampy northern wetlands, often with soupy sphagnum pools, typically adjacent to coniferous or mixed coniferous/deciduous woodlands where the adults hunt and roost (Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program, 2003a) | Yes | Yes, species could occur in and around Black Gum Swamp | very low possibility of disturbance during sampling |
| Ski-tipped Emerald (*Somatochlora elongata*) | SSC | Small to medium sized streams with moderate to very sluggish flow and dense or little emergent vegetation (Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program, 2003b) | Yes | Yes, This species could occur along the unnamed tributary to Bigelow Brook at the proposed aquatic site | very low possibility of disturbance during sampling |
| | | | | | |
| Relocatable and Aquatic Site Names: R-2 and A-2 | | | Mgmt. Agency: Town of Burlington | | State: Massachusetts |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status* (List those that apply)** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Eastern Box Turtle (*Terrapene carolina*) | SSC | Terrestrial turtle found in both dry and moist woodlands, brushy fields, thickets, marsh edges, bogs, swales, fens, stream banks, and well-drained bottomland (Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program, 2007) | Yes | Yes, This species could occur at either of the two proposed NEON locations | No impacts. Construction would avoid impacts to this species. |
| Variable Sedge (*Carex polymorpha*) | SE | Only 1 Massachusetts occurrence in an abandoned cranberry bog, where it grows on manmade dikes and into forest; grows in strongly acidic, friable, loamy-sands to sandy loams that are low in nutrients (Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program, 1990) | Yes | No | None, preferred habitat is not present |
| | | | | | |

| | | |
|---|---|---|
| Notes | | |
| [a] = Data from MacCallum, 2008, personal communication. | | |
| [b] = Species Status Codes | | |
| **Federal Status:** | **State:** | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program data base search** |
| Endangered Species Act status as published in the *Federal Register*: | Massachusetts species status as designated under M.G.L. c. 131A and 321 CMR 10.00. | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. |
| FE = Federally Endangered | SE = State Endangered | S2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6-20 occurrences. |
| FT = Federally Threatened | ST = State Threatened | S3 = Rare, uncommon, or threatened, but not immediately imperiled, typically with 21-100 occurrences. |
| FC = Federal Candidate | SSC = State Special Concern | |
| FP = Federal Proposed | | |

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| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 1 | | Domain Name: Northeast | | | |
| | | | | | |
| Relocatable Site Name: R-1 | | | Mgmt. Agency: USFS | | State: New Hampshire |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| American Cancer-root (*Conopholis americana*) | ST | Rich, mesic forests (Weakley, 2008) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Douglas' Knotweed (*Polygonum douglasii)* | SE, FSS | Rocky slopes and dry soils (Ibiblio, 2009). | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Fogg's Goosefoot (*Chenopodium foggii*) | SE, FSS | Dry to mesic sandy and/or thin soils, often over circumneutral or calcareous bedrock; in open areas such as hardwood, mixed woodlands and forests, rocky slopes or clearings (NatureServe, 2009) | Yes | No | None, preferred habitat is not present in construction area. |
| American Ginseng (*Panax quinquefolius*) | ST, FSS | Rich, cool, moist but not extremely wet woods, under a closed canopy (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Purple Cliffbrake (*Pellaea atropurpurea*) | SE | Outcrops of limestone and other rocks (Weakley, 2008) | Yes | No | None, preferred habitat is not present in construction area. |
| Rock Sandwort (*Minuartia michauxii)* | SE | limestone, dolostone, calcareous sandstone, and calcareous shale outcrops and barrens (Weakley, 2008) | Yes | No | None, preferred habitat is not present in construction area. |
| Smooth Sandwort (*Minuartia glabra*) | SE | Silicaceous rock outcrops (NatureServe, 2009) | Yes | No | None, preferred habitat is not present in construction area. |
| Square-stem Goldenrod (*Solidago patula*) | SE | Bogs, seepages over mafic rocks, grassy balds (Weakley, 2008) | Yes | No | None, preferred habitat is not present in construction area. |
| Eastern Small-footed bat (*Myotis leibii*) | FSS | Generally found in hilly or mountainous area in both deciduous and coniferous forests, require cold dry caves as hibernacula (USFS, 2007) | Yes | Yes | Very low. Towers would be stationary. USFWS recommended mitigation measures would be implemented. |
| Northern Bog Lemming (*Synaptomys borealis sphagnicola*) | FSS | mossy spruce woods, low elevation spruce-fir hemlock and beech forests, sphagnum bogs, damp weedy meadows, and alpine sedge meadows (USFS, 2007) | No | No | None. R-1 is not located at or near a bog or wet area. |
| Bicknell's Thrush (*Catharus bicknelli*) | FSS | In U.S. mainly occurs above 914 m in montane forests dominated by stunted balsam fir and re spruce (NatureServe, 2009) | No | No | None. R-1 site consists of mixed hardwoods and is below 914 m in elevation. |
| American Peregrine Falcon (*Falco peregrinus anatum*) | FSS | high cliffs or ledges overlooking riparian habitats (USFS, 2007) | No | No | None. R-1 is not being placed on a cliff or ledge. |
| Common Loon (*Gavia immer*) | FSS | Prefer larger lakes with islands, can occur on small ponds (USFS, 2007) | No | No | None. No water bodies are present at R-1 site. |
| Osprey (*Pandion haliaetus*) | FSS | Primarily along rivers, lakes, reservoirs, and seacoasts (NatureServe, 2009) | No | No | None. No water bodies are present at R-1 site. |
| Pied-billed Grebe (*Podilymbus podiceps*) | FSS | Water bodies typically greater than 12 acres with open water and emergent vegetation (USFS, 2004) | No | No | None. No water bodies are present at R-1 site. |
| Wood Turtle (*Clemmys insculpta*) (*Glyptemys*) | FSS | hibernates in slow-moving streams, rivers, and some ponds. spend summers usually near permanent streams in upland bogs, wet meadows, upland fields, farmland, and deciduous forest (USFS, 2007) | No | Yes | Very low. Prefer areas with nearby streams, but could forage in the area. Could be harmed during construction. |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |

| | | | | | |
|---|---|---|---|---|---|
| A Mayfly (*Ameletus browni*) | FSS | Larvae prefer erosional areas in cold, fast-moving headwater streams with high pH with canopy cover and rocks or boulders presence and adults typically remain along stream banks near emergence sites (USFS, 2005) | No | No | None. No water bodies are present at R-1 site. |
| A Mayfly (*Ameletus tertius*) | FSS | Larvae found in small and large streams in secondary depositional areas and on submerged grasses and detritus along margins of riffles. Typically remain along stream banks near emergence site (USFS, 2005) | No | No | None. No water bodies are present at R-1 site. |
| White Mountain Fritillary (*Boloria chariclea montina*) | FSS | Above to slightly below the timberline in Presidential Range, NH, especially around springs, above 1,219 m (NatureServe, 2009) | No | No | None. R-1 site is below 1,219 m. |
| Appalachian Tiger Beetle (*Cicindela ancocisconensis*) | FSS | along the margins of clear, clean mountain streams to moderate-sized rivers with some degree of shading (USFS, 2007) | No | No | None. No water bodies are present at R-1 site. |
| White Mountain Butterfly (*Oeneis melissa semidae*) | FSS | Alpine tundra of the Presidential Range, NH (NatureServe, 2009) | No | No | None. Alpine tundra not present at R-1 site. |
| Warpaint Emerald (*Somatochlora incurvata*) | FSS | bogs, fens, and heaths (USFS, 2007) | No | No | None. No bogs, fens, and heaths at R-1 site. |
| Missouri Rock Cress (*Arabis missouriensis v. deamii)* | FSS | talus slopes, rocky outcrops, balds, ledges, and cliffs (USFS, 2007) | No | No | None. R-1 would not be placed on rocky habitat. |
| Alpine Bearberry (*Arctostaphylos alpina*) | FSS | Rocky soil of subalpine heaths, alpine, and arctic tundra (NatureServe, 2009) | No | No | None. Suitable habitat is not present at R-1. |
| Lanceleaf Arnica (*Arnica lanceolata*) | FSS | Cool, moist sites including stream banks, ditches, gravel bars, wet rocky to gravelly shores, wet ledges and cliffs, seep areas, and moist subalpine meadows (NatureServe, 2009) | No | No | None. Habitat at R-1 is not suitable for this species. |
| Robbin's Milkvetch (*Astragalus robbinsii var minor*) | FSS | talus slopes, rocky outcrops, balds, ledges, and cliffs (USFS, 2007) | No | No | None. Tower would not be placed on rock. |
| Dwarf White Birch (*Betula minor*) | FSS | Prefers alpine meadows and can be found on the edges of krummholz (NatureServe, 2009) | No | No | None. Habitat not suitable at R-1. |
| Alpine Bitter-cress (*Cardamine bellidifolia*) | FSS | Found on alpine cliffs (acidic) habitat (Maine DOC, 2009). | No | No | None. Alpine cliff habitat not present at R-1 site. |
| Bailey's Sedge (*Carex baileyi*) | FSS | Moist open lands, typically moist to wet, exposed to full sun and high organic matter (USFS, 2007) | No | No | None. R-1 not being constructed in moist or open areas. |
| Head-like sedge (*Carex capitata ssp arctogena*) | FSS | Dry or wet acidic rocky or gravely soil in the alpine (USFS, 2004) | No | No | None. R-1 not being placed in wet rocky area. |
| Clustered Sedge (*Carex cumulata*) | FSS | talus slopes, rocky outcrops, balds, ledges, and cliffs (USFS, 2007) | No | No | None. Tower would not be placed on rock. |
| Bulrush Sedge (*Carex scirpoidea*) | FSS | Associated with rocky summits, outcrops, and cliffs and open ledges and subalpine habitats (USFS, 2004) | No | No | None. Tower would not be placed on rock. |
| Wiegand's Sedge (*Carex wiegandii*) | FSS | Moist open lands, typically moist to wet, exposed to full sun and high organic matter (USFS, 2007) | No | No | None. Tower not placed in open area. |
| Autumn Coral-root (*Corallorhiza odontorhiza*) | FSS | Non-enriched hardwood forests (USFS, 2007) | No | Yes | Low. Populations would be avoided, but impact could occur during construction. |
| Goldie's Woodfern (*Dryopteris goldiana*) | FSS | Mesic to moist, heavily shaded and high in nutrients and organic matter in enriched forests (USFS, 2007) | No | No | None. Not in enriched forest. |
| Oakes' Eyebright (*Euphrasia oakesii*) | FSS | Dry to mesic alpine/subalpine, wet alpine (NHDFL, 2008) | No | No | None. R-1 is not located in alpine or subalpine habitat. |
| Proliferous Red Fescue (*Festuca prolifera*) | FSS | Wet alpine (NHDFL, 2008) | No | No | None. R-1 is not located in alpine habitat. |
| | | | | | |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Boreal Bedstraw (*Galium kamtschaticum*) | FSS | Rich seep habitats with non-channelized flowing surface water; in cool, wet hardwood, mixed, or conifer woods, swamps, and stream sides (USFS, 2005) | No | No | None. R-1 is not located in a wet area. |
| Northern Comandra (*Geocaulon lividum*) | FSS | Moist, shaded habitats and forested seeps, and other shaded wet sites (USFS, 2007) | No | No | None. R-1 is not located in a wet area. |
| Mountain Avens (*Geum peckii*) | FSS | Dry to mesic alpine/subalpine, wet alpine, and riverbanks (NHDFL, 2008) | No | No | None. R-1 is not located in alpine or subalpine habitat or near a stream. |

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|---|---|---|---|---|---|
| Moss Bell-Heather (*Harrimanella hypnoides*) | FSS | Snow bank communities, wet seeps, ledges, and crevices in alpine habitats (USFS, 2004) | No | No | None. R-1 is not located in alpine habitat. |
| Butternut (*Juglans cinerea*) | FSS | Mesic to moist, heavily shaded and high in nutrients and organic matter in enriched forests (USFS, 2007) | No | No | None. Not in enriched forest. |
| Auricled Twayblade (*Listera auriculata*) | FSS | Temporarily flooded and seasonally ice-scoured riverbanks in northern forests (USFS, 2007) | No | No | None. No streams or rivers at R-1 site. |
| Broad-leaved (or Broad-lipped) Twayblade (*Listera convallarioides*) | FSS | Moist, shaded habitats and forested seeps, and other shaded wet sites (USFS, 2007) | No | No | None. R-1 not located in wet area. |
| Heartleaf Twayblade (*Listera cordata*) | FSS | Moist, shaded habitats and forested seeps, and other shaded wet sites (USFS, 2007) | No | No | None. R-1 not located in wet area. |
| Prairie Goldenrod (*Oligoneuron album*) | FSS | talus slopes, rocky outcrops, balds, ledges, and cliffs (USFS, 2007) | No | No | None. R-1 not to be constructed on rock. |
| Alpine Cudweed (*Omalotheca supina*) | FSS | Dry to mesic alpine/subalpine (NHDFL, 2008) | No | No | None. R-1 not in alpine or subalpine zone. |
| Northern Adder's-tongue (*Ophioglossum pusillum*) | FSS | Moist open lands, typically moist to wet, exposed to full sun and high organic matter (USFS, 2007) | No | No | None. R-1 is not located in open area. |
| Chilean Sweet Cicely (*Osmorhiza berteroi*) | FSS | Mesic to moist, heavily shaded and high in nutrients and organic matter in enriched forests (USFS, 2007) | No | No | None. Not in enriched forest. |
| Mountain Sorrel (*Oxyria digyna*) | FSS | Moist, rocky slopes and ledges; alpine stream sides and ravines; snow banks and headwalls, located above 1,067 m (USFS, 2004) | No | No | None. R-1 is well below 1,067 m. |
| Silverling (*Paronychia argyrocoma*) | FSS | talus slopes, rocky outcrops, balds, ledges, and cliffs (USFS, 2007) | No | No | None. R-1 would not be constructed or placed on rock. |
| Sweet Coltsfoot (*Petasites frigidus var palmatus*) | FSS | Mesic to moist, heavily shaded and high in nutrients and organic matter in enriched forests (USFS, 2007) | No | No | None. Not in enriched forest. |
| Canada Mountain-ricegrass (*Piptatherum canadensis*) | FSS | open, dry sunny locations with sandy or rocky substrate including sandy roadsides, exposed ledges, open woodlands, young woods, and open shrub lands (USFS 2007) | No | No | None. Suitable habitat is not present at R-1. |
| Wavy Bluegrass (*Poa laxa* ssp. *Fernaldiana*) | FSS | Dry to mesic alpine/subalpine (NHDFL, 2008) | No | No | None. R-1 not in alpine or subalpine zone. |
| Alpine Meadow Grass (*Poa pratensis* ssp *alpigena*) | FSS | Nutrient poor soils in alpine/subalpine dry-mesic heath and meadow communities (USFS, 2004) | No | No | None. R-1 not in alpine or subalpine zone. |
| Viviparous Knotweed (*Polygonum viviparum*) | FSS | Wet, mossy rocks, cool or damp slopes, gravels, and seeps in alpine and subalpine areas (USFS, 2004) | No | No | None. R-1 not in alpine or subalpine zone. |
| Robbins' cinquefoil (*Potentilla robbinsiana*) | FSS | Dry to mesic alpine/subalpine (NHDFL, 2008) | No | No | None. R-1 not in alpine or subalpine zone. |
| Boott's Rattlesnake Root (*Prenanthes boottii*) | FSS | Dry to mesic alpine/subalpine (NHDFL, 2008) | No | No | None. R-1 not in alpine or subalpine zone. |
| Pink Wintergreen (*Pyrola asarifolia*) | FSS | Mesic to moist, heavily shaded and high in nutrients and organic matter in enriched forests (USFS, 2007) | No | No | None. Not in enriched forest. |
| Northern Willow (*Salix argyrocarpa*) | FSS | Moist soils in alpine or subalpine at stream sides and ravines (USFS, 2004) | No | No | None. R-1 not in alpine or subalpine zone. |
| New England Dwarf Willow (*Salix herbacea*) | FSS | Snow bank/wet ravine alpine system (USFS, 2004) | No | No | None. R-1 not in alpine zone. |
| Three-leaved Blake Snakeroot (*Sanicula trifoliata*) | FSS | Mesic to moist, heavily shaded and high in nutrients and organic matter in enriched forests (USFS, 2007) | No | No | None. Not in enriched forest. |
| | | | | | |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Alpine Brook Saxifrage (*Saxifraga rivularis*) | FSS | Alpine ravines, wet and mossy areas, wet cliffs, and some dry-mesic heath alpine/subalpine communities (USFS, 2004) | No | No | None. R-1 not in alpine or subalpine zone. |
| Creeping sibbaldia (*Sibbaldia procumbens*) | FSS | Snow bank/wet meadow/streamside alpine communities; only known at snowfield in Tuckerman's (USFS, 2004) | No | No | None. R-1 not in alpine zone. |
| Moss Campion (*Silene acaulis var exscapa*) | FSS | Dry to mesic alpine/subalpine (NHDFL, 2008) | No | No | None. R-1 not in alpine or subalpine zone. |
| Alpine Meadow-sweet (*Spiraea septentrionalis*) | FSS | Cool wet ravine alpine and subalpine habitats (USFS, 2004) | No | No | None. R-1 not in alpine or subalpine zone. |
| Nodding Pogonia (*Triphora trianthophora*) | FSS | Non-enriched hardwood forests (USFS, 2007) | No | Yes | Low. Populations would be avoided, but impact could occur during construction. |
| Northern Blueberry (*Vaccinium boreale*) | FSS | Dry to mesic alpine/subalpine and wet alpine (NHDFL, 2008) | No | No | None. R-1 not in alpine or subalpine zone. |

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|---|---|---|---|---|---|
| Mountain Hairgrass (*Vahlodea atropurpurea*) | FSS | Limited to alpine/subalpine zone, especially herbaceous snow bank communities (USFS, 2004) | No | No | None. R-1 not in alpine or subalpine zone. |
| Anderson's sphagnum (*Sphagnum andersonianum*) | FSS | Moist open lands, typically moist to wet, exposed to full sun and high organic matter (USFS, 2007) | No | No | None. R-1 site is not exposed to full sun. |
| Angerman's sphagnum (*Sphagnum angermanicum*) | FSS | Moist open lands, typically moist to wet, exposed to full sun and high organic matter (USFS, 2007) | No | No | None. R-1 site is not exposed to full sun. |
| A sphagnum (*Sphagnum flavicomans*) | FSS | Moist open lands, typically moist to wet, exposed to full sun and high organic matter (USFS, 2007) | No | No | None. R-1 site is not exposed to full sun. |
| | | | | | |
| Notes | | | | | |
| [a] = Data from Coppola, 2008, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |

| Federal Status: | State: | Federal Agency Status |
|---|---|---|
| Endangered Species Act status as published in the *Federal Register*: | New Hampshire plant species status as designated under the Native Plant Protection Act. | FSS = White Mountain National Forest Regional Forester Sensitive Species (Rees, 2003) |
| FE = Federal Endangered | SE = State Endangered | |
| FT = Federal Threatened | ST = State Threatened | |
| FC = Federal Candidate . | | |
| FP = Federal Proposed | | |


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| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 2 | | Domain Name: Mid-Atlantic | | | |
| | | | | | |
| Relocatable and Streon Site Name: R-3 and S-4 | | | Mgmt. Agency: Smithsonian | | State: Maryland |
| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence Within 5 km | Is suitable habitat present? | Likelihood of impact and rationale |
| No State or Federal records for rare, threatened, or endangered species within the project sites. | | | | | |
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| Notes | | | | | |
| [a] = Data from Byrne, 2009, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |

| Federal Status: | State: | Natural Heritage Program: S1, S2, or S3 rank from Heritage Program |
|---|---|---|
| Endangered Species Act status as published in the *Federal Register*: | Maryland species status as designated from Maryland Department of Natural Resources. | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. |
| FE = Federal Endangered | SE = State Endangered | S2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6-20 occurrences. |
| FT = Federal Threatened | ST = State Threatened | S3 = Rare, uncommon, or threatened, but not immediately imperiled, typically with 21-100 occurrences. |
| FC = Federal Candidate | | |
| FP = Federal Proposed | | |

References:

Byrne, L / Maryland Department of Natural Resources, 2009. Personal communication with CH2M HILL. January 13.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| **Domain (number): 2** | | **Domain Name: Mid-Atlantic** | | | |
| | | | | | |
| **Core, Relocatable, and Aquatic Site Name: C-4, C-5, C-6, R-4, and A-3** | | | **Mgmt. Agency: University of Virginia** | | **State: Virginia** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| No species are reported within the project area. | | | | | |
| | | | | | |
| Notes | | | | | |
| [a] = Data from Hypes, 2008, personal communication and Hypes, 2009, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |
| **Federal Status:** | **State:** | | | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program data base search** | |
| Endangered Species Act status as published in the *Federal Register*: | Virginia species status as designated by the Virginia Department of Agriculture and Consumer Services. | | | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. | |
| FE = Federal Endangered | SE = State Endangered | | | S2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6-20 occurrences. | |
| FT = Federal Threatened | ST = State Threatened | | | S3 = Rare, uncommon, or threatened, but not immediately imperiled, typically with 21-100 occurrences. | |
| FC = Federal Candidate | SPE = State Proposed Endangered | | | | |
| FP = Federal Proposed | SPT = State Proposed Threatened | | | | |
| | SC = State Candidate | | | | |


References:
Hypes, S./ Commonwealth of Virginia, Department of Conservation and Recreation, 2008. Personal communication with CH2M HILL. November 25.
Hypes, S./ Commonwealth of Virginia, Department of Conservation and Recreation, 2009. Personal communication with CH2M HILL. January 22.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 3 | | Domain Name: Southeast | | | |
| | | | | | |
| Core Site and Aquatic Site Name: C-7, C-8, C-9, A-5, and A-6 | | | Mgmt. Agency: University of Florida | | State: Florida |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Eastern Indigo Snake *(Drymarchon couperi)* | FT, ST | Scrub, sandhill, wet prairies, mangrove swamps (FNAI, 2001a) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Wood Stork (*Mycteria americana*) | FE, SE | Forested wetlands - cypress strands and domes, mixed hardwood swamps, sloughs, mangroves (FNAI, 2001b) | Yes | Yes, species may occur near proposed sites A-05, A-06 and C-09 | very low, tower and guy wire collision is the only possibility |
| American Alligator (*Alligator mississippiensis*) | Fed SAT, LS | Permanent bodies of fresh water, including marshes, swamps, lakes, and rivers (FNAI, 2001c) | Yes | Yes, species may occur in Barco and Suggs Lake | None, preferred habitat is not present |
| Gopher Tortoise (*Gopherus polyphemus*) | ST | Dry upland habitats, including sandhills, scrub, xeric oak hammock, and dry pine flatwoods; also, uses disturbed habitats such as pastures, old fields, and road shoulders (FNAI, 2001d) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Florida Pine Snake *(Pituophis melanoleucus mugitus)* | SS | Open canopies and dry sandy soils, especially sandhills (FNAI, 2001e) | Yes | Yes, may occur near proposed sites C-07 and C-08 | No impacts. Construction would avoid impacts to this species. |
| Sherman's Fox Squirrel *(Sciurus niger shermani)* | SS | Sandhills (high pine), pine flatwoods, and pastures (FNAI, 2001f) | Yes | Yes, may occur near proposed sites C-07 and C-09 | No impacts. Construction would avoid impacts to this species. |
| Gopher Frog *(Rana capito)* | SS | Dry, sandy uplands mostly sandhill and scrub, with isolated wetlands or large ponds within about 1.7 km (FNAI, 2001g) | Yes | Yes, This species may occur near the proposed NEON sites on OSBS | No impact. Tower placed outside areas the species would use. |
| Florida mouse (*Podomys floridanus*) | SS | Xeric upland communities with sandy soils , including scrub, sandhill, and ruderal sites where they inhabit burrows of the gopher tortoise (FNAI, 2001h) | Yes | Yes, associated with gopher tortoise burrows | No impacts. Construction would avoid impacts to this species. |
| Florida Sandhill Crane (*Grus Canadensis pratensis*) | ST | Prairies, freshwater marshes, and pasture lands (FNAI, 2001i) | Yes | No | None, preferred habitat is not present |
| Southeastern American Kestrel (*Falco sparverius paulus*) | ST | Open pine habitats, woodland edges, prairies, and pastures (FNAI, 2001j) | Yes | No | None, preferred habitat is not present |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |

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|---|---|---|---|---|---|
| Florida toothache-grass (*Ctenium floridanum*) | SE | Sandhills and other dry pinelands (FNAI, 2000) | Yes | Yes, This species may occur near the proposed NEON sites on OSBS | No impacts. Construction would avoid impacts to this species. |
| Spoon-leaved Sundew (*Drosera intermedia*) | ST | Sedge prairie (Horton, 2008, personal communication) | Yes | No | None, preferred habitat is not present |
| | | | | | |
| **Relocatable Site Name: R-5** | | | | **Mgmt. Agency: The Nature Conservancy** | **State: Florida** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Crested Caracara *(Caracara cheriway)* | FT, ST | Open country, including dry prairie and pasture lands with cabbage palm, cabbage palm/live oak hammocks, and shallow ponds and sloughs (FNAI, 2001k) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Wood Stork (*Mycteria americana*) | FE, SE | Forested wetlands (cypress strands and domes, mixed hardwood swamps, sloughs, mangroves) (FNAI, 2001b) | Yes | No | None, preferred habitat is not present |
| Florida Scrub-jay *(Aphelocoma coerulescens)* | FT, ST | Fire-dominated, low-growing, oak scrub habitat found on well-drained sandy soils (FNAI, 2001l) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Sand Skink (*Neoseps reynoldsi*) | FT, ST | Rosemary scrub, sand pine and oak scrubs, scrubby flatwood, turkey oak ridges within scrub, and along edges of citrus groves occupying former scrub (FNAI, 2001m) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Small's Jointweed (*Polygonella myriophylla*) | FE, SE | Open, sandy areas within scrub; mostly on white sands (FNAI, 2000b) | Yes | No | None, preferred habitat is not present |
| Gopher Tortoise (*Gopherus polyphemus*) | ST | Dry upland habitats, including sandhills, scrub, xeric oak hammock, and dry pine flatwoods; also, uses disturbed habitats such as pastures, old fields, and road shoulders (FNAI, 2001d) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Gopher Frog *(Rana capito)* | SS | Dry, sandy uplands mostly sandhill and scrub, with isolated wetlands or large ponds within about 1.7 km (FNAI, 2001g) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Cutthroat Grass (*Panicum abscissum*) | SE | Mesic flatwoods (Horton, 2008, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Giant Orchid (*Pteroglossaspis ecristata*) | ST | Sandhill, scrub, pine flatwoods, pine rocklands (FNAI, 2000c) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Many flowered Grasspink (*Calopogon multiflorus*) | SE | Dry to moist flatwoods with longleaf pine, wiregrass, saw palmetto (FNAI, 2001n) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Ashe's Savory (*Calamintha ashei*) | ST | Dry pinelands and sand pine scrub in canopy openings (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Red-cockaded Woodpecker (*Picoides borealis*) | FE, SE | Open, mature pine woodlands (NatureServe, 2009) | Yes | No | None, preferred habitat is not present |
| Notes | | | | | |
| [a]= Data from Horton, 2008, personal communication. Red-cockaded woodpecker data is from Boring, 2008, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |
| **Federal Status:** | **State:** | | | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program data base search** | |
| Endangered Species Act status as published in the *Federal Register*: | Florida species status as designated from "Florida's Endangered Species and Species of Special Concern, Official Lists", published by Florida Fish and Wildlife Conservation Commission (FFWCC), 1 August 1997, and subsequent updates. | | | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. | |

| | | |
|---|---|---|
| FE = Federal Endangered | SE = State Endangered | S2 = Imperiled because of rarity or because other factors demonstrably |
| FT = Federal Threatened | ST = State Threatened | S3 = Rare, uncommon, or threatened, but not immediately imperiled, |
| FC = Federal Candidate | SS = State Species of Special Concern | |
| FP = Federal Proposed | | |
| SAT = threatened due to similarity of appearance with threatened species | | |


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| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 3 | | Domain Name: Southeast | | | |
| | | | | | |
| Relocatable and Aquatic Site Name: R-6 and A-7 | | | Mgmt. Agency: Woodruff Foundation | | State: Georgia |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Shinyrayed Pocketbook *(Hamiota subangulata)* | FE, SE | Freshwater; muddy sand in slight to moderate current (NatureServe, 2009) | Yes | Yes | very low possibility of disturbance during sampling |
| Pond Spicebush *(Lindera melissifolia)* | FE, SE | Variety of habitats as long as hydrological requirements are met; floodplain/bottomland hardwood forests, forested swales, seasonal ponds (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Chaffseed *(Schwalbea americana)* | FE, SE | Acidic, sandy, peaty soils in open pine flatwoods, pitch pine lowland forests, seepage bogs, palustrine pine savannahs, and other grass- and sedge-dominated plant communities (NatureServe, 2009) | Yes | No | None, preferred habitat not present |
| Purple Bankclimber *(Elliptoideus sloatianus)* | FT, ST | Freshwater; sand, fine gravel or muddy sand substrates in moderate current in large freshwater rivers or streams (NatureServe, 2009) | Yes | Yes | very low possibility of disturbance during sampling |
| Gulf Moccasinshell (*Medionidus penicillatus*) | FE, SE | sandy areas with a slight current, streams and rivers where there is a moderate current and sand and gravel substrates, and in muddy sand substrates around tree roots in medium-sized stream with moderate current (NatureServe, 2009) | Yes | Yes | very low possibility of disturbance during sampling |
| Oval Pigtoe (*Pleurobema pyriforme*) | FE, SE | Silty sand to sand and gravel in medium-sized creeks to small rivers, usually in slow to moderate current (NatureServe, 2009) | Yes | Yes | very low possibility of disturbance during sampling |
| Bluestripe Shiner *(Cyprinella callitaenia)* | SR | Large, alluvial freshwater rivers with open, sand- or rock-bottomed channels with flowing water and little or no aquatic vegetation (NatureServe, 2009) | Yes | Yes, may occur at or near proposed A 07 site | very low possibility of disturbance during sampling |
| Delicate Spike *(Elliptio arctata)* | SE | Freshwater rivers, along shorelines, under rocks; sand and gravel, and sand and limestone rock substrates (NatureServe, 2009) | Yes | Yes | very low possibility of disturbance during sampling |
| Southeastern Pocket Gopher *(Geomys pinetis)* | ST | Deep, sandy soils of open areas; cropland/hedgerow, grassland/herbaceous, woodland - conifer (NatureServe, 2009) | Yes | Yes, may occur near proposed R-6 tower | No impacts. Construction would avoid impacts to this species. |
| Barbour's Map Turtle *(Graptemys barbouri)* | ST | Alluvial and spring-fed rivers and associated waters (e.g., river swamps, impoundments); clear limestone-bottomed streams with an abundance of fallen trees and mollusks (NatureServe, 2009) | Yes | Yes, may occur at or near proposed A 07 site | very low possibility of disturbance during sampling |
| Alligator Snapping Turtle (*Macrochelys temminckii*) | ST | Slow moving, deep water of rivers, sloughs, oxbows, and canals or lakes associated with rivers; also, swamps, bayous, and ponds near rivers, and shallow creeks (NatureServe, 2009) | Yes | Yes, may occur at or near proposed A 07 site | very low possibility of disturbance during sampling |
| Highscale Shiner (*Notropis hypsilepis*) | SR | Sandy runs and pools of freshwater creeks and small rivers (NatureServe, 2009) | Yes | Yes, may occur at or near proposed A 07 site | very low possibility of disturbance during sampling |
| Marl Spleenwort (*Asplenium heteroresiliens*) | ST | Limestone and marl outcroppings in dense hardwood forests (NatureServe, 2009) | Yes | No | None, preferred habitat not present |
| Sandywoods Sedge (*Carex dasycarpa*) | SR | Sandy woods in acid soils; shady woods, floodplains, bluffs (NatureServe, 2009) | Yes | No | None, preferred habitat not present |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |

| | | | | | |
|---|---|---|---|---|---|
| Swamp Buckthorn (*Sideroxylon thornei*) | SR | Oak flatwoods where the soils usually remain water-saturated; also, wetlands over limestone (NatureServe, 2009) | Yes | Yes, may occur at or near proposed A 07 site | very low possibility of disturbance during sampling |
| Red-cockaded Woodpecker (*Picoides borealis*) | FE, SE | Open, mature pine woodlands (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| | | | | | |
| Notes | | | | | |
| [a] = Data from Morris, 2008, personal communication. Red-cockaded woodpecker data is from Boring, 2008, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |
| **Federal Status:** | **State:** | | | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program data base search** | |
| Endangered Species Act status as published in the *Federal Register*: | Georgia species status as designated from the Georgia Department of Natural Resources | | | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. | |
| FE = Federal Endangered | SE = State Endangered | | | S2 = Imperiled because of rarity or because other factors demonstrably | |
| FT = Federal Threatened | ST = State Threatened | | | S3 = Rare, uncommon, or threatened, but not immediately imperiled, | |
| FC = Federal Candidate | SR = State Rare | | | | |
| FP = Federal Proposed | | | | | |

References:


Boring, L. 2008. Personal Communication to Rich Reaves of CH2M HILL.

Morris, K./Georgia Department of Natural Resources, Wildlife Resources Division, 2008. Personal communication with CH2M HILL. December 4.

NatureServe Explorer. 2009. Species Quick Search. http://www.NatureServe.org/explorer/index.htm. Accessed January 7, 2009.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| **Domain (number): 5** | | **Domain Name: Great Lakes** | | | |
| | | | | | |
| **Core Site and Aquatic Site Name: C-13, C-14, C-15, and A-11** | | | **Mgmt. Agency: University of Notre Dame** | | **State: Michigan** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Bald eagle (*Haliaeetus leucocephalus*) | ST | Within 1/2 mile of water at the top of tall, established trees; forested habitats adjacent to water where prey is available (Michigan DNR, 2008). | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Common Loon (*Gavia immer*) | ST | Large inland lakes containing islands and minimal shoreline development (Michigan DNR, 2008) | Yes | Yes, could occur near proposed core sites | very low, tower and guy wire collision is the only possibility |
| Golden Hedge-hyssop (*Gratiola aurea*) | ST | Along the coastal shores, in swamps, and in moist to wet areas; usually soft water to 13' deep in peaty, sandy, acidic soil (Michigan DNR, 2008) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| | | | | | |
| Notes | | | | | |
| [a] = Data from Sargent, 2008, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |
| **Federal Status:** | **State:** | | | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program data base search** | |
| Endangered Species Act status as published in the *Federal Register*: | Michigan species status as designated under the Endangered Species Act of the State of Michigan (Part 365 of PA 451, 1994 Michigan Natural Resources and Environmental Protection Act). | | | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. | |
| FE = Federal Endangered | SE = State Endangered | | | S2 = Imperiled because of rarity or because other factors demonstrably | |
| FT = Federal Threatened | ST = State Threatened | | | S3 = Rare, uncommon, or threatened, but not immediately imperiled, | |
| FC = Federal Candidate | SS = State Species of Special Concern | | | | |
| FP = Federal Proposed | | | | | |

References:
NatureServe Explorer. 2009. Species Quick Search. http://www.NatureServe.org/explorer/index.htm. Accessed January 7, 2009.
Sargent, L./ Michigan Department of Natural Resources (DNR), 2008. Personal communication with CH2M HILL. November 21.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 5 | | Domain Name: Great Lakes | | | |
| | | | | | |
| Relocatable Site Name: R-9 | | | Mgmt. Agency: Private | | State: Wisconsin |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Bald eagle (*Haliaeetus leucocephalus*) | SS | Large trees in isolated areas near large areas of surface water, large complexes of deciduous forest, coniferous forest, wetland, and shrub communities (Engelman, 2009, personal communication) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Osprey (*Pandion haliaetus*) | ST | Large trees in isolated areas near large areas of surface water, large complexes of deciduous forest, coniferous forest, wetland, and shrub communities (Engelman, 2009, personal communication) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Wood Turtle (*Clemmys insculpta*) | ST | Deciduous forests and open meadows along moderate- to fast-moving streams and rivers (Engelman, 2009, personal communication) | Yes | Yes | very low possibility of disturbance during sampling |
| Purple Bladderwort (*Utricularia purpurea*) | SS | Soft-water, acidic ponds and lakes, shallow sandy water (Engelman, 2009, personal communication) | Yes | Yes | very low possibility of disturbance during sampling |
| Algae-like Pondweed (*Potamogeton confervoides*) | FS, ST | Shallow water of acidic inland lakes (Engelman, 2009, personal communication) | Yes | Yes | very low possibility of disturbance during sampling |
| Autumnal Water-starwort (*Callitriche hermaphroditica*) | SS | Cold clean flowing streams and spring ponds (Engelman, 2009, personal communication) | Yes | Yes | very low possibility of disturbance during sampling |
| Farwell's Water-milfoil (*Myriophyllum farwellii*) | SS | Lakes, streams, and ponds; in small shallow reservoirs in the bed of the glacial lake area (Engelman, 2009, personal communication) | Yes | Yes | very low possibility of disturbance during sampling |
| Northeastern Bladderwort (*Utricularia resupinata*) | SS | Wet sandy shorelines of fluctuating soft-water ponds and lakes (Engelman, 2009, personal communication) | Yes | Yes | very low possibility of disturbance during sampling |
| Hidden-fruited Bladderwort (*Utricularia geminiscapa*) | SS | Shallow lakes and ponds; common in reservoirs and cranberry ditches in the bed of glacial-lake Wisconsin and in interdunal swales in Door County (Engelman, 2009, personal communication) | Yes | Yes | very low possibility of disturbance during sampling |
| Gray Wolf (*Canis lupus*) | FT, ST | No special habitat except for the presence of native ungulates within it territory on a year round basis (Montana Field Guide, 2009) | Yes | Yes | very low possibility of disturbance during sampling and construction |
| Deam's Rockcress (*Arabis missouriensis var. deamii*) | FS, SS | Mesic alluvial floodplain forests (Engelman, 2009, personal communication) | Yes | Yes | very low possibility of disturbance during sampling and construction |

| Relocatable Site Name: R-10 | | | Mgmt. Agency: Wisconsin, Stevens | | State: Wisconsin |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Bald eagle (*Haliaeetus leucocephalus*) | SS | Large trees in isolated areas near large areas of surface water, large complexes of deciduous forest, coniferous forest, wetland, and shrub communities (Engelman, 2009, personal communication) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Osprey (*Pandion haliaetus*) | ST | Large trees in isolated areas near large areas of surface water, large complexes of deciduous forest, coniferous forest, wetland, and shrub communities (Engelman, 2009, personal communication) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Wood Turtle (*Clemmys insculpta*) | ST | Deciduous forests and open meadows along moderate- to fast-moving streams and rivers (Engelman, 2009, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Purple Bladderwort (*Utricularia purpurea*) | SS | Soft-water, acidic ponds and lakes, shallow sandy water (Engelman, 2009, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Algae-like Pondweed (*Potamogeton confervoides*) | FS, ST | Shallow water of acidic inland lakes (Engelman, 2009, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Autumnal Water-starwort (*Callitriche hermaphroditica*) | SS | Cold clean flowing streams and spring ponds (Engelman, 2009, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Farwell's Water-milfoil (*Myriophyllum farwellii*) | SS | Lakes, streams, and ponds; in small shallow reservoirs in the bed of the glacial lake area (Engelman, 2009, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Hidden-fruited Bladderwort (*Utricularia geminiscapa*) | SS | Shallow lakes and ponds; common in reservoirs and cranberry ditches in the bed of glacial-lake Wisconsin and in interdunal swales in Door County (Engelman, 2009, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Gray Wolf (*Canis lupus*) | FT, ST | No special habitat except for the presence of native ungulates within it territory on a year round basis (Montana Field Guide, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Deam's Rockcress (*Arabis missouriensis var. deamii*) | FS, SS | Mesic alluvial floodplain forests (Engelman, 2009, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Purple Clematis (*Clematis occidentalis*) | SS | Cool forests (usually mixed conifer-hardwoods), cliffs and ravines with igneous rock (basalt, quartzite) (Engelman, 2009, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |

| Aquatic Site Name: A-12 | | | Mgmt. Agency: Private | | State: Wisconsin |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Bald eagle (*Haliaeetus leucocephalus*) | SS | Large trees in isolated areas near large areas of surface water, large complexes of deciduous forest, coniferous forest, wetland, and shrub communities (Engelman, 2009, personal communication) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Osprey (*Pandion haliaetus*) | ST | Large trees in isolated areas near large areas of surface water, large complexes of deciduous forest, coniferous forest, wetland, and shrub communities (Engelman, 2009, personal communication) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Wood Turtle (*Clemmys insculpta*) | ST | Deciduous forests and open meadows along moderate- to fast-moving streams and rivers (Engelman, 2009, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |

| | | | | | |
|---|---|---|---|---|---|
| Algae-like Pondweed (*Potamogeton confervoides*) | FS, ST | Shallow water of acidic inland lakes (Engelman, 2009, personal communication) | Yes | Yes, if conditions are favorable | No impacts. Construction would avoid impacts to this species. |
| Autumnal Water-starwort (*Callitriche hermaphroditica*) | SS | Cold clean flowing streams and spring ponds (Engelman, 2009, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Farwell's Water-milfoil (*Myriophyllum farwellii*) | SS | Lakes, streams, and ponds; in small shallow reservoirs in the bed of the glacial lake area (Engelman, 2009, personal communication) | Yes | Yes, if conditions are favorable | No impacts. Construction would avoid impacts to this species. |
| Hidden-fruited Bladderwort (*Utricularia geminiscapa*) | SS | Shallow lakes and ponds; common in reservoirs and cranberry ditches in the bed of glacial-lake Wisconsin and in interdunal swales in Door County (Engelman, 2009, personal communication) | Yes | Yes, if conditions are favorable | No impacts. Construction would avoid impacts to this species. |
| Gray Wolf (*Canis lupus*) | FT, ST | No special habitat except for the presence of native ungulates within it territory on a year round basis (Montana Field Guide, 2009) | Yes | No | None, preferred habitat not present |
| Deam's Rockcress (*Arabis missouriensis var. deamii*) | FS, SS | Mesic alluvial floodplain forests (Engelman, 2009, personal communication) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Purple Clematis (*Clematis occidentalis*) | SS | Cool forests (usually mixed conifer-hardwoods), cliffs and ravines with igneous rock (basalt, quartzite) (Engelman, 2009, personal communication) | Yes | No | None, preferred habitat not present |
| | | | | | |
| Notes | | | | | |
| [1] = Data from Engelman, 2009, personal communication. | | | | | |
| [2] = Species Status Codes | | | | | |

| | | |
|---|---|---|
| **Federal Status:** | **State:** | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program data base search** |
| Endangered Species Act status as published in the *Federal Register*: | Michigan species status as designated under the Wisconsin Endangered Species Law (29.604 State Stats.). | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. |
| FE = Federal Endangered | SE = State Endangered | S2 = Imperiled because of rarity or because other factors demonstrably |
| FT = Federal Threatened | ST = State Threatened | S3 = Rare, uncommon, or threatened, but not immediately imperiled, |
| FC = Federal Candidate | SS = State Species of Special Concern | |
| FS = Federal Species of Concern | | |


References:
NatureServe Explorer. 2009. Species Quick Search. http://www.NatureServe.org/explorer/index.htm. Accessed January 7, 2009.
Engelman, A./ Wisconsin Department of Natural Resources. Personal communication with CH2M HILL. January 9.
Montana Field Guide, 2009. Gray Wolf - Canis lupus. http://fieldguide.mt.gov/detail_AMAJA01030.aspx. Accessed January 20.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 6 | | Domain Name: Prairie Peninsula | | | |
| | | | | | |
| **Core, Relocatable, Aquatic, and Streon Site Name: C-16, C-17, C-18, R-12, A-14, S-15** | | | **Mgmt. Agency: Kansas State and Nature Conservancy** | | **State: Kansas** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Henslow's sparrow (*Ammodramus henslowii*) | SC | Open fields and meadows with grass and weeds or shrubby vegetation (breeding); grassy areas adjacent to pine woods or second-growth woods (non-breeding) (NatureServe, 2009) | Yes | Yes, may occur at or near two proposed core towers (C-18 and C-16) and at relocatable site R-12 | very low, tower and guy wire collision is the only possibility |
| Southern bog lemming (*Synaptomys cooperi*) | SC | Boggy habitat, marshes, meadows, upland forests with thick humus layer; also areas with intermixture of herbaceous/shrubby vegetation (NatureServe, 2009) | Yes | Yes, may occur at or near two proposed core towers (C-18 and C-16) and at relocatable site R-13 | No impacts. Construction would avoid impacts to this species. |
| Bobolink (*Dolichonyx oryzivorus*) | SC | Tall grassy areas, flooded meadows, prairie, deep cultivated grains, hayfields, rice fields, open woody areas (NatureServe, 2009) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Blue sucker (*Cycleptus elongatus*) | SC | Largest rivers and lower parts of major tributaries (NatureServe, 2009) | Yes | Yes, could occur at the proposed aquatic site (A-14) | very low possibility of disturbance during sampling |
| Topeka shiner (*Notropis Topeka*) | FE, ST | Quiet, open, permanent pools of small, clear, high-quality headwaters and creeks that drain upland prairie areas (NatureServe, 2009) | Yes | Yes, could occur at the proposed STREON site (S 15), Core Site C-17, and aquatic site A-14 | very low possibility of disturbance during sampling and construction |
| | | | | | |

| Relocatable Site Name: R-11 | | | Mgmt. Agency: University of Kansas | | State: Kansas |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats**[a] | **Mgmt. or Legal Status** [b] | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Smooth earth snake (*Virginia valeriae*) | ST | Deciduous woods, exposed rocky slopes in mixed deciduous-pine associations, pine woodland, grassy slopes with rocks in areas of deciduous forest, mesic hammocks, moist woodland, old fields, vacant lots (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Redbelly snake (*Storeria occipitomaculata*) | ST | Mountainous or hilly woodland/forest, upland meadows, and swamp and bog edges (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Henslow's sparrow (*Ammodramus henslowii*) | SC | Open fields and meadows with grass and weeds or shrubby vegetation (breeding); grassy areas adjacent to pine woods or second-growth woods (non-breeding) (NatureServe, 2009) | Yes | No | No documented occurrences in area |
| Mead's milkweed (*Asclepias meadii*) | FT | Tallgrass prairies (NatureServe, 2009) | Yes | No | None, preferred habitat not present |
| Western prairie fringed orchid (*Platanthera praeclara*) | FT | Western portion of tallgrass prairie; most common on moist, calcareous or sub saline prairies and sedge meadows (NatureServe, 2009) | Yes | No | None, preferred habitat not present |
| Sturgeon chub (*Macrhybopsis gelida*) | ST | Heavily turbid, warm, medium to large rivers (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Least Tern (*Sterna antillarum*) | FE, SE | Deep and shallow water in or near shore, bag/sound, lagoon, also sand/dune areas (NatureServe, 2009) | Yes | No | None, preferred habitat not present |
| Piping plover (*Charadrius melodus*) | FT, ST | Sandy upper beaches, tidal fats and shores (NatureServe, 2009) | Yes | No | None, preferred habitat not present |
| Bald eagle (*Haliaeetus leucocephalus*) | ST | Coastal areas, bays, rivers, and lakes; conifers or other sheltered sites; deciduous and coniferous trees; in tall trees or cliffs near water (NatureServe, 2009) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| | | | | | |
| Notes | | | | | |
| [a] = Data from Delisle, 2008, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |

| **Federal Status:** | **State:** | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program data base search** |
|---|---|---|
| Endangered Species Act status as published in the *Federal Register*: | Kansas species status as designated by the Kansas Department of Wildlife and Parks. | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 |
| FE = Federal Endangered | SE = State Endangered | S2 = Imperiled because of rarity or because other factors demonstrably |
| FT = Federal Threatened | ST = State Threatened | S3 = Rare, uncommon, or threatened, but not immediately imperiled, |
| FC = Federal Candidate | SC = State Species in Need of Conservation | |
| FP = Federal Proposed | | |


References:
NatureServe Explorer. 2009. Species Quick Search. http://www.NatureServe.org/explorer/index.htm. Accessed January 12, 2009.
Delisle, J./ The University of Kansas, 2008. Personal communication with CH2M HILL. December 17.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 7 | | Domain Name: Appalachian/Cumberland Plateaus | | | |
| | | | | | |
| Core Sites and Streon Site Name: C-19, C-20, C-21 and S-18 | | | Mgmt. Agency: US DOE | | State: Tennessee |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Cerulean Warbler (*Dendroica cerulea*) | SD | Forested wetland; Hardwood forest and woodlands, mixed forest and woodlands (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Tennessee Dace (*Phoxinus tennesseensis*) | SD | Cool, clear, small freshwater creeks (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Pink Lady's-slipper (*Cypripedium acaule*) | SS-CE | Bogs and swamps, and also drier oak or coniferous woodlands in acidic soil (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Tall Larkspur (*Delphinium exaltatum*) | SE | Rich woods, rocky slopes, semi-open woodlands, glades, and prairie openings (NatureServe, 2009) | Yes | Yes, may occur near proposed NEON locations on ORR | No impacts. Construction would avoid impacts to this species. |
| Mountain Witch-alder (*Fothergilla major*) | ST | Dry ridge top forests of middle elevations ridges in the mountains (NatureServe, 2009) | Yes | Yes, may occur near proposed NEON locations on ORR | No impacts. Construction would avoid impacts to this species. |
| American Ginseng (*Panax quinquefolius*) | SS-CE | Rich, cool, moist but not extremely wet woods, under a closed canopy (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Tubercled Rein-orchid (*Platanthera flava var. herbiola*) | ST | Low, wet, woods, meadows, swales; sandy soil with much leaf litter (NatureServe, 2009) | Yes | Yes, could be located down slope of proposed NEON locations near the Clinch River | No impacts. Construction would avoid impacts to this species. |
| Common Shrew (*Sorex cinereus*) | SD | Most terrestrial habitats excluding areas with little or no vegetation; Favorite habitat is thick leaf litter in damp forests (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Southern Bog Lemming (*Synaptomys cooperi*) | SD | Boggy habitat, marshes, meadows, upland forests with thick humus layer; also areas with intermixture of herbaceous/shrubby vegetation (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Four-toed Salamander (*Hemidactylium scutatum*) | SD | Under objects or among mosses in swamps, boggy streams, and wet, wooded or open areas near ponds or quiet, mossy or grassy/sedge pools (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Sharp-shinned Hawk (*Accipiter striatus*) | SD | Forest and open woodland, coniferous, mixed, or deciduous (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Bachman's Sparrow (*Aimophila aestivalis*) | SE | Old field, Savanna, Conifer or Hardwood Woodland (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Swainson's Warbler (*Limnothlypis swainsonii*) | SD | Rich, damp, deciduous floodplain and swamp forests with deep shade (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Common Barn-owl (*Tyto alba*) | SD | Fields of dense grass (grasslands, marsh, lightly grazed pasture, hayfields); nests in buildings, caves, crevices on cliffs, burrows, and hollow trees (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Highfin Carpsucker (*Carpiodes velifer*) | SD | Shallow water in rivers, oxbows, sloughs, and ponds over sand or gravel bottom (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |

| | | | | | |
|---|---|---|---|---|---|
| Blue Sucker (*Cycleptus elongatus*) | ST | Largest rivers and lower parts of major tributaries (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Spotfin Chub (*Cyprinella monacha*) | FT, ST | Cool and warm, typically clear, large creeks or medium-sized rivers of moderate gradient, in upland and montane areas (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Flame Chub (*Hemitremia flammea*) | SD | Springs, shallow seepage waters, and spring-fed streams, where aquatic vegetation is abundant or slack water near the bank in large streams (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Spreading False-foxglove (*Aureolaria patula*) | SS | Steep limestone bluffs in shade of open stands of mixed hardwoods (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Appalachian Bugbane (*Actaea rubifolia*) | ST | At the base of north-facing slopes on talus and rocky soils derived from dolomite (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Northern Bush honeysuckle (*Diervilla lonicera*) | ST | Rock outcrops and ridges at high elevations (Weakley, 2008) | Within 6.4 km | No | None, suitable habitat not present |
| Nuttall's Waterweed (*Elodea nuttallii*) | SS | Lakes, ponds, stagnant waters of streams (Weakley, 2008) | Within 6.4 km | No | None, suitable habitat not present |
| Goldenseal (*Hydrastis canadensis*) | SS-CE | Rich, mesic hardwood forest (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Butternut (*Juglans cinerea*) | ST | Rich mesophytic forests, lower slopes, ravines, and various types of bottomland, including banks and terraces of creeks and streams, and floodplain forests (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Small-headed Rush (*Juncus brachycephalus*) | SS | Calcareous wetlands (Weakley, 2008) | Within 6.4 km | No | None, suitable habitat not present |
| Canada Lily (*Lilium canadense*) | ST | Moist sunny areas with acidic soils: swamps, bogs, roadside, ditches, moist fields, edges of moist woods (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Fen Orchis (*Liparis loeselii*) | ST | Seepages at moderate to high elevations in the mountains, mucky bay swamps at about sea level, and other moist, seep habitats, especially over mafic or calcareous rocks (Weakley, 2008) | Within 6.4 km | No | None, suitable habitat not present |
| Mountain Honeysuckle (*Lonicera dioica*) | SS | Rocky banks, dry woods, thickets (Maine Department of Conservation, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Three-parted Violet (*Viola tripartita var. tripartita*) | SS | Rich woods on basic soils (Alabama Plants, 2008) | Within 6.4 km | No | None, suitable habitat not present |
| Gray Bat (*Myotis grisescens*) | FE, SE | Caves, occasionally a storm sewer (NatureServe, 2009) | Within 6.4 km | Yes, may occur near proposed NEON locations on ORR | no, echolocation ability would prevent bats from colliding with towers or guy wires |
| Woodland Jumping Mouse (*Napaeozapus insignis*) | SD | Deciduous and coniferous forests with herbaceous groundcover; brushlands (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Long-tailed or Rock Shrew (*Sorex dispar*) | SD | Mountainous, forested areas (deciduous or evergreen) with loose talus (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |

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|---|---|---|---|---|---|
| Smoky Shrew (*Sorex fumeus*) | SD | Damp wooded areas, both in conifer and hardwood habitats; nest sites are beneath sumps, rotted logs, or rocks (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Southeastern Shrew (*Sorex longirostris*) | SD | Bogs, damp woods, upland shrubby or wooded areas; prefers moist to wet areas; usually lives underground or under ground cover (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Meadow Jumping Mouse (*Zapus hudsonius*) | SD | Moist lowland habitats; prefers relatively thick vegetation of open grassy and brushy areas of marshes, meadows, swamps, and stream sides (NatureServe, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Northern White Cedar (*Thuja occidentalis*) | SS | Swamps and along streams and lakes (Michigan DEQ, 2009) | Within 6.4 km | No | None, suitable habitat not present |
| Eastern Slender Glass Lizard (*Ophisaurus attenuatus longicaudus*) | SD | Old rodent burrows, under grass mats, underground; in general, in grasslands and pine woodland (Virginia Department of Game and Inland Fisheries, 2009a) | Within 6.4 km | No | None, suitable habitat not present |
| Northern Pine Snake (*Pituophis melanoleucus melanoleucus*) | ST | Dry ridges and hillsides, usually in scrub pine, laurel and rhododendron thickets (Virginia Department of Game and Inland Fisheries, 2009b) | Within 6.4 km | No | None, suitable habitat not present |

| **Relocatable and Aquatic Site Name: R-14 and A-17** | | | **Mgmt. Agency: Federal - DOI-NPS** | | **State: Tennessee** |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats [c]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Indiana bat (*Myotis sodalis*) | FE | Caves, loose bark of dead or dying trees or in tree cavities, riparian areas, upland forests, ponds, fields, and forested landscapes (NatureServe, 2009) | Listed in the Great Smoky Mountains website | Yes, could roost or forage near the NEON infrastructure in the GSMNP | no, echolocation ability would prevent bats from colliding with towers or guy wires |
| Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*) | FE | Coniferous and mixed forest, deciduous and riparian woods, any cool, moist, mature forest with abundant standing and down snags (NatureServe, 2009) | Listed in the Great Smoky Mountains website | Yes, could occur the NEON infrastructure in the GSMNP | very low possibility of disturbance during sampling and construction |
| Spotfin chub (*Cyprinella monacha*) | FT | Cool and warm, typically clear, large creeks or medium-sized rivers of moderate gradient, in upland and montane areas (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Duskytail darter (*Etheostoma percnurum*) | FE | Pools and riffles of large creeks and medium rivers of moderate gradient, warm, and clear (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Smoky madtom (*Noturus baileyi*) | FE | Clear, cool, rocky riffles, runs, and flowing pools of creeks (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Yellowfin madtom (*Noturus flavipinnis*) | FT | Medium creeks and rivers that are unpolluted, warm to cool, unsilted, and of moderate to gentle gradient (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Spruce-fir moss spider (*Microhexura montivaga*) | FE | High-elevation fir-forest communities on moist but well-drained moss mats growing on rocks and boulders in well-shaded areas (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |

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|---|---|---|---|---|---|
| Spreading avens (*Geum radiatum*) | FE | Exposed, high elevation situations in the southern Appalachians with elevations over 1310 m (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Virginia spiraea (*Spiraea virginiana*) | FT | Creek edges with margins of exposed rock and piled detritus, bars of gravel, rubble and/or boulder and including dolomitic limestone (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Eastern small-footed bat (*Myotis leibii*) | FS | Hilly or mountainous areas, in or near deciduous or evergreen forests, open farmland, hollow trees, caves, bridges, coal mines, buildings (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| **Protected / MIS / Sensitive Species or Habitats [c]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Water shrew (*Sorex palustris*) | FS | Small, cold streams with thick overhanging riparian growth, around lakes, ponds, marshes, bogs, and other lentic habitats (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Appalachian cottontail (*Sylvilagus obscurus*) | FS | Dense cover and conifers at higher elevations (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Henslow's Sparrow (*Ammodramus henslowii*) | FS | Open fields and meadows with grass and weeds or shrubby vegetation (breeding); grassy areas adjacent to pine woods or second-growth woods (non-breeding) (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Olive-sided Flycatcher (*Contopus cooperi)* | FS | Forest, woodland, and open areas with scattered trees, especially with tall dead trees (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Cerulean Warbler (*Dendroica cerulea*) | FS, SD | Forested wetland; Hardwood forest and woodlands, mixed forest and woodlands (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Red Crossbill (*Loxia curvirostra*) | FS | Coniferous and mixed coniferous-deciduous forests, pine savanna, pine-oak areas (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Black-capped Chickadee (*Poecile atricapillus*) | FS | Deciduous and mixed forest and woodland, tall thickets, open woodland and parks (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Yellow-bellied Sapsucker (*Sphyrapicus varius*) | FS | Open woodland habitats (such as deciduous and mixed-coniferous forests), parks, orchards (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |

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|---|---|---|---|---|---|
| Golden-winged Warbler (*Vermivora chrysoptera*) | FS | Deciduous open woodlands, woodland edge with low cover, hillside scrub, overgrown pastures and old fields (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Eastern hellbender (*Cryptobranchus alleganiensis*) | FS | Rocky, clear creeks and rivers (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Seepage salamander (*Desmognathus aeneus*) | FS | Leaf litter or surface debris on floors or mixed hardwood forests near small creeks, springs, and seepage areas; also damp shaded ravines (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Junaluska salamander (*Eurycea junaluska*) | FS | Under objects in or along streams (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| **Protected / MIS / Sensitive Species or Habitats[c]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Olive darter (*Percina squamata*) | FS | Small to medium upland rivers with moderate to high current over rubble and boulders; also shallow pools with gravel or rock bottoms (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Tennessee dace (*Phoxinus tennesseensis*) | FS, SD | Cool, clear, small freshwater creeks (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Fraser fir (*Abies fraseri*) | FS | High elevation peaks (>4921 ft) in the southern Appalachians, often with red spruce (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Cain's reed-bent grass (*Calamagrostis cainii*) | FS | High elevation open areas like rocky summits and disturbed areas where landslides have occurred (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Mountain bittercress (*Cardamine clematitis*) | FS | High summits in southern Appalachians and elevations above 1,000 meters (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Smoky Mountain manna grass (*Glyceria nubigena*) | FS | Mid to high elevation bogs and seeps; wet areas in open woods, open areas, and along trails (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
| Blue Ridge catchfly (*Silene ovata*) | FS | Rich woods; in Tennessee, it occurs in a variety of open or forested sandy or pebbly habitats including floodplains (NatureServe, 2009) | Listed in the Great Smoky Mountains website | No | None, suitable habitat not present |
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| Notes | | | | | |
| [a] = Data from Mathes, 2008, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |
| **Federal Status:** | **State:** | | | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program data base search** | |
| Endangered Species Act status as published in the *Federal Register*: | Tennessee species status as designated in the Tennessee Division of Natural Areas | | | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. | |
| FE = Federally Endangered. | SE = State Endangered | | | S2 = Imperiled because of rarity or because other factors demonstrably | |
| FT = Federally Threatened | ST = State Threatened | | | S3 = Rare, uncommon, or threatened, but not immediately imperiled, | |
| FS = Federal Species of Concern | SS = State Special Concern | | | | |
| | SD = State Deemed in Need of Management | | | | |
| | SS-CE = State Special Concern - Commercially Exploited | | | | |
| | | | | | |
| [c] = Species in R-14 and A-17 are from National Park Service, 2009. Species that have been extirpated from the Park are not included. | | | | | |


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| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 7 | | Domain Name: Appalachian/Cumberland Plateaus | | | |
| | | | | | |
| Relocatable Site Name: R-13 | | | Mgmt. Agency: Inc, leased to UVa | | State: Virginia |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Bentley's coralroot (*Corallorhiza bentleyi*) | SE | Dry-mesic to mesic forests, especially near roadsides (Weakley, 2008) | Yes | No | None, suitable habitat not present |
| Long-stalk Holly (*Ilex collina*) | SE | Bog borders, beaver ponds, mucky ground, hydric peat, and oligotrophic saturated wetlands (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Appalachian Bewick's Wren (*Thryomanes bewickii altus*) | SE | Prefers early successional habitat, forest edges, and upland shrub habitat (James and Green, 2009) | Yes | No | None, suitable habitat not present |
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| Notes | | | | | |
| [a] = Data from Hypes, 2009, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |

| Federal Status: | State: | Natural Heritage Program: S1, S2, or S3 rank from Heritage Program data base search |
|---|---|---|
| Endangered Species Act status as published in the *Federal Register*: | Virginia species status as designated by the Virginia Department of Agriculture and Consumer Services. | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. |
| FE = Federal Endangered | SE = State Endangered | S2 = Imperiled because of rarity or because other factors demonstrably |
| FT = Federal Threatened | ST = State Threatened | S3 = Rare, uncommon, or threatened, but not immediately imperiled, |
| FC = Federal Candidate | SPE = State Proposed Endangered | |
| FP = Federal Proposed | SPT = State Proposed Threatened | |
| | SC = State Candidate | |

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Weakley, Alan S. 2008. Flora of the Carolinas, Virginia, Georgia, northern Florida, and surrounding areas. Working Draft of 7 April 2008.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 8 | | Domain Name: Ozarks Complex | | | |
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| Core Site and Streon Site Names: C-22, C-23, C-24, and S-22 | | | Mgmt. Agency: USFS | | State: Alabama |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Mitchell's satyr (*Neonympha mitchellii*) | FE, SP | Beaver dam meadows in Alabama (Alabama Natural Heritage Program, 2008); also, bogs/fens and herbaceous wetlands (NatureServe, 2009) | Yes | Yes, This species could occur at Choctaw NWR | No impacts. Construction would avoid impacts to this species. |
| Red-cockaded woodpecker (*Picoides borealis*) | FE, SP | Open, mature pine woodlands (NatureServe, 2009) | Yes | Yes, This species could occur near the proposed Core Site towers on TNF (C 22, C-23, C-24) | Possible, if nesting trees are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |
| Southern Clubshell (*Pleurobema decisum*) | FE, SP | Highly oxygenated streams with sand and gravel substrate in large rivers to small streams (NatureServe, 2009) | Yes | Yes, This species could occur in the stream proposed for the STREON location in TNF (S-22) | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions. |
| Crystal Darter (*Crystallaria asprella*) | SP, RFSS | Clear to slightly turbid water and swift to moderately swift riffles of small to medium rivers with clean sand or gravel (NatureServe, 2009) | Yes | Yes, This species could occur in the stream proposed for the STREON location in TNF (S-22) | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions. |
| Bald eagle (*Haliaeetus leucocephalus*) | SP | Coastal areas, bays, rivers, and lakes; conifers or other sheltered sites; deciduous and coniferous trees; in tall trees or cliffs near water (NatureServe, 2009) | Yes | Yes, The bald eagle is known to occur on Choctaw NWR and could occur at Armistead Selden Lock | very low, tower and guy wire collision is the only possibility |
| Cahaba Shiner (*Notropis cahabae*) | FE, SP | Slow-moderate current over sand substrate in medium river; small tributaries during flood events; also pools and shallow gravel riffles (NatureServe, 2009) | Yes | Yes, This species could occur in the stream proposed for the STREON location in TNF (S-22) | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions in the downstream reservoir. |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |

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|---|---|---|---|---|---|
| Frecklebelly Madtom (*Noturus munitus*) | SP, RFSS | Rocky riffles, rapids, and runs of medium to large rivers (NatureServe, 2009) | Yes | Yes, This species could occur in the stream proposed for the STREON location in TNF (S-22) | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions. |
| Bachman's Sparrow (*Aimophila aestivalis*) | RFSS | Longleaf pine forests, woodlands, savannas, and grasslands (USFS, 2004) | No | Yes | Very low. Stationary towers would pose as a slight risk for incidental impacts. Avoidance measures would occur during construction. |
| A crayfish (*Procambarus marthae*) | RFSS | Prefer low gradient sluggish to standing water currents over sand-clay substrates within streams and rivers (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| Alabama shad (*Alosa alabamae*) | RFSS | Reside in reservoirs or coastal estuaries and bays and migrate upstream into large rivers or reservoir tributaries to spawn. Spawning occurs in March-April in open, moderate currents over coarse sand, gravel, and cobble substrates in shoals and sand bars (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions in the downstream reservoir. |
| Goldstripe darter (*Etheostoma parvipinne*) | RFSS | Inhabit clear sluggish currents over gravel, sand, or clay substrates within runs, pools, or riffles of small streams (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| Alabama darter (*Etheostoma ramseyi*) | RFSS | Prefers cobble, rubble broken bedrock, or large woody debris in pools and riffles of small streams (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| Blackwater darter (*Etheostoma zonifer*) | RFSS | Prefer turbid sluggish to stagnant currents over muddy substrate within runs and adjacent pools of small streams (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| Skygazer shiner (*Notropis uranoscopus*) | RFSS | Primarily inhabit shallow moderate to swift currents over sand-gravel substrates within shoals of large streams and rivers (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| Coal darter (*Percina brevicauda*) | RFSS | Prefer swift currents over gravel-cobble-sand substrates within bedrock troughs at foot of rapids or riffle heads of large streams and rivers (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| Freckled darter (*Percina lenticula*) | RFSS | Prefer deep swift currents over sand substrates within runs and rapids of the main channel of large streams and rivers (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| A caddisfly (*Cheumatopsyche bibbensis*) | RFSS | Tributary streams and the main stem of the Cahaba River and associated riparian zones (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| Cocoa clubtail (*Gomphus hybridus*) | RFSS | Primarily inhabit sand-silt substrates within medium to large rivers with emergent vegetation and may forage in forested floodplains, forest edges, or upland ridges (USFS, 2004) | No | Yes | None. Highly unlikely that species would be impacted during construction or operation of NEON sites. |
| A caddisfly (*Hydropsyche hageni*) | RFSS | Primarily inhabits small sandy streams and associated riparian zones with rocky crevices or woody debris (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| A caddisfly (*Hydroptila paralatosa*) | RFSS | Inhabits small streams near the transition of the fall line in Alabama and associated riparian zone (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| Morse's long-horn sedge (*Oecetis morsei*) | RFSS | Inhabits sand substrates within small streams in and around the fall line transition and associated riparian zone (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |

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| Treetop emerald dragonfly (*Somatochlora provocans*) | RFSS | Inhabit trickling flow over sphagnum moss within seeps and bogs with emergent vegetation and can be found in association with forest openings and roadways (USFS, 2004) | No | Yes | None. Highly unlikely that species would be impacted during construction or operation of NEON sites. |
| Laura's clubtail (*Stylurus laurae*) | RFSS | Inhabits sand-mud substrates within small wooded streams with emergent vegetation and forages as adults in forested floodplains, forest edges, or upland ridges (USFS, 2004) | No | Yes | None. Highly unlikely that species would be impacted during construction or operation of NEON sites. Species can easily relocate. |
| Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) | RFSS | Prefers den trees, lakeshores, late successional riparian zones, and open wetlands (USFS, 2004) | No | Yes at S-22 only | None. STREON sites do not include tower. |
| Southeastern myotis (*Myotis austroriparius*) | RFSS | Prefers den trees, lakeshores, late successional riparian zones, and open wetlands (USFS, 2004) | No | Yes at S-22 only | None. STREON sites do not include tower. |
| Rayed creekshell (*Anodontoides radiatus*) | RFSS | Inhabit low to moderate gradient sluggish currents over mud-sand or gravel substrates within pools and riffles of small headwater streams and large rivers (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| Alabama heelsplitter (*Lasmigona complanta alabamensis*) | RFSS | Tributary streams and small to medium sized rivers (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| Southern hickorynut (*Obovaria jacksoniana*) | RFSS | Only known to inhabit the Sipsey, Buttahatchee, and Upper Tombigbee Rivers and prefers moderate gradients and currents over sand and gravel substrates within streams and rivers (USFS, 2004) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Ridged mapleleaf (*Quadrula rumphiana*) | RFSS | Primarily inhabit moderate gradient slow to fast currents over sand-gravel substrates within medium sized rivers and reservoirs (USFS, 2009) | No | Yes at S-22 only | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions downstream . |
| Small-flowered buckeye (*Aesculus parviflora*) | RFSS | Mature mesic hardwood forests (USFS, 2004) | No | Yes | Low. There could be incidental impact during construction of NEON infrastructure. |
| Georgia rockcress (*Arabis georgiana*) | RFSS | Glades and barrens (USFS, 2004) | No | No | None. Suitable habitat not present. |
| Apalachicola wild indigo (*Baptisia megacarpa*) | RFSS | Mature mesic hardwood forests and late successional riparian zones (USFS, 2004) | No | Yes | Low. Impact could occur during construction of S-22. |
| Cypress-knee sedge (*Carex decomposita*) | RFSS | Coastal Plains ponds and swamps (USFS, 2004) | No | No | None. No ponds or swamps near proposed NEON locations. |
| Ravine sedge (*Carex impressinervia*) | RFSS | Late successional riparian zone (USFS, 2004) | No | Yes | Low. Impact could occur during construction of S-22. |
| Kral's Indian paintbrush (*Castilleja kraliana*) | RFSS | Woodlands, savannas, and grasslands (USFS, 2004) | No | Yes | Low. There could be incidental impact during construction of NEON infrastructure. |
| Alabama croton (*Croton alabamensis*) | RFSS | Glades and barrens and basic mesic forests (USFS, 2004) | No | Yes | Very low. There could be incidental impact during construction of NEON infrastructure. |
| Southern lady's slipper (*Cypripedium kentuckiense*) | RFSS | Late successional riparian zone (USFS, 2004) | No | Yes at S-22 only | Low. Impact could occur during construction of S-22. STREON experiment could alter habitat conditions downstream. |
| Large witchalder (*Fothergilla major*) | RFSS | Mature oak forests, woodlands, savannas, and grasslands (USFS, 2004) | No | Yes | Low. There could be incidental impact during construction of NEON infrastructure. |
| Longleaf sunflower (*Helianthus longifolius*) | RFSS | Glades and barrens (USFS, 2004) | No | No | None. Suitable habitat not present. |
| Harper's heartleaf (*Hexastylis speciosa*) | RFSS | Baygalls and bayheads | No | No | None. Suitable habitat not present. |
| Carolina spider lily (*Hymenocallis caroliniana*) | RFSS | Early successional riparian zones, open wetlands, and river channels (USFS, 2004) | No | Yes at S-22 only | Low. Impact could occur during construction of S-22. STREON experiment could alter habitat conditions downstream. |
| Alabama warbonnet (*Jamesianthus alabamensis*) | RFSS | Late successional riparian zones, canopy gaps, and river channels (USFS, 2004) | No | Yes | Low. There could be incidental impact during construction of NEON infrastructure. |
| Alabama snow-wreath (*Neviusia alabamensis*) | RFSS | Canopy gaps, basic mesic forests, and late successional riparian zones (USFS, 2004) | No | Yes | Low. There could be incidental impact during construction of NEON infrastructure. |

| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence Within 5 km | Is suitable habitat present? | Likelihood of impact and rationale |
|---|---|---|---|---|---|
| Arkansas oak (*Quercus arkansana*) | RFSS | Woodlands, savannas, and grasslands (USFS, 2004) | No | Yes | Low. There could be incidental impact during construction of NEON infrastructure. |
| Thorne's beaksedge (*Rhynchospora thornei*) | RFSS | Open wetlands, wet savannas, and flatwoods (USFS, 2004) | No | No | None. Suitable habitat for this species is not present. |
| Eared coneflower (*Rudbeckia auriculata*) | RFSS | River channels and early-successional riparian zones (USFS, 2004) | No | Yes at S-22 only | Low. Impact could occur during construction of S-22. STREON experiment could alter habitat conditions downstream. |
| Bay starvine (*Schisandra glabra*) | RFSS | Late successional riparian zones and mature mesic hardwood forests (USFS, 2004) | No | Yes | Low. There could be incidental impact during construction of NEON infrastructure. |
| Royal catchfly (*Silene regia*) | RFSS | Woodlands, savannas, and grasslands, also glades, barrens and mature oak forests (USFS, 2004) | No | Yes | Low. There could be incidental impact during construction of NEON infrastructure. |
| Lanceleaf trillium (*Trillium lancifolium*) | RFSS | Late successional riparian zones and basic mesic forests (USFS, 2004) | No | Yes | Low. There could be incidental impact during construction of NEON infrastructure. |
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| **Relocatable and Aquatic Site Name: R-15 and A-20** | | | **Mgmt. Agency: MICO Timber** | | **State: Alabama** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Black-knobbed Sawback (*Graptemys nigrinoda nigrinoda*) | SP | Rivers and streams with moderate current, sand or clay bottom, and logs and other basking sites; eggs are laid on sandy beaches (NatureServe, 2009) | Yes | Yes, This species could occur near the aquatic sites proposed for A-21 and A-20 | very low possibility of disturbance during sampling |
| Alabama Map Turtle (*Graptemys pulchra*) | SP | Medium-sized rivers to large creeks with sand and dunes; logs, and other basking sites; deep pools (NatureServe, 2009) | Yes | Yes, This species could occur near the aquatic sites proposed for A-21 and A-21 | very low possibility of disturbance during sampling |
| Bald eagle (*Haliaeetus leucocephalus*) | SP | Coastal areas, bays, rivers, and lakes; conifers or other sheltered sites; deciduous and coniferous trees; in tall trees or cliffs near water (NatureServe, 2009) | Yes | Yes, The bald eagle is known to occur on Choctaw NWR and could occur at Armistead Selden Lock | very low, tower and guy wire collision is the only possibility |

| Relocatable and Aquatic Site Name: R-16 and A-21 | | | Mgmt. Agency: USFWS | | State: Alabama |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Bald eagle (*Haliaeetus leucocephalus*) | SP | Coastal areas, bays, rivers, and lakes; conifers or other sheltered sites; deciduous and coniferous trees; in tall trees or cliffs near water (NatureServe, 2009) | Yes | Yes, The bald eagle is known to occur on Choctaw NWR and could occur at Armistead Selden Lock | very low, tower and guy wire collision is the only possibility |
| Alligator snapping turtle (*Macrochelys temminckii*) | SP | Slow moving, deep water of rivers, sloughs, oxbows, and canals or lakes associated with rivers; also, swamps, bayous, and ponds near rivers, and shallow creeks (NatureServe, 2009) | Yes | Yes, this species could occur at Choctaw NWR and Armistead Selden Lock | No impacts. Construction would avoid impacts to this species and sampling would not impact species. |
| Black-knobbed Sawback (*Graptemys nigrinoda nigrinoda*) | SP | Rivers and streams with moderate current, sand or clay bottom, and logs and other basking sites; eggs are laid on sandy beaches (NatureServe, 2009) | Yes | Yes, This species could occur near the aquatic sites proposed for A-21 and A-20 | very low possibility of disturbance during sampling |
| Alabama Map Turtle (*Graptemys pulchra*) | SP | Medium-sized rivers to large creeks with sand and dunes; logs, and other basking sites; deep pools (NatureServe, 2009) | Yes | Yes, This species could occur near the aquatic sites proposed for A-21 and A-21 | very low possibility of disturbance during sampling |
| Snowy plover (*Charadrius alexandrinus*) | BCR-T1-IM | Barren or sparsely vegetated sand beaches along the coast, and on alkaline flats and river bars farther inland (Seattle Audubon Society, 2005-2008) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Henslow's sparrow (*Ammodramus henslowii*) | BCR-T1-IM | Large, flat fields with no woody plants, and with tall, dense grass, a dense litter layer, and standing dead vegetation. Breeds in weedy grasslands of the east-central United States (All About Birds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Cerulean warbler (*Dendroica cerulea*) | BCR-T1-IM | Woodland breeding habitats, mid-story/canopy nesting (Gough et al., 1998) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Painted bunting (*Passerina ciris*) | BCR-T1-IM | Successional-scrub breeding habitats, ground-low nesting location (Gough et al., 1998) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Purple gallinule (*Porphyrio porphyrio*) | BCR-T1-IM | Freshwater marshes with aquatic vegetation. Builds nest on a floating tussock, in a clump of sawgrass or in a thicket. (NHPT, 2009) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Limpkin (*Aramus guarauna*) | BCR-T1-IM | Found in wetland habitats; builds platform type nest of either on ground or in trees (All About Birds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |

| | | | | | |
|---|---|---|---|---|---|
| Common ground-dove (*Columbina passerina*) | BCR-T1-IM | Open country with trees and bushes, sandy reefs, open sandy areas in forest and savanna, cultivated lands, and around human habitation in villages and towns. May nest on ground or in shrub. Ground nests may be just a few grasses, weeds, rootlets, palm fibers, or pine needles lining a slight depression. Above-ground nests thin frail structure, loose foundation of twigs or pine needles lined with rootlets and grasses (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Loggerhead shrike (*Lanius ludovicianus*) | BCR-T1-IM | Preferred habitats include grasslands, orchards, and open areas with scattered trees (Field Guide to Birds of North America, 2002-2007) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Bewick's wren (*Thryomanes bewickii*) | BCR-T1-IM | Successional-scrub breeding habitats, ground-low nesting location (Gough et al., 1998) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Black-throated green warbler (*Dendroica virens*) | BCR-T1-IM | Boreal coniferous forest and transitional coniferous-deciduous forest. Nests are an open cup of twigs, grass, bark, and spider silk, lined with moss, hair, and feathers. Typically located at a fork in tree branches, one to three meters (three to ten feet) from the ground. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| American coot (*Fulica americana*) | BCR-T1-IM | large freshwater ponds, lakes, and slow-moving rivers. For nesting, they require tall marsh vegetation in shallow water. (Seattle Audubon Society, 2005-2008) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Common tern (*Sterna hirundo*) | BCR-T1-IM | Nests on islands, marshes, and sometimes beaches of lakes and ocean. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Black rail (*Laterallus jamaicensis*) | BCR-T1-MA | Nests in high portions of salt marshes, shallow freshwater marshes, wet meadows, and flooded grassy vegetation. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| American oystercatcher (*Haematopus palliatus*) | BCR-T1-MA | rocky and sandy beaches, on mudflats and on the edges of salt marshes (NHPT, 2009) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Bachman's sparrow (*Aimophila aestivalis*) | BCR-T1-MA | Woodland breeding habitats, ground-low nesting (Gough et al., 1998) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Wilson's plover (*Charadrius wilsonia*) | BCR-T1-MA | Ocean beaches, lagoons, and salt flats. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Black skimmer (*Rynchops niger*) | BCR-T1-MA | Seashore, rocky or sandy (Field Guide to Birds of North American, 2002-2007) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Brown-headed nuthatch (*Sitta pusilla*) | BCR-T1-MA | Pine forests, especially in open, mature forests with periodic fires. Nests in holes in trees, usually dead trees. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| King rail (*Rallus elegans*) | BCR-T1-MA | Freshwater and brackish marshes, rice fields. Typically builds nests in grass clumps just above the water. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Prairie warbler (*Dendroica discolor*) | BCR-T1-MA | Various shrubby habitats, including regenerating forests, open fields, and Christmas-tree farms. Nests usually in thick shrubs close to ground. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Sandwich tern (*Thalasseus sandvicensis*) | BCR-T1-MA | Seacoasts, bays, estuaries, and mudflats, occasionally ocean far from land. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |

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| Northern bobwhite (*Colinus virginianus*) | BCR-T1-MA | Grasslands mixed with shrubs or widely spaced trees (National Audubon Society, 2009) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Chuck-will's-widow (*Caprimulgus carolinensis*) | BCR-T1-MA | Open woodlands and clearings near agricultural country are preferred habitats. Nest not constructed, eggs laid on ground or in dead leaves. (Field Guide to Birds of North America, 2002-2007) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Eastern towhee (*Pipilo erythrophthalmus*) | BCR-T1-MA | Breeds in shrub habitats, often in dry environments and open ground. Old fields and forest edges. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Yellow-billed cuckoo (*Coccyzus americanus*) | BCR-T1-MA | Open woodlands with clearings and dense scrubby vegetation, often along water. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Chimney swift (*Chaetura pelagica*) | BCR-T1-MA | Nests in variety of habitats, especially common in urban areas. (AllAboutBirds, 2003). | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Northern flicker (*Colaptes auratus*) | BCR-T1-MA | Found in open woodlands and forest edge, including cities and suburbs (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Eastern kingbird (*Tyrannus tyrannus*) | BCR-T1-MA | Breeds in open environments with scattered perches, such as fields, orchards, shelterbelts, and forest edges. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Brown thrasher (*Toxostoma rufum*) | BCR-T1-MA | Breeds in brushy open country, thickets, shelter belts, riparian areas, and suburbs (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Wood thrush (*Hylocichla mustelina*) | BCR-T1-MA | Breeds in the interior and edges of deciduous and mixed forests, generally in cool, moist sites, often near water (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Field sparrow (*Spizella pusilla*) | BCR-T1-MA | Breeds in old fields, woodland openings, and edges. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Eastern wood-pewee (*Contopus virens*) | BCR-T1-MA | Breeds in all woodland types in the East. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Eastern meadowlark (*Sturnella magna*) | BCR-T1-MA | Grasslands, pastures, and hayfields (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Prothonotary warbler (*Protonotaria citrea*) | BCR-T1-PR | Breeds in wooded areas near water, especially flooded bottomland hardwood forests, cypress swamps, and along large lakes and rivers. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Kentucky warbler (*Oporornis formosus*) | BCR-T1-PR | Woodlands, low-ground nesting. (Gough et al, 1998) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Blue-winged warbler (*Vermivora pinus*) | BCR-T1-PR | Early to mid-succession habitats, especially abandoned farmland and forest clearings. Breeds at forest/field edges, often shaded by large trees. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Worm-eating warbler (*Helmitheros vermivorus*) | BCR-T1-PR | Breeds in mature deciduous or mixed deciduous-coniferous forest with patches of dense understory, usually on steep hillside. (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |

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| Dickcissel (*Spiza americana*) | BCR-T1-PR | Tall grasslands, including prairie, hayfields, lightly grazed pastures, and roadsides (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
| Mottled duck (*Anas fulvigula*) | BCR-T1-PR | Freshwater wetlands, ditches, wet prairies, and seasonally flooded marshes (AllAboutBirds, 2003) | Possible | Possible | very low possibility of disturbance during sampling and construction. Towers will be placed outside of wetland areas. |
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| Notes | | | | | |
| [a] = Data from Barbour, 2008, personal communication and USFS, 2004 | | | | | |
| [b] = Species Status Codes | | | | | |

| **Federal Status:** | **State:** | **Federal Agency Status** |
|---|---|---|
| Endangered Species Act status as published in the *Federal Register*: | Alabama does not have a state list of threatened and endangered species comparable to the ESA. However, certain species do receive stat protections under the Nongame Species Regulation and Invertebrate Species Regulation of the Alabama Regulations on Game, Fish, and Fur Bearing Animals (Alabama Natural Heritage Program, 2008). | RFSS = Regional Forester's Sensitive Species on Oakmulgee Division of the Talladega National Forest (C-22, C-23, C-24) (USFS, 2004) |
| FE = Federal Endangered | SP = State Protected | BCR-T1-IM = Bird Conservation Region - Tier 1- Immediate Management; only listed breeding birds not federally or state listed in Alabama |
| FT = Federal Threatened | | BCR-T1-MA = Bird Conservation Region - Tier 1- Management Attention; only listed breeding birds not federally or state listed in Alabama |
| FC = Federal Candidate | | BCR-T1-PR = Bird Conservation Region - Tier 1- Planning and Responsibility; only listed breeding birds not federally or state listed in Alabama |
| FP = Federal Proposed | | |

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| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 9 | | Domain Name: Northern Plains | | | |
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| Relocatable Site Name: R-18 | | | Mgmt. Agency: USDA Agricultural Research Service | | State: North Dakota |
| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence Within 5 km | Is suitable habitat present? | Likelihood of impact and rationale |
| No species listed as Threatened and Endangered. | | | | | |
| | | | | | |
| Relocatable Site Name: R-17 | | | Mgmt. Agency: State of North Dakota Land Trust | | State: North Dakota |
| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence Within 5 km | Is suitable habitat present? | Likelihood of impact and rationale |
| No species listed as Threatened and Endangered. | | | | | |
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| Core Site and Aquatic Site Names: C-25, C-26, C-27, A-23, and A-24 | | | Mgmt. Agency: USGS/USFWS | | State: North Dakota |
| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence in Vicinity | Is suitable habitat present? | Likelihood of impact and rationale |
| No species listed as Threatened and Endangered. | | | | | |
| | | | | | |
| Notes | | | | | |
| [a] = Data from Hanson, 2008, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |
| **Federal Status:** | **State:** | | | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program** | |
| Endangered Species Act status as published in the *Federal Register*: | North Dakota species status as designated from the North Dakota Natural Heritage Inventory. | | | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 | |
| FE = Federal Endangered | SE = State Endangered | | | S2 = Imperiled because of rarity or because other factors demonstrably | |
| FT = Federal Threatened | ST = State Threatened | | | S3 = Rare, uncommon, or threatened, but not immediately imperiled, | |
| FC = Federal Candidate | SS = State Species of Special Concern | | | | |
| FP = Federal Proposed | | | | | |

References:

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| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| **Domain (number): 10** | | **Domain Name: Central Plains** | | | |
| | | | | | |
| **Relocatable Site Name: R-19 [a]** | | | **Mgmt. Agency: Private (Mr. Gilbert Lindstrom)** | | **State: Colorado** |
| **Protected / MIS / Sensitive Species or Habitats [b]** | **Mgmt. or Legal Status [c]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| No species listed with a Status Code. | | | | | |
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| **Core Site Name: C-28, C-29, C-30** | | | **Mgmt. Agency: USFS** | | **State: Colorado** |
| **Protected / MIS / Sensitive Species or Habitats [b]** | **Mgmt. or Legal Status [c]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Swift Fox (*Vulpes velox*) | FS-SEN, SSC | Open prairie and arid plains, intermixed with winter wheat fields; dens are in burrows (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Black-footed ferret (*Mustela nigripes*) | FE, SE | Open habitat such as grasslands, steppe, and shrub steppe; nests in burrows (NatureServe, 2009) | No | Yes | None, they do not occur. (Morgon, 2009, personal communication) |
| Ferruginous hawk (*Buteo regalis*) | BLM-SEN, FS-SEN, SC | Open country, mostly prairies, plains and badlands; sagebrush, saltbush-greasewood shrub land, edge of woodlands, and desert (NatureServe, 2009) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| McCown's Longspur (*Calcarius mccownii*) | FS-SEN | Sparse short-grass plains, plowed and stubble fields, and areas of almost bare ground (NatureServe, 2009) | Yes | Yes | Possible, if nesting trees are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |
| Mountain Plover (*Charadrius montanus*) | BLM-SEN, SC | High plains/shortgrass prairie and desert tablelands (NatureServe, 2009) | Yes | Yes | Possible, if nesting trees are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |
| Northern Leopard Frog (*Rana pipiens*) | BLM-SEN, FS-SEN, SC | Springs, slow streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Burrowing Owl (*Athene cunicularia*) | FS-SEN, ST | Open grasslands such as prairie, plains, savanna; vacant lots near human population or airports (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Cassin's Sparrow (*Aimophila cassinii*) | FS-SEN | Open grassland and short-grass plains with some bushes or shrubs, sagebrush, mesquite or yucca (NatureServe, 2009) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| | | | | | |
| **Relocatable Site Name: R-20 [a]** | | | **Mgmt. Agency: NPS** | | **State: Colorado** |
| **Protected / MIS / Sensitive Species or Habitats [b]** | **Mgmt. or Legal Status [c]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Boreal Toad (Southern Rocky Mountain Population) (*Bufo boreas pop. 1*) | SE | Subalpine lakes, reservoirs, ponds, creek pools, marshy areas, wet meadows, and adjacent terrestrial habitats (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Greenback Cutthroat Trout (*Oncorhynchus clarkii stomias*) | LT, ST | Clear, swift-flowing mountain streams with cover such as overhanging banks and vegetation; lakes, pools, and riffles (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Boreal Owl (*Aegolius funereus*) | FW-SEN | Dense coniferous forest, mixed forest, thickets of alder, aspen, or stunted spruce, close to open grassy areas; usually nests in tree holes (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| **Relocatable Site Name: R-20 [a]** | | | **Mgmt. Agency: NPS** | | **State: Colorado** |
| **Protected / MIS / Sensitive Species or Habitats [b]** | **Mgmt. or Legal Status [c]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |

| | | | | | |
|---|---|---|---|---|---|
| Black Swift (*Cypseloides niger*) | FW-SEN | Aerial; forages over forests and in open areas; nests near waterfalls, wet cliffs, sea cliffs, in sea caves, and limestone caves (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Lewis's Woodpecker (*Melanerpes lewis*) | FW-SEN | Open forest and woodland, including oak, coniferous forest, riparian woodland and orchards; standing snag or hollow tree (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Rocky Mountain cinquefoil (*Potentilla rubricaulis*) | FS-SEN | Granite shelves, granite rock, and cliff faces (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Pale blue-eyed grass (*Sisyrinchium pallidum*) | BLM-SEN | Wet, poorly drained meadows, stream banks, roadside ditches, and irrigated hay meadows where standing water is present (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| Selkirk violet (*Viola selkirkii*) | FS-SEN | Moist woods and alder thickets (NatureServe, 2009) | Yes | No | None, suitable habitat not present |
| **Aquatic Site Name: A-25** | | | **Mgmt. Agency:** | | **State: Colorado** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Boreal Owl (*Aegolius funereus*) | FS-SEN | Dense coniferous forest, mixed forest, thickets of alder, aspen, or stunted spruce, close to open grassy areas; usually nests in tree holes (NatureServe, 2009) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Pale blue-eyed grass (*Sisyrinchium pallidum*) | BLM-SEN | Wet, poorly drained meadows, stream banks, roadside ditches, and irrigated hay meadows where standing water is present (NatureServe, 2009) | Yes | No | None, no suitable habitat present |
| Greenback Cutthroat Trout (*Oncorhynchus clarkii stomias*) | LT, ST | Clear, swift-flowing mountain streams with cover such as overhanging banks and vegetation; lakes, pools, and riffles (NatureServe, 2009) | Yes | Yes, occurs in North Boulder Creek and Como Creek | very low possibility of disturbance during sampling |
| Boreal Toad (Southern Rocky Mountain Population) *(Bufo boreas pop. 1)* | SE | Subalpine lakes, reservoirs, ponds, creek pools, marshy areas, wet meadows, and adjacent terrestrial habitats (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Black Swift (*Cypseloides niger*) | FS-SEN | Aerial; forages over forests and in open areas; nests near waterfalls, wet cliffs, sea cliffs, in sea caves, and limestone caves (NatureServe, 2009) | Yes | No | None, no suitable habitat present |
| Rocky Mountain cinquefoil (*Potentilla rubricaulis*) | FS-SEN | Granite shelves, granite rock, and cliff faces (NatureServe, 2009) | Yes | No | None, no suitable habitat present |
| Selkirk violet (*Viola selkirkii*) | FS-SEN | Moist woods and alder thickets (NatureServe, 2009) | Yes | No | None, no suitable habitat present |
| | | | | | |
| Notes | | | | | |
| [a] = Location of site has changed. Data in table is subject to change. | | | | | |
| [b] = Data from Menefee, 2009, personal communication. | | | | | |
| [c] = Species Status Codes | | | | | |
| **Federal Status:** | **State:** | | | | |
| U.S. Fish & Wildlife Service, under the Endangered Species Act status as published in the *Federal Register*: | Colorado species status as designated by the Colorado Division of Wildlife (CDOW). | | | | |
| FE = Federal Endangered | SE = State Endangered | | | | |
| FT = Federal Threatened | ST = State Threatened | | | | |
| FC = Federal Candidate | SSC = State Species of Special Concern | | | | |
| FP = Federal Proposed | | | | | |

References:


National Park Service, 2009. Rocky Mountain National Park. http://www.nps.gov/archive/romo/resources/plantsandanimals/names/amphibandreptiles.html
NatureServe Explorer. 2009. Species Quick Search. http://www.NatureServe.org/explorer/index.htm. Accessed January 20, 2009.
Morgan, J./ ARS, CPER, 2009. Personal communication with CH2M HILL. January 23.
Menefee M./ Colorado Natural Heritage Program. Personal communication with CH2M HILL. January 15.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| **Domain (number): 11** | | **Domain Name: Southern Plains** | | | |
| | | | | | |
| **Relocatable and Aquatic Site Names: R-21, R-22, and A-27** | | | **Mgmt. Agency: Oklahoma State** | | **State: Oklahoma** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| No record of elements of concern at or near the project locations. | | | | | |
| | | | | | |
| Notes | | | | | |
| [a] = Data from Collins, 2008, personal communication.. | | | | | |
| [b] = Species Status Codes | | | | | |
| **Federal Status:** | **State:** | | | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program** | |
| Endangered Species Act status as published in the *Federal Register*: | Oklahoma species status as designated by Oklahoma Natural Heritage Inventory. | | | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 | |
| FE = Federal Endangered | SE = State Endangered | | | S2 = Imperiled because of rarity or because other factors demonstrably | |
| FT = Federal Threatened | ST = State Threatened | | | S3 = Rare, uncommon, or threatened, but not immediately imperiled, | |
| FC = Federal Candidate | | | | | |
| FP = Federal Proposed | | | | | |
| References:<br>Collins, J./ Oklahoma Natural Heritage Inventory, 2008. Personal communication with CH2M HILL. December 4. | | | | | |

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| **Domain (number): 11** | | **Domain Name: Southern Plains** | | | |
| | | | | | |
| **Core Site and Aquatic Site Names: C-31, C-32, C-33, and A-26** | | | **Mgmt. Agency: USFS** | | **State: Texas** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Texas Kangaroo Rat (*Dipodomys elator*) | ST | Clay soils supporting sparse, short grasses and small, scattered mesquite bushes (The Mammals of Texas - Online Edition, 2009) | Yes | Yes, This species could occur near proposed NEON infrastructure on the LBJ | Possible, if nesting and burrowing mesquite shrubs are impacted by vegetation removal activity. Conduct nest and burrow surveys prior to construction. |
| Black-capped Vireo (*Vireo atricapilla*) | SE, FE | Rangelands with scattered clumps of shrubs separated by open grassland (Texas Parks and Wildlife, 2009) | Yes | Yes, This species could occur near proposed NEON sites on the LBJ (C-31, C-32, C-33, A-26) | Possible, if nesting grasses are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |
| Bald Eagle-(Haliaeetus leucocephalus) | CNG-SEN | Along river systems or near large bodies of water such as a lake or reservoir; usually near large trees (Sanchez, 2009, personal communication) | No | No | None, no suitable habitat present |
| Migrant loggerhead shrike (Lanius ludovicianus migrans) | CNG-SEN | orchards, and thickets along roadsides and hedge-row; also altered habitats such as cemeteries, rural parks and golf courses, power lines | No | No | None, no suitable habitat present |
| Texas heelsplitter (Potamilus amphichaenus) | CNG-SEN | Near river systems; quiet waters on sand and mud (Sanchez, 2009, personal communication) | No | No | None, no suitable habitat present |
| Comanche Peak Prairie Clover (Dalea reverchonii) | CNG-SEN | Limestone with sandy surface (Sanchez, 2009, personal communication) | No | No | None, no suitable habitat present |
| American burying Beetle (Nicrophorus americanus) | FE | Oak-hickory forest or Forest/pasture ecotone and open pastures (Sanchez, 2009, personal communication) | No | No | None, no suitable habitat present |
| Ouachita Rock Pocketbook (Arkansia wheeleri) | FE | Pools, backwaters, and side channels of certain rivers and large creeks (Sanchez, 2009, personal communication) | No | No | None, no suitable habitat present |

| | | |
|---|---|---|
| Notes | | |
| [a] = Data from Scott, 2008, personal communication. | | |
| [b] = Species Status Codes | | |
| **Federal Status:** | **State:** | **Federal Agency Status:** |
| Endangered Species Act status as published in the *Federal Register*: | Texas species status as designated from Texas Parks and Wildlife Department. | CNG-SEN = Caddo National Grassland Sensitive Species (Sanchez, 2009, personal communication) |
| FE = Federal Endangered | SE = State Endangered | |
| FT = Federal Threatened | ST = State Threatened | |
| FC = Federal Candidate | | |
| FP = Federal Proposed | | |

References:


The Mammals of Texas - Online Edition, 2009. Texas Kangaroo Rat. http://www.nsrl.ttu.edu/tmot1/dipoelat.htm. Accessed January 19, 2009.
Sanchez, A./ Biologist at Caddo National Grassland. 2009. Personal communication with CH2M HILL. February 17.
Scott, D./ Texas Natural Diversity Database, 2008. Personal communication with CH2M HILL. December 23.
Texas Parks and Wildlife, 2009. Black-capped Vireo. http://www.tpwd.state.tx.us/huntwild/wild/species/endang/animals/birds/bcv.phtml. Accessed January 19, 2009.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| **Domain (number): 12** | | **Domain Name: Northern Rockies** | | | |
| **Relocatable Site and Aquatic Site Names: R-23 and A-29** | | | **Mgmt. Agency: Montana State** | | **State: Montana** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Gray wolf (*Canis lupus*) | FE, FFE, BSP, Tier I | No special habitat except for the presence of native ungulates within it territory on a year round basis (Montana Field Guide, 2009) | Yes | Yes, This species could occur at any of the proposed sites at YNP | No impacts. Construction would avoid impacts to this species. |
| Wolverine (*Gulo gulo*) | FFSS, BSS, Tier II | Alpine tundra, and boreal and mountain forests (Montana Field Guide, 2009) | Yes | Yes, potential to occur near R-24 | No impacts. Construction would avoid impacts to this species. |
| Canada Lynx (*Lynx canadensis*) | FT, FFT, BSP, Tier 1 | Subalpine forests made of pure lodgepole pine as well as mixed strands of subalpine fir, lodgepole pine, Douglas-fir, grand fir, western larch and hardwoods (Montana Field Guide, 2009) | Yes | Yes | It is highly unlikely that this species would occur near the proposed sites at YNP |
| Dwarf Purple Monkeyflower (*Mimulus nanus*) | FFSS, BSS | Dry, open, often gravelly or sandy slopes in the valleys and foothills (Montana Field Guide, 2009) | Yes | Yes | It is highly unlikely that this species would occur near the proposed sites at YNP |
| **Relocatable Site Name: R-24** | | | **Mgmt. Agency: Montana Fish,** | | **State: Montana** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Bald Eagle (*Haliaeetus leucocephalus*) | FDM, FFT, BSP, Tier I | Riparian and lacustrine habitats (forested areas around rivers and lakes), tallest, oldest, large diameter trees (Montana Field Guide, 2009) | Yes | Yes, known to occur near R-24 | very low, tower and guy wire collision is the only possibility |
| Yellowstone Cutthroat Trout (*Oncorhynchus clarkii bouvieri*) | FFSS, BSS, Tier I | Clear, cold streams, rivers, and lakes (Montana Field Guide, 2009) | Yes | Yes, in the Yellowstone River | very low possibility of disturbance during sampling |
| Gray wolf (*Canis lupus)* | FE, FFE, BSP, Tier I | No special habitat except for the presence of native ungulates within it territory on a year round basis (Montana Field Guide, 2009) | Yes | Yes, This species could occur at any of the proposed sites at YNP | No impacts. Construction would avoid impacts to this species. |
| Grizzly Bear (*Ursus arctos*) | FT, FFT, BSP, Tier 1 | Meadows, seeps, riparian zones, mixed shrub fields, closed timber, open timber, sidehill parks, snow chutes, and alpine slab rock habitats (Montana Field Guide, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Wolverine *(Gulo gulo)* | FFSS, BSS, Tier II | Alpine tundra, and boreal and mountain forests (Montana Field Guide, 2009) | Yes | Yes, potential to occur near R-24 | No impacts. Construction would avoid impacts to this species. |
| Canada Lynx (*Lynx canadensis*) | FT, FFT, BSP, Tier 1 | Subalpine forests made of pure lodgepole pine as well as mixed strands of subalpine fir, lodgepole pine, Douglas-fir, grand fir, western larch and hardwoods (Montana Field Guide, 2009) | Yes | Yes | It is highly unlikely that this species would occur near the proposed sites at YNP |
| Notes | | | | | |
| [a] = Data from Miller, 2008, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |
| **Federal Status:** | | | **State Status:** | | |
| **U.S. Fish & Wildlife Service** | **U.S. Forest Service** | **U.S. Bureau of Land Management** | **Montana Fish, Wildlife, and Parks** | | |
| FE = U.S Fish & Wildlife Service listed as Endangered | FFE = U.S. Forest Service listed as Endangered | BSS = U.S. Bureau of Land Management listed as Sensitive Species | Tier I = Greatest conservation need. | | |

| | | | |
|---|---|---|---|
| FT = U.S Fish & Wildlife Service listed as Threatened | FFT = U.S. Forest Service listed as Threatened | BSP = U.S. Bureau of Land Management listed as Special Status | Tier II = Moderate conservation need. |
| FDM = U.S. Fish & Wildlife Service listed as recovered, delisted, and being monitored | FFSS = U.S. Forest Service listed as Sensitive species | | |
| | FFSC = U.S. Forest Service listed as Species of Concern | | |
| | FFSI = U.S. Forest Service listed as Species of Interest | | |


References:
Miller, Martin P./ Montana Natural Heritage Program, 2008. Personal communication with CH2M HILL. December 2.
Montana Field Guide, 2009. Gray Wolf - Canis lupus. http://fieldguide.mt.gov/detail_AMAJA01030.aspx. Accessed January 20.
Montana Field Guide, 2009. Wolverine - Gulo gulo. http://fieldguide.mt.gov/detail_AMAJF03010.aspx. Accessed January 20, 2009.
Montana Field Guide, 2009. Canada Lynx - Lynx canadensis. http://fieldguide.mt.gov/detail_AMAJH03010.aspx. Accessed January 20, 2009.
Montana Field Guide, 2009. Dwarf Purple Monkeyflower - Mimulus nanus. http://fieldguide.mt.gov/detail_PDSCR1B1Y0.aspx. Accessed January 20, 2009.
Montana Field Guide, 2009. Bald eagle - Haliaeetus leucocephalus. http://fieldguide.mt.gov/detail_ABNKC10010.aspx. Accessed January 20, 2009.
Montana Field Guide, 2009. Yellowstone Cutthroat Trout - Oncorhynchus clarkii bouvieri. http://fieldguide.mt.gov/detail_AFCHA02087.aspx. Accessed January 20, 2009.
Montana Field Guide, 2009. Grizzly Bear - Ursus arctos. http://fieldguide.mt.gov/detail_AMAJB01020.aspx. Accessed January 20, 2009.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 12 | | Domain Name: Northern Rockies | | | |
| | | | | | |
| Core Site and Aquatic Site Name: C-34, C-35, C-36, and A-28 | | | Mgmt. Agency: NPS/ USFS | | State: Wyoming |
| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence Within 5 km | Is suitable habitat present? | Likelihood of impact and rationale |
| American Peregrine Falcon (*Falco peregrinus anatum*) | FD | Open areas such as tundra, moorlands, and seacoasts, especially where there are suitable nesting cliffs, mountains, open forested areas, and human population centers (NatureServe, 2009) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Whooping Crane (*Grus americana*) | FE | Freshwater marshes, wet prairies, grain and stubble fields, and on shallow lakes and lagoons (NatureServe, 2009) | Yes | Yes, potential habitat at A-28 | very unlikely, species thought to be gone from YNP |
| Gray Wolf (*Canis lupus*) | FT | No special habitat except for the presence of native ungulates within it territory on a year round basis (Montana Field Guide, 2009) | Yes | Yes, This species could occur at any of the proposed sites at YNP | No impacts. Construction would avoid impacts to this species. |
| Grizzly Bear (*Ursus arctos*) | FT | Meadows, seeps, riparian zones, mixed shrub fields, closed timber, open timber, sidehill parks, snow chutes, and alpine slabrock habitats (Montana Field Guide, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Canada Lynx (*Lynx canadensis*) | FT | Subalpine forests made of pure lodgepole pine as well as mixed strands of subalpine fir, lodgepole pine, Douglas-fir, grand fir, western larch and hardwoods (Montana Field Guide, 2009) | Yes | Yes | It is highly unlikely that this species would occur near the proposed sites at YNP |
| American Bison (Free-ranging Herds) (*Bos bison*) | FPT | Open plains and grasslands in south; woodland and openings in boreal forest, meadows, and river valleys in north (NatureServe, 2009) | Yes | Yes, managed for in YNP | No impacts. Construction would avoid impacts to this species. |
| | | | | | |
| Notes | | | | | |
| [a] = Data from Arnett, 2008, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |

| Federal Status: | State: | Natural Heritage Program: S1, S2, or S3 rank from Heritage Program |
|---|---|---|
| Endangered Species Act status as published in the *Federal Register*: | Wyoming species status as designated | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 |
| FE = Federal Endangered | SE = State Endangered | S2 = Imperiled because of rarity or because other factors demonstrably |
| FT = Federal Threatened | ST = State Threatened | S3 = Rare, uncommon, or threatened, but not immediately imperiled, |
| FC = Federal Candidate | SS = State Species of Special Concern | |
| FP = Federal Proposed | | |
| FD = Federal Delisted | | |
| FPT = Federal Petitioned | | |

References:

Arnett, M./ Wyoming Natural Diversity Database, University of Wyoming, 2008. Personal communication with CH2M HILL. December 17.
NatureServe Explorer. 2009. Species Quick Search. http://www.NatureServe.org/explorer/index.htm.. Accessed January 20, 2009.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| **Domain (number): 13** | | **Domain Name: Southern Rockies** | | | |
| | | | | | |
| **Aquatic Site Name: A-30** | | | **Mgmt. Agency:** | | **State: Colorado** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Boreal Toad (Southern Rocky Mountain Population) (*Bufo boreas pop. 1*) | SE | Subalpine lakes, reservoirs, ponds, creek pools, marshy areas, wet meadows, and adjacent terrestrial habitats (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Greenback Cutthroat Trout (*Oncorhynchus clarkii stomias*) | FT, ST | Clear, swift-flowing mountain streams with cover such as overhanging banks and vegetation; lakes, pools, and riffles (NatureServe, 2009) | Yes | Yes, occurs in North Boulder Creek and Como Creek | very low possibility of disturbance during sampling |
| Wolverine (*Gulo gulo*) | FS-SEN, SE | Alpine and arctic tundra, boreal and mountain forests (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Slender cottongrass (*Eriophorum gracile*) | BLM-SEN, FS - SEN | Sedge meadows and floating bogs in saturated soil to shallow standing water at 6,900 to 8,000 feet (Wyoming Natural Diversity Database, 2009) | Yes | No | None, no suitable habitat present |
| Narrowleaf grapefern (*Botrychium lineare*) | FS-SEN | Habitat varies from higher elevations in mountains to meadow dominated by knee-high grass, shaded woods and woodlands, grassy horizontal ledges on a north-facing limestone cliff, and a flat upland part of a river valley (NatureServe, 2009) | Yes | No | None, no suitable habitat present |
| Clawless draba (*Draba exunguiculata*) | FS-SEN | Rocky, gravelly slopes and talus, alpine; usually granite bedrock. 3300 m and above (NatureServe, 2009) | Yes | No | None, no suitable habitat present |
| Kotzebue's grass-of-Parnassus (*Parnassia kotzebuei*) | FS-SEN | Moist sub-alpine areas in meadows, thickets, and along creeks in boggy soil (Washington Department of Natural Resources, 2009) | Yes | No | None, no suitable habitat present |
| **Core Site Name: C-37, C-38, C-39** | | | **Mgmt. Agency: CU/ Forest Service** | | **State: Colorado** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Boreal Owl (*Aegolius funereus*) | FS-SEN | Dense coniferous forest, mixed forest, thickets of alder, aspen, or stunted spruce, close to open grassy areas; usually nests in tree holes (NatureServe, 2009) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| Lynx (*Lynx canadensis*) | SE | Boreal and montane regions dominated by coniferous or mixed forest with thick undergrowth or open forest; rocky areas; tundra to forage (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Boreal Toad (Southern Rocky Mountain Population) (*Bufo boreas pop. 1*) | SE | Subalpine lakes, reservoirs, ponds, creek pools, marshy areas, wet meadows, and adjacent terrestrial habitats (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Wolverine (*Gulo gulo*) | FS-SEN, SE | Alpine and arctic tundra, boreal and mountain forests (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Northern Leopard frog (*Rana pipiens*) | BLM-SEN, FS-SEN, SSC | Springs, slow streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes (NatureServe, 2009) | Yes | No | None, no suitable habitat present |
| **Relocatable and Aquatic Site Name: R-26 and A-31** | | | **Mgmt. Agency: USFS** | | **State: Colorado** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Wolverine (*Gulo gulo*) | FS-SEN, SE | Alpine and arctic tundra, boreal and mountain forests (NatureServe, 2009) | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Boreal Owl (*Aegolius funereus*) | FS-SEN | Dense coniferous forest, mixed forest, thickets of alder, aspen, or stunted spruce, close to open grassy areas; usually nests in tree holes (NatureServe, 2009) | Yes | Yes | very low, tower and guy wire collision is the only possibility |

| | | | | | |
|---|---|---|---|---|---|
| Colorado River Cutthroat Trout (*Oncorhynchus clarkii pleuriticus*) | BLM-SEN, FS-SEN, SSC | Cool, clear water and well-vegetated streambanks for cover and bank stability (NatureServe, 2009) | Yes | Yes, currently is found in small headwater streams of the Green and upper Colorado Rivers | very low possibility of disturbance during sampling |
| Northern Leopard Frog (*Rana pipiens*) | BLM-SEN, FS-SEN, SC | Springs, slow streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes (NatureServe, 2009) | Yes | No | None, no suitable habitat present |
| Burrowing Owl (*Athene cunicularia*) | FS-SEN, ST | Open grasslands such as prairie, plains, savanna; vacant lots near human population or airports (NatureServe, 2009) | Yes | Yes, may occur around R-26 | very low, tower and guy wire collision is the only possibility |
| Cassin's Sparrow (*Aimophila cassinii*) | FS-SEN | Open grassland and short-grass plains with some bushes or shrubs, sagebrush, mesquite or yucca (NatureServe, 2009) | Yes | No | None, no suitable habitat present |
| **Relocatable and Aquatic Site Name: R-26 and A-31** | | | **Mgmt. Agency: USFS** | | **State: Colorado** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Ferruginous hawk (*Buteo regalis*) | BLM-SEN, FS-SEN, SC | Open country, mostly prairies, plains and badlands; sagebrush, saltbush-greasewood shrub land, edge of woodlands, and desert (NatureServe, 2009) | Yes | Yes, may occur around R-26 | very low, tower and guy wire collision is the only possibility |

Notes

[a] = Data from Menefee, 2009, personal communication.

[b] = Species Status Codes

| **Federal Status:** | **State:** | **USFS, BLM, NPS Status** | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program data base search** |
|---|---|---|---|
| U.S. Fish & Wildlife Service, under the Endangered Species Act status as published in the *Federal Register*: | Colorado species status as designated by the Colorado Division of Wildlife (CDOW). | MIS = USFS Management Indicator Species | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. |
| FE = Federal Endangered | SE = State Endangered | FS-SEN = USFS Sensitive | S2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6-20 occurrences. |
| FT = Federal Threatened | ST = State Threatened | BLM-SEN = BLM Sensitive | S3 = Rare, uncommon, or threatened, but not immediately imperiled, typically with 21-100 occurrences. |
| FC = Federal Candidate | SSC = State Species of Special Concern | NPS = National Park Service Species of Management Concern | |
| FP = Federal Proposed | | | |

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| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 13 | | Domain Name: Southern Rockies | | | |
| | | | | | |
| **Relocatable Site Name: R-25** | | | **Mgmt. Agency: BLM** | | **State: Utah** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| No species of concern. | | | | | |
| | | | | | |
| Notes | | | | | |
| [a] = Data from Lindsey, 2008, personal communication | | | | | |
| [b] = Species Status Codes | | | | | |
| **Federal Status:** | **State:** | | **USFS, BLM, NPS Status** | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program data base search** | |
| U.S. Fish & Wildlife Service, under the Endangered Species Act status as published in the *Federal Register*: | Utah species status as designated on the Utah Sensitive species List (10/17/2006) | | MIS = USFS Management Indicator Species | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. | |
| FE = Federal Endangered | U-CA = Conservation agreement species" means wildlife species or subspecies that are currently receiving special management under a conservation agreement developed or implemented by the state to preclude the need for listing under the ESA | | FS-SEN = USFS Sensitive | S2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6-20 occurrences. | |
| FT = Federal Threatened | ST = State Threatened | | BLM-SEN = BLM Sensitive | S3 = Rare, uncommon, or threatened, but not immediately imperiled, typically with 21-100 occurrences. | |
| FC = Federal Candidate | U-SEN = Utah sensitive species | | NPS = National Park Service Species of Management Concern | | |
| FP = Federal Proposed | SS = State species of special concern. | | | | |

References:
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| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| **Domain (number): 14** | | **Domain Name: Desert Southwest** | | | |
| | | | | | |
| **Relocatable Site Name: R-27** | | | **Mgmt. Agency: State of Arizona and Coronado National Forest** | | **State: New Mexico** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| western burrowing owl *(Athene cunicularia hypugaea)* | BLM-S | Variable in open, well-drained grasslands, steppes, deserts, prairies, and agricultural lands, often associated with burrowing mammals. Sometimes in open areas such as vacant lots near human habitation, golf courses or airports (Arizona Game and Fish Department, 2001) | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| sandhill goosefoot (*Chenopdium cycloides)* | S2, USFS-S, BLM-S | Habitat of sandhill goosefoot consists of unstable sandy soils on dunes, and stabilized sand in blowouts in sand prairie (Spackman et al. 1997). | Yes | Yes | very low possibility of disturbance during sampling and construction |

Notes:

[a]= Data from McCollough, 2008, personal communication and Spackman et al., 1997.

[b] = Species Status Codes

| **Federal Status:** | **State:** | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program** |
|---|---|---|
| Endangered Species Act status as published in the *Federal Register*: | Arizona and New Mexico species status as designated by the Arizona Game and Fish Department and New Mexico Natural Heritage respectively. | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 |
| LE = Listed Endangered | HS = Highly Safeguarded: no collection allowed | S2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6-20 occurrences. |
| LT = Listed Threatened | SR = Salvage Restricted: collection only with permit | S3 = Rare, uncommon, or threatened, but not immediately imperiled, typically with 21-100 occurrences. |
| SC = Species of Concern | WSC = Wildlife of Special Concern in Arizona. Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona (WSCA, in prep). | |
| LP = Listed Proposed | | |

References:


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McCollough, R/ Natural Heritage New Mexico, 2008. Personal communication with CH2M HILL. December 16.

Spackman, S., B. Jennings, J. Coles, C. Dawson, M. Minton, A. Kratz, and C. Spurrier. 1997. Colorado rare plant field guide. Prepared for the Bureau of Land Management, the U.S. Forest Service, and the U.S. Fish and Wildlife Service by the Colorado Natural Heritage Program.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 14 | | Domain Name: Desert Southwest | | | |
| | | | | | |
| Core Site Names: C-40, C-41, and C-42 | | | Mgmt. Agency: State of Arizona and Coronado National Forest | | State: Arizona |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Pima pineapple cactus *(Coryphantha scheeri var. robustipina)* | LE, HS | Ridges in semidesert grassland and alluvial fans in Sonoran desert scrub. Desert Botanical Garden (1999) reports that "Plants are found on alluvial hillsides in rocky, sandy soils.... habitat type is primarily desert grassland...." | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| northern goshawk *(Acciptiter gentilis)* | SC, WSC, FS-S | Overall, goshawk's nests in a wide variety of forest types including deciduous, coniferous and mixed forests. They typically nest in mature or old-growth forests, generally selecting larger tracts of forests over smaller tracts. In Arizona, goshawk's nest most commonly in ponderosa pine forests along the Mogollon Rim and on the Kaibab Plateau, and in Arizona pine and ponderosa pine forests in the southeastern mountains. Occasionally, they breed in relatively low elevation oak forests in the southeastern portion of the state. The lowest-elevation nest found was at 4,900 feet. (Snyder and Snyder, in Glinski 1998). In the western U.S. they characteristically nest in coniferous forests including those dominated by ponderosa pine and lodgepole pine, or in mixed forests dominated by various coniferous species including fir, Douglas-fir, cedar, hemlock, spruce. They will also nest in deciduous forests with aspen, paper birch and willow. | Yes | No | None, no suitable habitat present |
| giant spotted whiptail *(Aspidoscelis burti stictogrammus)* | SC, FS-S, BLM-S | Inhabits mountain canyons, arroyos, and mesas in arid and semi-arid regions, entering lowland desert along stream courses. Found in dense shrubby vegetation, often among rocks near permanent and intermittent streams (Stebbins 1985). Open areas of bunch grass within these riparian habitats are also occupied (Degenhardt et. al. 1996). | Yes | Yes | very low possibility of disturbance during sampling |
| Mexican spotted owl *(Strix occidentalis lucida)* | LT, FS-S, WSC | They primarily breed in dense old growth mixed-conifer forests located on steep slopes, especially deep, shady ravines. These sites have high canopy closure, high basal area, many snags, and many downed logs. For foraging, multistoried forest with many potential patches is desirable. In Arizona, they occur primarily in mixed-conifer, pine-oak, and evergreen oak forests; also occurs in ponderosa pine forest and rocky canyonlands (Ganey and Balda 1989). In Arizona, they generally foraged more than or as frequently as expected (based on availability) in virgin mixed-conifer forests (Ganey and Balda 1994 in NatureServe 2005). Range size for single owls in Arizona averages 1,600 acres and combined home ranges occupied by pairs averages 2,000 acres. MSO nest and roost primarily in closed-canopy forests or rocky canyons. Vegetation ranges from desert scrubland and semi-desert grassland in the valleys upwards to montane forests. The montane vegetation includes interior chaparral, encinal woodlands, and Madrean pine-oak woodlands at lower and middle elevations, with ponderosa pine, mixed-conifer, and spruce-fir forests at higher elevations. Riparian forests may also function as important components of ecosystems supporting spotted owls. They may serve as direct avenues of movement between mountain ranges or as stopover | Yes | No | None, no suitable habitat present |

| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence in Vicinity | Is suitable habitat present? | Likelihood of impact and rationale |
|---|---|---|---|---|---|
| Mexican long-tongued bat *(Choeronycleris mexicana)* | SC, WSC | Mesic areas in canyons of mixed oak-conifer forests in mountains rising from the desert. Caves and abandoned mines are favored daytime retreats where they prefer to roost in the dimly lit areas often near the entrance. They are also often found in shallow caves or rock shelters. A few are found in palo verde-saguaro areas. Usually occupies higher elevations when it arrives in spring, and they may use the same roost year after year. Based on a study conducted by Carter and Peachey in 1996, al roost sites in the Cienega Creek Natural Preserve, except one, were located immediately adjacent to the creek. The roost sites consisted of pocketed, eroded clay soil holes such as sink holes, or soil piping caves. The majority of the soil piping caves where only a few meters long and 1-2 meters high, having a characteristic dome ceiling which seems to be where the bats prefer to roost. | Yes | No | None, no suitable habitat present |
| Sonoran desert tortoise *(Gopherus agassizii)* | SC, WSC | The Sonoran population of the desert tortoise occurs primarily on rocky slopes and bajadas of Mojave and Sonoran desert scrub (see references in AIDTT 2000). Caliche caves in incised, cut banks of washes (arroyos) are also used for shelter sites, especially in the Lower Colorado River Valley subdivision. Shelter sites are rarely found in shallow soils. | Yes | Yes | Possible, conduct surveys for active burrows and avoid construction in those areas if possible |
| mock-pennyroyal *(Hedeoma dentatum)* | FS-S | Oak woodland, oak-pine forest, pine forest. In finger Rock Canyon, it grows on fairly open slopes and along the trail. It can be found on open road cuts, steep rocky outcrops, and gravelly slopes in wooded canyons with open to full sunlight (Irving 1980, Bennett et al. 1996). | Yes | No | None, no suitable habitat present |
| western red bat *(Lasiurus blossevillii)* | WSC | Riparian and other wooded areas. Roosts by day in trees. Summer roosts usually in tree foliage, sometimes in leafy shrubs or herbs. Often found in trees of fruit orchards. May also roost in saguaro boots and occasionally in cave-like situations (E.L. Cockrum pers. comm. 1992) although they generally avoid caves and buildings during both summer/winter. Solitary female roosts with young in tree foliage. This species primarily roosts in cottonwood trees, and it's notable decline in abundance is suspected to be attributable to the 70-98% loss of cottonwood habitat in North America. Cottonwood distribution throughout the range of this species is thought to determine this species ability to complete it's annual migration. | Yes | No | None, no suitable habitat present |
| lesser long-nosed bat *(Leptonycteris curasoae yerbabuenae)* | LE, FS-S, WSC | Desert grassland and shrub land up to oak transition. They roost in caves, mine tunnels, and occasionally in old buildings. They forage in areas of saguaro, ocotillo, paloverde, prickly pear and organ pipe cactus and later in the summer among agaves. There appear to be seasonal differences in when certain habitats are occupied. | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| Lemon lily *(Lilium paryi)* | SC, FS-S, SR | Mesic, shady canyon bottoms along perennial streams or adjacent hillside springs. Sandy soil is high in organic material and remains saturated, or nearly so, year-round. | Yes | No | None, no suitable habitat present |
| Arizona manihot *(Manihot davisiae)* | FS-S | In Arizona, this species grows on rocky limestone hillsides. In Sonora, it prefers decomposed granite on slopes (Arizona Game and Fish Department 2009). | Yes | No | None, no suitable habitat present |
| Box Canyon muhly *(Muhlenbergia dubioides)* | FS-S | Rocky slopes in canyons and along stream courses, often on cliffs. | Yes | No | None, no suitable habitat present |

| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence in Vicinity | Is suitable habitat present? | Likelihood of impact and rationale |
|---|---|---|---|---|---|
| weeping muhly *(Muhlenbergia xerophila)* | FS-S | In seeps or associated with water. Most often growing in crevices of cliffs, bedrock, and other rocks along canyon bottoms, but also known from rocky canyon slopes in oak, pine-oak, and riparian woodlands. | Yes | No | None, no suitable habitat present |
| cave myotis *(Myotis velifer)* | SC, BLM-S | Desert scrub of creosote, brittlebush, palo verde and cacti. Roost in caves, tunnels, and mineshafts and under bridges and sometimes in buildings within a few miles of water. There are a number of records of one or a few individuals roosting in cliff and barn swallow nests. In summer are apparently tolerant of high temperatures and low humidity's. One group was found in an attic in Gila County where July temperatures were 37° C and relative humidity was 23%.<br>Winter roosts in Arizona are wet mine tunnels above 6000 feet. Preferred temperatures reported as 8°-11° C. In other areas have been found to prefer hibernation roosts with high relative humidity's, usually above 55% in February and frequently in roosts over water with humidity's near 100%. | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| black-capped gnatcatcher *(Polioptila nigriceps)* | WSC | Riparian woodland and associated brushy areas. Per NatureServe (2001), "Riparian thickets, thorn forest, wooded washes; mesquite/hackberry thickets especially favored in Arizona (Dunn and Garrett 1987). In Arizona, nests have been found in the upper branches of mesquite, Arizona sycamore, and hackberry trees (Groschupf 1992)." | Yes | No | None, no suitable habitat present |
| Chiricahua mountain brookweed *(Samolus vagans)* | FS-S | Wet, sandy soil between 1070 and 1830 m elevation (NatureServe, 2009) | Yes | No | None, no suitable habitat present |
| Chiricahua leopard frog *(Rana chiricahuensis)* | LT, FS-S, WSC | The primary habitat type of R. chiricahuensis is oak, mixed oak and pine woodlands. Other habitat types range into areas of chaparral, grassland, and even desert. R. chiricahuensis are habitat generalists that live and breed in lentic and lotic habitats in natural and man-made systems (Mecham 1968; Zweifel 1968; Frost and Bagnara 1977; Scott and Jennings 1985; Sredl and Saylor 1998; Sredl in Lannoo 2005). Natural aquatic systems include cienegas, rocky streams with deep rock-bound pools, river overflow pools, oxbows, permanent springs, permanent pools in intermittent streams, and beaver ponds. Man-made aquatic systems include earthen stock tanks, livestock drinkers, irrigation sloughs, wells, mine adits, abandoned swimming pools, and ornamental backyard ponds. | Yes | No | None, no suitable habitat present |
| lowland leopard frog *(Rana yavapaiensis)* | SC, FS-S, WSC | Rana yavapaiensis inhabit aquatic systems in desert grasslands to pinyon-juniper (Platz and Frost 1984). They are habitat generalists and breed in a variety of natural and man-made aquatic systems. Natural systems include rivers, permanent streams, permanent pools in intermittent streams, beaver ponds, cienegas (=wetlands), and springs, while man-made systems include earthen cattle tanks, livestock drinkers, canals, irrigation sloughs, wells, mine adits, abandoned swimming pools, and ornamental backyard ponds (Platz and Frost 1984; Scott and Jennings 1985; Sredl and Saylor 1998). Most historical localities are small to medium-sized streams and rivers (Jennings 1987; Sredl and Saylor 1998). In lotic habitats, they are concentrated at springs, near debris piles, at heads of pools, and near deep pools associated with root masses (Jennings 1987; Sredl unpublished data). | Yes | Yes | No impacts. Construction would avoid impacts to this species. |

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| Tumamoc globeberry *(Tumamoca macdougalii)* | FS-S, BLM-S, SR | This vine grows in the Arizona Upland subdivision of Sonoran Desert scrub. It is associated with a variety of nurse plants and in settings ranging from sandy valley bottoms to rocky bajada slopes (Reichenbacher 1990). | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| **Relocatable Site Name: R-28** | | | **Mgmt. Agency: State of Arizona and Coronado National Forest** | | **State: Arizona** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Notes: No special status species were documented as occurring within the project vicinity. | | | | | |
| | | | | | |
| **Streon Site Name: S-33** | | | **Mgmt. Agency: State of Arizona and Coronado National Forest** | | **State: Arizona** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Maricopa tiger beetle *(Cicindela oregona maricopa)* | SC, FS-S, BLM-S | C. o. maricopa collected in several different habitats within its range, most commonly on sandy stream banks and less commonly on gravels and clays along stream banks. May occur near seeps or reservoir banks. According to McKown (1994), substrate utilized by larval stages is a major factor determining presence, absence and abundance of this subspecies throughout its range. Substrate appears to be a sand/silt material capable of holding together around a burrow throughout larval stage development, and capable of retaining sufficient moisture to prevent larval desiccation and capable of being burrowed into by larval stages. Wismann states that the larvae burrow into moist soil, seal mouth of burrow and pupate there. No nest site per se. | Yes | Yes | very low possibility of disturbance during sampling and construction |
| Sonoran desert tortoise *(Gopherus agassizii)* | SC,WSC | See Above | Yes | No | None, no suitable habitat |

| | | | | | |
|---|---|---|---|---|---|
| Obsolete voceroy butterfly *(Limentis archippus obsoleta)* | FS-S | Found in association with stands of willow along major water courses (Tilden and Smith 1986). Desert grassland, scrub. Host is genus Salix (willow). According to Brock and Prchal (2001), they are found in "Riparian areas in the Coronado National Forest below 1800m with healthy, extensive stands of Salix gooddingii. A prime area is Patagonia Lake in Santa Cruz County." | Yes | Yes | very low possibility of disturbance during sampling and construction |
| Gila topminnow *(Poeciliopsis occidentalis occidentalis)* | LE, WSC | Gila topminnow occupied headwater springs and vegetated margins and backwater areas of intermittent and perennial streams and rivers. This species prefers shallow warm water in a moderate current with dense aquatic vegetation and algae mats. Topminnows can withstand water temperatures from near freezing to 90-100 degrees F. They also can live in a fairly wide range of water chemistries, with pH's ranging from 6.6 to 8.9, dissolved oxygen readings from 2.2 to 11 mg/l (Meffe et al. 1983, in Stefferud 1982), and salinities from tap water to sea water (Stefferud 1982). | Yes | Yes | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions. |
| lowland leopard frog *(Rana yavapaiensis)* | SC, FS-S, WSC | See Above | Yes | Yes | very low possibility of disturbance during sampling and construction |
| Notes | | | | | |
| [a]= Data from Ritter, 2008, personal communication | | | | | |
| [b] = Species Status Codes | | | | | |

| | | |
|---|---|---|
| **Federal Status:** | **State:** | **Federal Agency Status** |
| Endangered Species Act status as published in the *Federal Register*: | Arizona and New Mexico species status as designated by the Arizona Game and Fish Department and New Mexico Natural Heritage respectively. | MIS = USFS Management Indicator Species |
| LE = Listed Endangered | HS = Highly Safeguarded: no collection allowed | FS-S = USFS Sensitive |
| LT = Listed Threatened | SR = Salvage Restricted: collection only with permit | BLM-S = BLM Sensitive |
| SC = Species of Concern | WSC = Wildlife of Special Concern in Arizona. Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona (WSCA, in prep). | |
| LP = Listed Proposed | | |

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| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| **Domain (number)** | **15** | **Domain Name: Great Basin** | | | |
| | | | | | |
| **Core Site Name: C-43, C-44, and C-45** | | | **Mgmt. Agency: BLM** | | **State: Utah** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s) [c]** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Bobolink (*Dolichonyx oryzivorus)* | BLM-SEN | grasslands, hay fields | No | low possibility around C-44 | very low, tower and guy wire collision is the only possibility |
| Burrowing owl (*Athene cunicularia*) | BLM-SEN | open grasslands, prairies, savannas | Yes | yes | very low, tower and guy wire collision is the only possibility |
| Dark kangaroo mouse (*Microdipodops megacephalus)* | BLM-SEN | desert, playa / salt flat, sand dunes, shrub land | No | yes | unlikely, soil pits would be covered |
| Ferruginous hawk (*Buteo regalis*) | BLM-SEN, U-CA | short-grass prairie, shrub-steppe, juniper woodlands | Yes | yes | very low, tower and guy wire collision is the only possibility |
| Grasshopper sparrow (*Ammodramus savannarum*) | BLM-SEN, U-CA | grassland, open savanna | No | yes | very low, tower and guy wire collision is the only possibility |
| Greater sage-grouse (*Centrocercus urophasianus)* | BLM-SEN | sagebrush communities, wet meadows in spring | Yes | yes | very low possibility of disturbance during sampling |
| Kit fox (*Vulpes macrotis*) | BLM-SEN | desert, grassland, playa/salt flat, savanna, shrub land | No | yes | unlikely, soil pits would be covered |
| Long-billed curlew (*Numenius americanus)* | BLM-SEN | short grasslands | Yes | yes | very low, tower and guy wire collision is the only possibility |
| Short-eared owl (*Asio flammeus*) | BLM-SEN, U-CA | grassland, herbaceous, savanna | Yes | yes | very low, tower and guy wire collision is the only possibility |
| Townsend's big-eared bat (*Plecotus townsendii*) | BLM-SEN | deserts, grassland, savanna, shrub land, conifer woodland. Maternity and hibernation colonies typically are in caves and mine tunnels. | No | yes but no hibernacula present in the immediate area of the towers | no, echolocation ability would prevent bats from colliding with towers or guy wires |
| Lewis's woodpecker (*Melanerpes lewis*) | U-CA | oak woodland and large conifer snags | No | no | None, preferred habitat is not present |
| | | | | | |
| **Relocatable and Streon Site Name: R-30 and A-35** | | | **Mgmt. Agency: USFS Research Natural Area, Wasatch-Cache National Forest (W-CNF)** | | **State: Utah** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Canada lynx (*Lynx canadensis*) | FT | mid to high elevation conifer forest | No | Preferred forested habitat is not present, and lower Red Butte Canyon is considered to be non-habitat | None, preferred habitat is not present |
| Black-footed ferret (*Mustela nigripes*) | FE | prairie dog colonies | No | no | None, preferred habitat is not present |
| Spotted bat (*Euderma maculatum*) | Forest Service Sensitive | | No | Not documented to be present on the W-CNF. | None, does not occur on the W-CNF |

| Relocatable and Streon Site Name: R-30 and A-35 | | | Mgmt. Agency: USFS Research Natural Area, Wasatch-Cache National Forest (W-CNF) | | State: Utah |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Townsend's big-eared bat (*Plecotus townsendii*) | Forest Service Sensitive | See above | No | Known to occur on the Salt Lake Ranger District; however, caves and mines are not present in vicinity of the relocatable or STREON sites. If present it could forage in the area. | no, echolocation ability would prevent bats from colliding with towers |
| Wolverine (*Gulo gulo*) | Forest Service Sensitive | high elevation conifer forest | No | Preferred forested habitat is not present in lower Red Butte Canyon Not known to be present on the W-CNF | None, preferred habitat is not present |
| Pygmy rabbit (*Brachylagus idahoensis*) | Forest Service Sensitive | dense sagebrush with deep soils | No | Preferred forested habitat is not present in lower Red Butte Canyon. Not known to be present on the W-CNF | None, preferred habitat is not present |
| Snowshoe hare (*Lepus americanus*) | Forest Service MIS | Prefers the dense cover of coniferous and mixed forests; abundant understory cover is important. | No | May be present in forested areas with a well developed shrubby vegetation understory. | very low; area of disturbance would be very small |
| Beaver (*Castor canadensis*) | Forest Service MIS | streams and lakes | No | beavers have been removed from Red Butte Creek | none present |
| Bald eagle (*Haliaeetus leucocephalus*) | Forest Service Sensitive | streams and lakes and nearby forest stands, also big game winter range | Yes, recent occurrence | may use big game winter range in the vicinity; Red Butte Creek does not provide useable habitat | none; activities would not affect eagles |

| Relocatable and Streon Site Name: R-30 and A-35 | | | Mgmt. Agency: USFS Research Natural Area, Wasatch-Cache National Forest (W-CNF) | | State: Utah |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) | FC | dense riparian areas, especially large riparian areas with cottonwood overstory and willow understory | No | very unlikely; not documented by Perry (1973) | None, preferred habitat is not present |
| Northern goshawk (*Accipter gentilis*) | MIS and Forest Service Sensitive | conifer and deciduous forest and riparian zones | Yes, recent occurrence | Known from the Salt Lake Ranger District. | very low, tower and guy wire collision is the only possibility |
| Boreal owl (*Aegolius funereus*) | Forest Service Sensitive | high elevation conifer forest | No | Not known to be present on the W-CNF. | None, preferred habitat is not present |
| Flammulated owl (*Otus flammeolus*) | Forest Service Sensitive | Montane forest, usually open conifer forests containing pine, with some brush or saplings | No | Not known to be present on the Salt Lake Ranger District. | no |
| Great gray owl (*Strix nebulosa*) | Forest Service Sensitive | high elevation conifer forest | No | Not known to be present on the W-CNF. | None, preferred habitat is not present |
| Peregrine falcon (*Falco peregrinus*) | Forest Service Sensitive | open country especially near water | No | very unlikely | None, preferred habitat is not present |
| Northern three-toed woodpecker (*Picoides tridactytus*) | Forest Service Sensitive | Conifer and aspen are preferred habitats. | No | Conifer and aspen are not present in the vicinity of the NEON sites | None, preferred habitat is not present |
| Columbian sharp-tailed grouse (*Tympauchus phasianellus columbianus*) | Forest Service Sensitive | sagebrush /grassland communities at the lower elevations of the W-CNF in Box Elder, Weber, and Cache Counties. | No | not known to occur on the W-CNF in Salt Lake County | None, preferred habitat is not present |
| Greater sage-grouse (*Centrocercus urophasianus*) | Forest Service Sensitive | sagebrush communities, wet meadows in spring | No | no suitable habitat present | None, preferred habitat is not present |
| Mountain Plover (*Charadrius montanus*) | FP | high plains, shortgrass prairie and desert tablelands | No | no suitable habitat | None, preferred habitat is not present |
| Grasshopper sparrow (*Ammodramus savannarum*) | U-CA | grassland, open savanna | Yes, historical record | No, not in affected areas | None, preferred habitat is not present |
| Columbia Spotted frog (*Rana luteiventris*) | Forest Service Sensitive | small springs, ponds or slough with a variety of herbaceous emergent, floating and submergent vegetation | Yes, historical record | very unlikely because of the number of predators (salmonid species) present in Red Butte Creek | none, not present |
| Bonneville cutthroat trout (*Oncorhynchus clarkii utah*) | Forest Service Sensitive and MIS, U-CA | stocked in Red Butte Reservoir as nursery population for reintroduction elsewhere | Yes, recent occurrence | yes, in Red Butte Reservoir downstream of the NEON sites | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions in the downstream reservoir. |

| Relocatable and Streon Site Name: R-30 and A-35 | | | Mgmt. Agency: USFS Research Natural Area, Wasatch-Cache National Forest (W-CNF) | | State: Utah |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats [a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| June sucker (*Chasmistes liorus)* | FE | stocked in Red Butte Reservoir as nursery population for reintroduction elsewhere | Yes, recent occurrence | yes, in Red Butte Reservoir downstream of the NEON sites | No direct impacts expected. Addition of nutrients for the STREON experiment could alter habitat conditions in the downstream reservoir. |
| Least chub *(Iotichthys phlegethontis*) | U-SEN | Historically occurred in slow rivers, clear creeks, springs, ponds, and marshes. Now it is basically an alkaline spring inhabitant. Typically it is found in moderate-dense submergent and emergent vegetation, at depths of 10-90 centimeters, over bottoms of clay, muck, mud, and peat | Yes, historical record | Possibly, need to verify occurrence with local USFS sources | No impacts. Addition of tracer-level nutrients would not affect this species or its habitat. |
| Smooth green snake (*Liochlorophis vernalis*) | U-SEN | Habitats include meadows, grassy marshes, moist grassy fields at forest edges, mountain shrub lands, stream borders, bogs, and open moist woodland. | Yes, historical record | Yes | No impacts. Construction would avoid impacts to this species. |
| Western toad (*Bufo boreas*) | U-SEN | A wide variety of habitats ranging from desert springs to mountain wetlands, and it ranges into various uplands habitats around ponds, lakes, reservoirs, and slow-moving rivers and streams. | Yes, historical record | Yes | No impact. Tower placed outside areas the species would use. |
| Ute ladies'-tresses (*Spiranthes diluvialis*) | FT | Adapted to early- to mid-seral, moist to wet conditions, where competition for light, space, water, and other resources is normally kept low by periodic or recent disturbance events. | No | no | None, preferred habitat is not present |
| Maguire primrose (*Primula maguirei*) | FE | Damp overhanging cliffs, rocks, and crevices in mixed aspen-conifer communities. | No | no | None, preferred habitat is not present |
| Starvling milkvetch (*Astragalus jejunus* var *jenunus*) | Forest Service Sensitive | Sagebrush and sagebrush juniper communities often on windswept ridges. | No | yes, marginal habitat on lower cheatgrass invaded sagebrush sites | Surveys should be completed prior to construction of preferred habitat, even if marginal. |
| Clustered lady's slipper or Brownie ladyslipper (*Cypripedium fasciculatum*) | Forest Service Sensitive | Duff in spruce-fir or lodgepole pine forests and along shaded streams. | No | no habitat in areas of towers | None, preferred habitat is not present in construction area. |
| Rockcress draba (*Draba globosa=D. densifolia* var *apiculata*) | Forest Service Sensitive | Moist, sparsely vegetated calcareous soils near or above treeline. | No | no | None, preferred habitat is not present in construction area. |
| Maguire's draba (*Draba maguirei*) | Forest Service Sensitive | Open areas, often on talus slopes and rocky outcrops, in spruce-fir forests on dolomitic soils. | No | no | None, preferred habitat is not present in construction area. |
| Burke's draba (*Draba maguirei* var *burkei*) | Forest Service Sensitive | Talus slopes and rocky outcrops on quartzite, limestone, or calcareous shale in Douglas-fir, mixed conifer, and maple oak. | No | Marginal habitat may be present in maple and oak habitats. | Low, but if rocky soils are present in affected maple oak sites, surveys would be conducted prior to construction. |
| Cronquist daisy (*Erigeron cronquistii*) | Forest Service Sensitive | Crevice's in limestone cliffs and talus. | No | no | None, preferred habitat is not present in construction area. |
| Logan buckwheat (*Eriogonum brevicaule* var *loganum*) | Forest Service Sensitive | Sagebrush bunchgrass communities and rocky outcrops. | No | Sagebrush communities at lower elevations would not be affected | None, preferred habitat is not present in construction area. |
| Wasatch jamesia (*Jamesia americana* var *macrocalyx*) | Forest Service Sensitive | Mountain brush and spruce-fir communities, mostly on rocky soils. | No | Marginal habitat may be present in maple and oak habitats. | Low, but if rocky soils are present in affected maple oak sites, surveys would be conducted prior to construction. |

| Relocatable and Streon Site Name: R-30 and A-35 | | | Mgmt. Agency: USFS Research Natural Area, Wasatch-Cache National Forest (W-CNF) | | State: Utah |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Garrett's bladderpod (*Lesquerella garrettii*) | Forest Service Sensitive | Alpine tundra, sub-alpine meadows, spruce-fir, and pine communities on limestone parent material above 9,000 feet, typically on talus or rock outcrops. | No | no | None, preferred habitat is not present in construction area. |
| Alpine poppy (*Papaver radicum* ssp *kluanense*) | Forest Service Sensitive | Open, rocky alpine tundra above 11,000 feet. | No | no | None, preferred habitat is not present in construction area. |
| Cache beardtongue (*Penstemon compactus*) | Forest Service Sensitive | Subalpine rocky or talus openings in coniferous communities on limestone parent material. | No | no | None, preferred habitat is not present in construction area. |
| Cottam's cinquefoil (*Potentilla cottamii*) | Forest Service Sensitive | Cracks and crevices in shady quartzite outcrops above 7,000 feet. | No | no | None, preferred habitat is not present in construction area. |
| Uinta greenthread (*Thelesperma pubescens*) | Forest Service Sensitive | Grassland, sagebrush-grassland, or low prostrate forb communities on cobbly soils. | No | Sagebrush communities at lower elevations would not be affected | None, preferred habitat is not present in construction area. |
| Beckwith's violet (*Viola beckwithii*) | Forest Service Sensitive | Clay soils in sagebrush-steppe. | No | no | No clay soils in construction area. |
| Frank Smith's violet (*Viola frank-smithii*) | Forest Service Sensitive | Shaded cracks, crevices and holes in limestone and dolomitic outcrops. | No | no | None, preferred habitat is not present in construction area. |

Notes
[a]= Data from Wasatch-Cache Revised Forest Plan, Utah Sensitive Species List, 2007 and Lindsey, 2008, personal communication.
[b] = Species Status Codes

| Federal Status: | State: Utah | Federal Agency Status |
|---|---|---|
| Endangered Species Act status as published in the *Federal Register*: | Utah species status as designated on the Utah Sensitive species List (10/17/2006) | MIS = USFS Management Indicator Species |
| FE = Federally Endangered | U-CA = Conservation agreement species" means wildlife species or subspecies that are currently receiving special management under a conservation agreement developed or implemented by the state to preclude the need for listing under the ESA | FS-SEN = USFS Sensitive |
| FT = Federally Threatened | U-SEN = Utah sensitive species | BLM-SEN = BLM Sensitive |
| FC = Federal Candidate | | |
| FP = Federally Proposed | | |

[c] = Information taken from the sources identified below.

References:
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Wasatch-Cache Revised Forest Plan, 2003 Appendix XI, Botany. http://www.fs.fed.us/r4/uwc/projects/wcnf/planning/feis/forest_plan/appendices/appendix_xi.pdf. Accessed January 5, 2009
Utah Sensitive Species List, 2007. http://www.wildlife.utah.gov. Accessed January 21, 2009.
Utah Department of Natural Resources, 2009. http://dwrcdc.nr.utah.gov/ucdc/. Accessed January 15, 2009.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 16 | | Domain Name: Pacific Northwest | | | |
| | | | | | |
| **Streon Site Name: S-37** | | **Mgmt. Agency: USFS Pacific Northwest Research Station, Willamette National Forest and Oregon State University** | | | **State: Oregon** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Northern pacific pond turtle *(Actinemys marmorata marmorata)* | SC,C | It is found in ponds, lakes, streams, large rivers, slow-moving sloughs, and quiet waters. The turtles prefer aquatic habitats with exposed areas for basking, with aquatic vegetation, such as algae and other water plants, but they also live in clear waters, especially where there is cover such as boulders or fallen trees in the water (Pritchard and Rhodin). The western pond turtle also spends significant amounts of time in upland terrestrial habitats and has been found more than one kilometer from water (USDA Forest Service 2005). | Yes | No | None, no suitable habitat present |
| white-footed vole *(Arborimus albipes)* | SC, SU | Found in mature, coastal forests, preferring the vicinity of small, clear streams, with dense alder and other deciduous trees and shrubs. Occupies the habitat from ground surface to canopy, feeding in all layers, and nesting on the ground. White-footed voles often are found near logs and in brush when on the ground. | Yes | No | None, no suitable habitat present |
| ringtail *(Bassariscus astutus)* | SU | coniferous forests | Yes | No | None, no suitable habitat present |
| Oregon slender salamander *(Batrachoseps wrightorum)* | SC, SU | This salamander is found only in the central and northern Cascade Mountains of Oregon. It is most often find in the spring under woody debris. | Yes | No | None, no suitable habitat present |
| gray wolf *(Canis lupus)* | LE, PS, LE | found in nearly all habitat types | Yes | Yes | Not likely. There are no known populations in the vicinity of any of the proposed NEON infrastructure. |
| tall bugbane *(Cimicifuga elata)* | C | Tall bugbane is typically found on moist slopes in mature (70-250 yr.) and old-growth forests (>250 yr.), but it can also occasionally be found in younger forests, clear cuts and on road edges. | Yes | No | None, no suitable habitat present |
| townsend's big-eared bat (*Plecotus townsendii*) | SC, C | Prefers mesic habitats. Gleans from brush or trees or feeds along habitat edges. | Yes | No | None, no suitable habitat present |
| harlequin duck *(Histrionicus histrionicus)* | SC, SU | Harlequin ducks breed in mountain streams and rivers. In western North America, most breeding sites are on relatively rapid streams of moderate size, typically surrounded by undisturbed forest. | Yes | No | None, no suitable habitat present |
| American marten *(Martes americana)* | SV | coniferous forests and cedar swamps | Yes | No | None, no suitable habitat present |
| fringed myotis *(myotis thysanodes)* | SC, SV | Uses open habitats, early successional stages, streams, lakes, and ponds as foraging areas. | Yes | No | None, no suitable habitat present |
| tombstone prairie caddisfly *(Oligophiebodes mostbento)* | SC | In Oregon they have been taken from small to mid-size streams. Parsons et al. (1991) note that adults were collected in riparian vegetation zones. Larvae of the genus occur in cold mountain streams (large and small) from sea level to alpine communities throughout western North America. Streams are perennial, cool or cold, free of fine sediment and filamentous algae, with moderate to strong current and are well-oxygenated (Wisseman pers. comm.). | Yes | No | None, no suitable habitat present |

| Streon Site Name: S-37 | | Mgmt. Agency: USFS Pacific Northwest Research Station, Willamette National Forest and Oregon State University | | | State: Oregon |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| A caddisfly *(Rhyacophila leechi)* | SC | This species is known from small, cool, densely forested streams in old-growth or mature forest watersheds (Wiggins 1996). Odontocerid larvae generally burrow under gravel, sand, or silt (Wiggins 1996); this species has been found in core samples taken from areas of coarse gravel intermixed with silt and organic sediments (Anderson 1976). | Yes | No | None, no suitable habitat present |
| Northern spotted owl *(Strix occidentalis caurina)* | LT, LT | Old growth forested habitats | Yes | Yes | Possible, if nesting trees are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |

Notes:

[a]= Data from Koepke, 2008., personal communication.

[b] = Species Status Codes

| **Federal Status:** | **State:** | **USFS, BLM, NPS Status** |
|---|---|---|
| Endangered Species Act status as published in the *Federal Register*: | Oregon species status as designated by the Oregon Department of Fish and Wildlife | MIS = USFS Management Indicator Species |
| LE = Listed Endangered | LE = Listed Endangered | FS-S = USFS Sensitive |
| LT = Listed Threatened | LT = Listed Threatened | BLM-S = BLM Sensitive |
| SC = Species of Concern | C = Sensitive-Critical for animals | NPS = National Park Service Species of Management Concern |
| LP = Listed Proposed | C = Candidate for plants | |
| PS = Partial Status for species | SV = Sensitive-vulnerable | |
| | SU = Sensitive-undetermined status | |

References:

Anderson, N.H. 1976. The distribution and biology of the Oregon Trichoptera. Oregon Agricultural Experiment Station Technical Bulletin, 134:1-152.

Koepke, L./ Oregon Natural Heritage Information Center. 2008. Personal communication with CH2M HILL. December 3.

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Pritchard, P.C.H. and Rhodin, A.G.J. *in press*. Conservation biology of freshwater turtles. *IUCN Species Survival Commission, Occasional Papers*.

USDA Forest Service, Pacific Southwest Research Station (October, 2005) http://www.krisweb.com/biblio/gen_usfs_ashtonetal_1997_turtle.pdf

Wiggins, G.B. 1996. Larvae of the North American Caddisfly Genera. 2nd ed. University of Toronto Press, Toronto. 424pp.

Wisseman, Robert W. Aquatic Biology Associates, Inc. Corvallis, OR.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 16 | | Domain Name: Pacific Northwest | | | |
| | | | | | |
| **Core and Aquatic Site Names: C-46, C-47, C-48, A-36** | | | **Mgmt. Agency: USFS** | | **State: Washington** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Pulsifer's Monkeyflower (*Mimulus pulsiferae*) | SS | Moist, open areas; sometimes in exposed mineral soil; grass/forb dominated openings in ponderosa pine and Douglas fir forests (Washington NHP, 1997a) | Yes | No | None, no suitable habitat present |
| Common blue-cup (*Githopsis specularioides*) | SS | Open areas at lower elevations, such as thin soils over bedrock outcrops, talus slopes, and gravelly prairies (Washington NHP, 1999) | Yes | No | None, no suitable habitat present |
| Clackamas corydalis (*Corydalis caseana* spp. *aquae-gelidae*) | FSC, SS | In or near cold flowing water at elevations ranging from 2500 to 3800 feet (Washington NHP, 1998) | Yes | No | None, no suitable habitat present |
| | | | | | |
| **Relocatable Site Name: R-31, R-32** | | | **Mgmt. Agency: Washington DNR** | | **State: Washington** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Small-flowered trillium (*Trillium parviflorum*) | SS | In moist areas dominated by hardwood, red alder, or Garry oak (Washington NHP, 1997b) | Yes | No | None, no suitable habitat present |
| Hairy-stemmed checker-mallow (*Sidalcea hirtipes*) | SE | Remnant prairie fragments along fencerows and openings along drainages; mesic habitats associated with creeks and streams (Washington NHP, 1997c) | Yes | No | None, no suitable habitat present |
| Clackamas corydalis (*Corydalis caseana* spp. *aquae-gelidae*) | FSC, SS | In or near cold flowing water at elevations ranging from 2500 to 3800 feet (Washington NHP, 1998) | Yes | No | None, no suitable habitat present |
| | | | | | |
| Notes | | | | | |

[a]= Data from Moody, 2008, personal communication.

[b] = Species Status Codes

| **Federal Status:** | **State:** |
|---|---|
| Endangered Species Act status as published in the *Federal Register*: | Washington species status as designated by the Washington State Department of Natural Resources |
| FE = Federally Endangered | SE = State Endangered |
| FT = Federally Threatened | ST = State Threatened |
| FSC = Federal Species of Concern | SS = State Sensitive |
| FLP = Federal Listed Proposed | |


References:
Moody, S./ Washington Natural Heritage Program. 2008. Personal communication with CH2M HILL. December 15.
Washington Natural Heritage Program (NHP), 1997a. Mimulus pulsiferae. http://www1.dnr.wa.gov/nhp/refdesk/fguide/pdf/mipu.pdf. Accessed February 13, 2009.
Washington Natural Heritage Program (NHP), 1997b. Trillium parviflorum. http://www1.dnr.wa.gov/nhp/refdesk/fguide/pdf/mipu.pdf. Accessed February 13, 2009.
Washington Natural Heritage Program (NHP), 1997c. Sidalcea hirtipes. http://www1.dnr.wa.gov/nhp/refdesk/fguide/pdf/sihi.pdf. Accessed February 13, 2009.
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Washington Natural Heritage Program (NHP), 1999. Githopsis specularioides. http://www1.dnr.wa.gov/nhp/refdesk/fguide/pdf/gisp.pdf. Accessed February 13, 2009.

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|---|---|---|---|---|---|
| **Protected Species or Habitats Within 5 km of the Proposed NEON Sites** | | | | | |
| **Domain (number): 17** | | **Domain Name: Pacific Southwest** | | | |
| | | | | | |
| **Core Site Name and Number: C-49** | | | **Mgmt. Agency: Sierra National Forest** | | **State: California** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| California tiger salamander (*Ambystoma californiense* | FT, ST | Seasonal ponds, vernal pools within annual grassland | Yes | Yes | No impacts. Construction would avoid impacts to this species. |
| western spadefoot (*Spea hammondii*) | CSC | Seasonal ponds within annual grassland | Yes | Yes, could occur at the proposed Core Sites and Relocatable Site (R-33) | No impacts. Construction would avoid impacts to this species. |
| western pond turtle (*Actinemys marmorata*) | CSC | Ponds, lakes, streams, irrigation ditches, and permanent pools | Yes | No | None, no suitable habitat present |
| Swainson's hawk (*Buteo swainsoni*) | FS-SEN, CSC | Grassland and cropland with scattered trees or small groves | No | No | None, no suitable habitat present |
| pallid bat (*Antrozous pallidus*) | CSC | Rocky outcrops, cliffs, and crevices | Yes | Yes, The pallid bat could occur at proposed NEON sites C-49, C-50, R-33, and A-39 in lower elevations | no, echolocation ability would prevent bats from colliding with towers or guy wires |
| American badger (*Taxidea taxus*) | CSC | Herbaceous shrub land, and open stages of most habitats with friable soils | Yes | Yes | very low possibility of disturbance during sampling and construction |
| Madera linanthus (*Leptosiphon serrulatus*) | CNPS 1B | Cismontane woodland, and lower montane coniferous woodland | Yes | No | None, no suitable habitat present |
| **Core Site Name and Number: C-50 and A-39** | | | **Mgmt. Agency: Sierra National Forest** | | **State: California** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| relictual slender salamander (*Batrachoseps relictus*) | FS-SEN | Swales and drainages with an overstory of trees or shrubs, and abundant litter, rocks, and woody debris | No | No | None, no suitable habitat present |
| Pacific tree frog (*Pseudacris regilla*) | MIS | All permanent and temporary waters except desert types | No | No | None, no suitable habitat present |
| sooty grouse (*Dendragapus fuliginosus*) | MIS | Mature coniferous forest with brushy understory and open forb/grass areas near water | No | No | None, no suitable habitat present |
| California Quail (*Callipepla californica*) | MIS | Brushland and brushy understory of woodland, as well as open forb/grass areas near water | No | No | None, no suitable habitat present |
| mountain quail (*Oreortyx pictus*) | MIS | Brushy understory, and steep thicket-covered slopes | No | No | None, no suitable habitat present |
| Osprey (*Pandion haliaetus*) | MIS, CSC | Open trees near large bodies of water | No | No | None, no suitable habitat present |
| Peregrine falcon (*Falco peregrinus*) | FS-SEN, SE | Cliffs and canyons near bodies of water | No | No | None, no suitable habitat present |
| band-tailed pigeon (*Columba fasciata*) | MIS | Mixed coniferous woodland with light understory and medium canopy | No | No | None, no suitable habitat present |
| California spotted owl (*Strix occidentalis*) | MIS, CSC | Large tracts of mature mixed coniferous woodland with permanent water | No | No | None, no suitable habitat present |
| great gray owl (*Strix nebulosa*) | FS-SEN, SE | Dense coniferous forests inter-spersed with wet meadows | No | No | None, no suitable habitat present |
| hairy woodpecker (*Picoides villosus*) | MIS | Patchy coniferous woodland with adjacent riparian areas and shrub-land ecotones | No | No | None, no suitable habitat present |
| pileated woodpecker (*Dryocopus pileatus*) | MIS | Large tracts of mature mixed coniferous woodland with permanent water | No | No | None, no suitable habitat present |
| **Core Site Name and Number: C-50 and A-39** | | | **Mgmt. Agency: Sierra National Forest** | | **State: California** |

| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence Within 5 km | Is suitable habitat present? | Likelihood of impact and rationale |
|---|---|---|---|---|---|
| red-breasted sapsucker (*Sphyrapicus ruber*) | MIS | Mixed riparian woodland with coniferous and hardwood components | No | No | None, no suitable habitat present |
| Williamson's sapsucker (*Sphyrapicus thyroideus*) | MIS | Montane coniferous forest with medium canopy | No | No | None, no suitable habitat present |
| willow flycatcher (*Empidonax traillii*) | MIS, CSC | Wet meadows, ponds, and backwaters with dense willows at edges | Yes | No | None, no suitable habitat present |
| warbling vireo (*Vireo gilvus*) | MIS | Mixed deciduous woodland with a medium canopy and shrubby understory | No | No | None, no suitable habitat present |
| brown creeper (*Certhia americana*) | MIS | Dense mature coniferous forest | No | No | None, no suitable habitat present |
| nashville warbler (*Vermivora ruficapilla*) | MIS | Brushy openings in mixed woodland | No | No | None, no suitable habitat present |
| yellow warbler (*Dendroica petechia*) | MIS, CSC | Medium density woodland with brushy understory | No | No | None, no suitable habitat present |
| fox sparrow (*Passerella iliaca*) | MIS | Dense brushland, brushy understory of woodland, and riparian thickets | No | No | None, no suitable habitat present |
| American marten *(Martes americana)* | MIS | Old growth coniferous forest with adjacent meadows and/or riparian areas for foraging | No | No | None, no suitable habitat present |
| fisher (*Martes pennanti*) | FS-SEN, CSC | Dense mature coniferous forest | No | No | None, no suitable habitat present |
| dusky-footed woodrat (*Neotoma fuscipes*) | MIS | Forest with moderate canopy and brushy understory | No | No | None, no suitable habitat present |
| golden-mantled squirrel (*Spermophilus lateralis*) | MIS | Montane forest with dense understory | No | No | None, no suitable habitat present |
| northern flying squirrel (*Glaucomys sabrinus*) | MIS | Dense, mature coniferous forest with riparian areas | No | No | None, no suitable habitat present |
| mule deer (*Odocoileus hemionus*) | MIS | Wide variety of brushland, woodland with herbaceous openings, meadows, riparian areas, and edges | No | No | None, no suitable habitat present |
| **Core Site Name and Number: C-51** | | | **Mgmt. Agency: Sierra National Forest** | | **State: California** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Yosemite toad (*Bufo canorus*) | FS-SEN, CSC | Alpine meadow pools | No | No | None, no suitable habitat present |
| mountain yellow-legged frog (*Rana muscosa*) | FE, FS-SEN, CSC | Montane riparian, streams, lakes, and ponds | No | No | None, no suitable habitat present |
| Northern goshawk (*Accipter gentilis*) | MIS, CSC | Dense mature coniferous, and mixed deciduous forest, interspersed with meadows, and riparian areas | Yes | Yes | very low, tower and guy wire collision is the only possibility |
| black-backed woodpecker (*Picoides arcticus*) | MIS | Montane coniferous forest, especially in areas that have recently burned | No | No | None, no suitable habitat present |
| Sierra Nevada red fox (*Vulpes vulpes necator*) | FS-SEN, CT | Alpine forest, meadows, and fell-fields | No | No | None, no suitable habitat present |

| Relocatable Name and Site Number: R-33 | | | Mgmt. Agency: USFS | | State: California |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| foothill yellow-legged frog (*Rana boylii*) | CSC | Rocky streams | Yes | Yes, This species could occur at the proposed Aquatic Site (A-39) | very low possibility of disturbance during sampling |
| Orangeflower lupine (Lupinus citrinus) | CT | Chaparral, cismontane woodland, and lower montane coniferous forest | Yes | Yes, species could occur at proposed Core Site C-49 | No impacts. Construction would avoid impacts to this species. |
| Yosemite lewisia (*Lewisia disepala*) | CNPS 1B | Montane coniferous forest, and pinyon juniper woodland | Yes | Yes, species could occur at proposed Core Site C-49 | No impacts. Construction would avoid impacts to this species. |
| Tree anemone (*Carpenteria californica*) | CT | Chaparral and cismontane woodland | Yes | Yes, species could occur at proposed Core Site C-49 | No impacts. Construction would avoid impacts to this species. |

| Aquatic or Streon Name and Site Number : S-40 and R-34 | | | Mgmt. Agency: | | State: California |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| California wolverine (*Gulo gulo*) | CT | Mixed coniferous forest, barren and wet meadows, and montane chaparral from 6500' to 11,000' | Yes | Yes, This species could occur at proposed sites C-51 and R-34 in the higher elevations | very low possibility of disturbance during sampling and construction |
| Muir's raillardiopsis (*Carlquistia muirii*) | CNPS 1B | Chaparral and montane coniferous forest | Yes | Yes, species could occur at proposed Core Site C-49 | No impacts. Construction would avoid impacts to this species. |

| | | |
|---|---|---|
| Notes | | |
| [a] = Information taken from the sources identified below. | | |
| [b] = Species Status Codes | | |
| **Federal Status:** | **State: California** | **Federal Agency Status** |
| Endangered Species Act status as published in the *Federal Register*: | SE = State Endangered: taxa that are in danger of becoming extinct within the foreseeable future throughout all or a significant portion of their range. | MIS = USFS Management Indicator Species |
| FE = Listed Endangered. In danger of extinction. | ST = State Threatened: taxa are those likely to become endangered within the foreseeable future. | FS-SEN = USFS Sensitive |
| FT = Listed Threatened. Likely to become endangered. | CSC = California Species of Special Concern: Taxa that are not currently listed, but are declining at such a rate that they are likely to become listed in the foreseeable future. | BLM-SEN = BLM Sensitive |
| FC = Candidate species. Sufficient information exists to support listing as Endangered or Threatened. | CNPS 1B = Considered rare, threatened, or endangered by the California Native Plant Society, but not necessarily any legislative body; for the purposes of this spreadsheet, species with this designation are classified as such by CNPS, but have no state or federal status. | NPS = National Park Service Species of Management Concern |
| | | |
| **Federal Status:** | **State: California** | **Federal Agency Status** |
| FP = Proposed species; candidate species that were found to warrant listing as either threatened or endangered and were officially proposed as such in the Federal Register | | |

**References:**


California Department of Fish and Game. 1988. *California's Wildlife, Volume I, Amphibians and Reptiles* . California Statewide Wildlife Habitat Relationships System. Sacramento, CA

California Department of Fish and Game. 1990. *California's Wildlife, Volume II, Birds* . California Statewide Wildlife Habitat Relationships System. Sacramento, CA

California Department of Fish and Game. 1990. *California's Wildlife, Volume III, Mammals* . California Statewide Wildlife Habitat Relationships System. Sacramento, CA

California Native Plant Society Inventory of Rare and Endangered Plants. http://cnps.web.aplus.net/cgi-bin/inv/inventory.cgi. (January 19, 2009)

U.S. Forest Service, Pacific Southwest Region, Sierra Nevada Forests Management Indicator Species Amendment, Final Environmental Impact Statement (Appendix B Species Reviews). http://www.fs.fed.us/r5/snfmisa/feis/appendixb. (January 19, 2009)

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 18 | | Domain Name: Tundra | | | |
| | | | | | |
| Core Site and Aquatic Site Name: C-52, C-53, C-54, A-42, S-43 | | | Mgmt. Agency: U. Alaska, Fairbanks/BLM | | State: Alaska |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Muir's Fleabane (*Erigeron muirii*) | BLM-SEN | Dry, south-facing fell fields, bluffs, terraces, alluvial fans, gravels, and sandstone outcrops; usually in sparsely vegetated communities (NatureServe, 2009) | Yes | Yes, populations of this species are known to occur near R-35, the C-52 and the Kuparak River | No impacts. Construction would avoid impacts to this species. |
| Buff-breasted Sandpiper (*Tryngites subruficollis*) | BLM-SEN, Audubon Alaska Watchlist | Breeding: Dry slopes with many sedge tussocks, on grass tundra with mosses and willows, in moist or wet-sedge meadows, in well-drained sandy areas and scant vegetation, and on well-vegetated hummocky ground bordering marshy ponds. Non-breeding: Southern temperate zone on mostly dry to moist open ground, short grass uplands (NatureServe, 2009) | No | No | None, no suitable habitat present |
| Bostock's Miner's-lettuce (*Montia bostockii*) | G3, S3 | Moist, springy, usually north-facing slopes of scree or alpine tundra, in the alpine zone; wet ridge crest gravels; moist to wet meadows (NatureServe, 2009) | Yes | Yes, known populations near C-53, C-54, and A-42 | No impact. Tower placed outside areas where species occurs |
| Alpine Smelowskia (*Smelowskia porsildii*) | G3, S3S4 | High in the mountains above the tree-line in rocky areas (Southwest Colorado Wildflowers, 2009) | No | Yes | No impacts. Construction would avoid impacts to this species. |
| Springbeauty (*Claytonia porsildii*) | G2G4, S2S4 | Mostly grassy places in Alaska (Ibiblio, 2009) | No | Yes | No impacts. Construction would avoid impacts to this species. |
| Arctic Pennycress (*Thlaspi arcticum*) | G3, S3 | Well-drained sites on alpine slopes, dry ridges, and sands and gravel of low river terrace and on the active flood plain (NatureServe, 2009) | No | Yes | No impacts. Construction would avoid impacts to this species. |
| Rocky Mountain Cinquefoil (*Potentilla rubricaulis*) | G4, S2S3 | In mountains between 2100 and 3200 feet; on gravelly soils; on shelves or niches of cliffs (USFS, 2009) | No | Yes | No impacts. Construction would avoid impacts to this species. |
| Palander's Whitlow-grass (*Draba palanderiana*) | G4G5, S4 | Rocky hillsides (NatureServe, 2009) | No | No | None, no suitable habitat present |
| Alaska Marmot (*Marmota broweri*) | G4, S4 | Dens located in boulder fields or in talus slopes with large rocks next to productive tundra (NatureServe, 2009) | No | No | None, no suitable habitat present |

| Relocatable Site Name: R-35 | | | Mgmt. Agency: Alaska State Forest | | State: Alaska |
|---|---|---|---|---|---|
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Muir's Fleabane (*Erigeron muirii*) | BLM-SEN | Dry, south-facing fell fields, bluffs, terraces, alluvial fans, gravels, and sandstone outcrops; usually in sparsely vegetated communities (NatureServe, 2009) | Yes | Yes, populations of this species are known to occur near R-35, the C-52 and the Kuparak River | No impacts. Construction would avoid impacts to this species. |
| | | | | | |
| Notes | | | | | |
| [a]= Data from Lenz, 2009, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |

| **Federal Status:** | **Federal Agency Status** | **Species State of Alaska Ranking** | **Species Global Rankings** |
|---|---|---|---|
| Endangered Species Act status as published in the *Federal Register*: | MIS = USFS Management Indicator Species | S1 = Critically imperiled | G1 = Critically imperiled |
| FE = Federally Endangered | FS-SEN = USFS Sensitive | S2 = Imperiled | G2 = Imperiled |
| FT = Federally Threatened | BLM-SEN = BLM Sensitive | S3 = Rare or uncommon | G3 = Rare or uncommon |
| FC = Federal Candidate | | | |
| FP = Federally Proposed | | | |

References:
Ibiblio, 2009. Plants For A Future: Database Search Results. http://www.ibiblio.org/pfaf/cgi-bin/arr_html?Claytonia+scammaniana. Accessed February 9, 2009.
Lenz, J./ Alaska Natural Heritage Program. 2009. Personal communication with CH2M HILL. January 30.
NatureServe Explorer. 2009. Species Quick Search. http://www.natureserve.org/explorer/index.htm. Accessed February 9, 2009.
Southwest Colorado Wildflowers, 2009. http://www.swcoloradowildflowers.com/Pink%20Enlarged%20Photo%20Pages/smelowskia%20calycina.htm. Accessed February 13, 2009.
USFS, 2009. Region 2 Sensitive Species Evaluation Form. http://www.fs.fed.us/r2/projects/scp/evalrationale/evaluations/dicots/potentillarupincola.pdf. Accessed February 17, 2009.

| Sensitive Species Within 5 km of the Proposed NEON Location | | | | | |
|---|---|---|---|---|---|
| Domain (number): 19 | | Domain Name: Taiga | | | |
| | | | | | |
| **Relocatable Site Name: R-36** | | | **Mgmt. Agency: Fort Greely Army Base** | | **State: Alaska** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Richardson's Phlox (Phlox richardsonii ssp. richardsonii) | G4, S2 | Dry mountain slopes, and rocky or gravelly alpine tundra; barrens (NatureServe, 2009) | No | No | None, no suitable habitat present |
| Woolly Cinquefoil (Potentilla hippiana) | G5, S2 | Dry soils; open grassland sagebrush (Ibiblio, 2009) | No | No | None, no suitable habitat present |
| | | | | | |
| **Relocatable and Aquatic Site Name: R-37 and A-45** | | | **Mgmt. Agency: White Mountain NRA, BLM** | | **State: Alaska** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Lake Huron Tansy (Tanacetum bipinnatum) | G5, S3 | Active dunes, old, stabilized dunes, and sandy or cobble beaches (Michigan State University Extension, 2009) | No | No | None, no suitable habitat present |
| Turner's Butter-cup (Ranunculus turneri) | G3, S2S3 | Subalpine meadows (NatureServe, 2009) | No | No | None, no suitable habitat present |
| Slender Cliff-brake (Cryptogramma stelleri) | G5, S2S3 | Moist wooded sloped and rock outcrops (NatureServe, 2009) | No | No | None, no suitable habitat present |
| | | | | | |
| **Relocatable Site Name: R-38** | | | **Mgmt. Agency: Alaska State Forest** | | **State: Alaska** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence Within 5 km** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Gorman's dwarf-primrose (Douglasia gormanii) | G4, S3 | Mountain slopes, in alpine tundra (NatureServe, 2009) | No | No | None, no suitable habitat present |
| | | | | | |
| **Core and Streon Site Name: C-55, C-56, C-57, and S-46** | | | **Mgmt. Agency: IATCA, AK DNR** | | **State: Alaska** |
| **Protected / MIS / Sensitive Species or Habitats[a]** | **Mgmt. or Legal Status [b]** | **Preferred habitat type(s)** | **Known Occurrence in Vicinity** | **Is suitable habitat present?** | **Likelihood of impact and rationale** |
| Crawford Sedge (Carex crawfordii) | G5, S3 | Moist to wet meadows in the lowland, steppe and montane zones (Klinkenberg, 2008) | No | No | None, no suitable habitat present |
| Alaskan Brook Lamprey (Lampetra alaskensis) | G3, S3 | Freshwater, streams, lakes (NatureServe, 2009) | No | No | None, no suitable habitat present |

| | | | | | |
|---|---|---|---|---|---|
| Notes | | | | | |
| [a]= Data from Lenz, 2009, personal communication. | | | | | |
| [b] = Species Status Codes | | | | | |
| **Federal Status:** | **Federal Agency Status** | | | | |
| Endangered Species Act status as published in the *Federal Register*: | MIS = USFS Management Indicator Species | S1 = Critically imperiled | G1 = Critically imperiled | | |
| FE = Federally Endangered | FS-SEN = USFS Sensitive | S2 = Imperiled | G2 = Imperiled | | |
| FT = Federally Threatened | BLM-SEN = BLM Sensitive | S3 = Rare or uncommon | G3 = Rare or uncommon | | |
| FC = Federal Candidate | | | | | |
| FP = Federally Proposed | | | | | |

References:


Ibiblio, 2009. Plants For A Future: Database Search Results, Potentilla hippiana. http://www.ibiblio.org/pfaf/cgi-bin/arr_html?Potentilla+hippiana. Accessed February 17, 2009.
Klinkenberg, Brian, 2008. Electronic Atlas of the Plants of British Columbia. http://web4.msue.msu.edu/mnfi/abstracts/botany/Tanacetum_huronense.pdf. Accessed February 17, 2009.
Lenz, J./ Alaska Natural Heritage Program. 2009. Personal communication with CH2M HILL. January 30.
NatureServe Explorer. 2009. Species Quick Search. http://www.natureserve.org/explorer/index.htm. Accessed February 9, 2009.

| Sensitive Species Within 5 km of the Proposed NEON Locatior | | | | | |
|---|---|---|---|---|---|
| Domain (number): 20 | | Domain Name: Hawaii | | | |
| | | | | | |
| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence Within 5 km | Is suitable habitat present? | Likelihood of impact and rationale |
| **Core Site and Aquatic Site Name: Core Sites C-58, C-59 & C-60. Laupahoehoe Hawai'i Experimental Tropical Forest.** | | | **Mgmt. Agency: USDA Forest Service & Hawaii Department of Land and Natural Resources** | | **State: Hawaii** |
| Oha wai (*Clermontia lindseyana*) | FE, SE, CH | Grows on the ground or in trees is wet and mesic forests between 1220 and 1825 m elevation. | Unknown | Critical habitat exists within 5 km of site C-60. It is unknown if any individuals occur within the critical habitat. | Moderate. Less than 1000 individuals left in wild (possibly less than 250). Move tower location if surveys indicate this species is within vegetation removal area. |
| Oha wai (*Clermontia peleana*) | FE, SE, CH | Occurs in montane wet forests between 530 and 1,160 m elevation, growing epiphytically on koa, ohia, olapa and amau. | Unknown. Number of total individuals is extremely low. | Critical habitat covers all 4 sites. It is unknown if any individuals occur within 5 km of the sites. | Very low. Less than 10 individuals left in wild. Move tower location if surveys indicate this species is within vegetation removal area. |
| *Oha wai (Clermontia pyrularia*) | FE, SE, CH | Occurs in koa and/or ohia montane wet forests, between 910 and 2,130 m elevation, on old lava flows and old cinder cones. | Yes | Critical habitat exists within 5 km of site C-60. | Low. Low density of individuals. Move tower location if surveys indicate this species is within vegetation removal area. |
| *Haha (Cyanea platyphylla*) | FE, SE, CH | Occurs in koa-ohia montane wet forests. | Unknown. Number of total individuals is thought to be less than 100, though current status is unknown. | Critical habitat is within 5 km buffer all 4 sites. Sites C-59 is located directly within the critical habitat area. It is unknown if any individuals occur within 5 km of the sites. | Very low. Less than 100 individuals thought to remain in wild. Move tower location if surveys indicate this species is within vegetation removal area. |
| *Haiwale (Cyanea tritomantha*) | FC | Occurs in wet forest on old volcanic substrates. | Unknown. Number of total individuals is low. | Yes | Moderate. Less than 500 individuals thought to remain in wild. Move tower location if surveys indicate this species is within vegetation removal area. |
| Haiwale (*Cyrtandra giffardii*) | FE, SE, CH | Previously recorded in koa-ohia lowland wet forests, between 940 and 1500 m. | Unknown. Number of total individuals is extremely low. | Critical habitat is within 2.5 km buffer for all 4 sites. Sites C-58 and C-59 are located directly within the critical habitat area. It is unknown if any individuals occur within 5 km of the sites. | Low. Less than 250 individuals thought to remain in wild. Move tower location if surveys indicate this species is within vegetation removal area. |

| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence Within 5 km | Is suitable habitat present? | Likelihood of impact and rationale |
|---|---|---|---|---|---|
| **Core Site and Aquatic Site Name: Core Sites C-58, C-59 & C-60. Laupahoehoe Hawaiʻi Experimental Tropical Forest.** | | | **Mgmt. Agency: USDA Forest Service & Hawaii Department of Land and Natural Resources** | | **State: Hawaii** |
| Haiwale (*Cyrtandra tintinnabula*) | FE, SE, CH | Occurs in koa-ohia lowland wet forests and koa-ohia montane wet forest between 730 and 1040 m. | Unknown. Number of total individuals is extremely low. | Critical habitat is within 2.5 km buffer for all 4 sites. Sites C-58 and C-59 are located directly within the critical habitat area and within the 2.5 km buffer of site C-60. It is unknown if any individuals occur within 5 km of the sites. | Very low. Less than 20 individuals thought to remain in wild. Move tower location if surveys indicate this species is within vegetation removal area. |
| *Nanu (Gardenia remyi*) | FC | Occurs in mesic and wet forests on ridges and gulch slopes. | Unknown. Number of total individuals is extremely low. | Yes | Very low. Less than 75 individuals thought to remain in wild, although the number may be as high as a few hundred. Move tower location if surveys indicate this species is within vegetation removal area. |
| Wawaeʻiole (*Huperzia mannii*) | FE | Occurs in koa-ohia montane wet forests and ohia-hapuu montane wet forest between 900 and 1600 m. | Unknown. Number of total individuals is extremely low. | Yes | Very low. Less than 35 individuals thought to remain in wild. Move tower location if surveys indicate this species is within vegetation removal area. |
| *Ohe (Joinvillea ascendens ssp. ascendens)* | FC | Occurs in mesic to wet koa-ohia lowland and montane forests, and along intermittent streams. | Unknown. | Yes | Moderate, there are 3 known populations on Hawaiʻi. Move tower location if surveys indicate this species is within vegetation removal area. |
| Aiea (*Nothocestrum breviflorum*) | FE, SE | Occurs in montane wet forest above 1,650 m at Laupahoehoe. | Unknown. | Yes | Low. Low density of individuals. Move tower location if surveys indicate this species is within vegetation removal area. |
| *Hawaiʻi phyllostegia (Phyllostegia floribunda*) or (*P.fl* | FC | Occurs in mesic and wet forest on old volcanic substrate. | Unknown. Number of total individuals is low. | Yes | Low. Less than 100 individuals thought to exist, although due to remote habitats the true number is unknown. Move tower location if surveys indicate this species is within vegetation removal area. |
| Kiponapona (*Phyllostegia racemosa*) | FE, SE, CH | Occurs in mesic to wet forest between 700 and 1,650 m. | Unknown. Number of total individuals is extremely low. | Critical habitat exists within 5 km of site C-60. It is unknown if any individuals occur within 5 km of the sites. | Very low. Less than 50 individuals thought to remain in wild. Move tower location if surveys indicate this species is within vegetation removal area. |

| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence Within 5 km | Is suitable habitat present? | Likelihood of impact and rationale |
|---|---|---|---|---|---|
| **Core Site and Aquatic Site Name: Core Sites C-58, C-59 & C-60. Laupahoehoe Hawai‘i Experimental Tropical Forest.** | | | **Mgmt. Agency: USDA Forest Service & Hawaii Department of Land and Natural Resources** | | **State: Hawaii** |
| *Laupahoehoe phyllostegia (Phyllostegia warshaueri*) or (*P. brevidens var. longipes*) | FE, SE, CH | Wet forests on old volcanic substrates. At Laupahoehoe in the ohia-hapuu montane wet forest between 720 and 1,150 m. | Unknown. Number of total individuals is extremely low. | Critical habitat is within the 5 km buffer for site C-60, and the 2.5 km buffer for sites C-58 and C-59. C-59 is located directly within the critical habitat area. It is unknown if any individuals occur within 5 km of the sites. | Very low. Less than 25 individuals thought to remain in wild. Move tower location if surveys indicate this species is within vegetation removal area. |
| *Hawai‘i pilo kea (Platydesma remyi*) | FC | Occurs in koa-ohia lowland wet forest. | Unknown | Yes | Moderate. Move tower location if surveys indicate this species is within vegetation removal area. |
| Picture-wing fly (*Drosophila heteroneura*) | FE | Mesic to wet lowland forest on island of Hawai‘i. Primary host plants are *Clermontia, Cheirodendron*, and *Delissea undulata.* | Not previously collected at Laupahoehoe, but expected to occur in the region by experts. | Yes | Moderate, as host plants are found in area. Move tower location if surveys indicate large numbers of host plants are within vegetation removal area. |
| Picture-wing fly (*Drosophila mulli*) | FT | Montane wet forests primarily on *Pritchardia beccariana* trees between 985 and 1,220 m elevation. | Not previously collected at Laupahoehoe, but expected to occur in the region by experts. | Yes | Moderate, as host plants are found in area. Move tower location if surveys indicate large numbers of host plants are within vegetation removal area. |
| Koloa maoli (*Anas wyvilliana*) | FE | Natural and artificial freshwater habitats from sea level to 3000 m. Nest on the ground. | Yes | Yes | Possible at the Aquatic Site A-47, if nesting areas are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |
| ‘Io or Hawaiian hawk (*Buteo solitarius*) | FE | Broad range of forest habitats from sea level to 2,600 m. | Yes | Yes | Possible, if nesting trees are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |

| Protected / MIS / Sensitive Species or Habitats[a] | Mgmt. or Legal Status [b] | Preferred habitat type(s) | Known Occurrence Within 5 km | Is suitable habitat present? | Likelihood of impact and rationale |
|---|---|---|---|---|---|
| **Core Site and Aquatic Site Name: Core Sites C-58, C-59 & C-60. Laupahoehoe Hawai‘i Experimental Tropical Forest.** | | | **Mgmt. Agency: USDA Forest Service & Hawaii Department of Land and Natural Resources** | | **State: Hawaii** |
| ‘Akiapola‘au (*Hemignathus munroi*) | FE | Mesic and wet ‘ohi‘a (*Metrosideros polymorpha*) and koa (*Acacia koa*) forests above 1,493 m. Nests and sometimes feeds is ohia trees. | Unknown. The habitat at all 4 sites at Laupahoehoe would support the presence, however due to the number of extant individuals, they are unlikely to occur. | Yes | Possible, if nesting trees are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |
| Hawai‘i creeper (*Oreomystis mana)* | FE | Mesic and wet ‘ohi‘a (*Metrosideros polymorpha*) and koa (*Acacia koa*) forests between 1,340 and 2,700 m. | Yes | Yes | Possible, if nesting trees are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |
| ‘Ope‘ape‘a or Hawaiian hoary bat (*Lasiurus cinereus semotus*) | FE | Sea level to 4,115 m on Hawai‘i, utilize a variety of both native and non-native vegetation types. Solitary roosters in trees and shrubs. | Yes | Yes | Possible, if roosting trees are impacted by vegetation removal activity. Trees and large shrubs to be removed during vegetation clearing activities should be inspected for Hawaiian hoary bats prior to removal. If bats are found, vegetation clearing activities should be delayed until the individuals have left the area, or tower placement should be shifted so as to not impact the species. |
| Remy’s gardenia (*Gardenia remyi*) | FC | prefers moist and wet forests on ridges and gulch slopes (NatureServe, 2009b) | Yes | Yes | Possible. Move tower location if surveys indicate this species is within vegetation removal area. |
| **Relocatable Site Name: R-39 &R-40, Pu‘u wa‘awa‘a Hawai‘i Experimental Tropical Forest** | | | **Mgmt. Agency: USDA Forest Service & Hawaii Department of Land and Natural Resources** | | **State: Hawaii** |
| Kau silversword (*Argyroxiphium kauense*) | FE, SE, CH | Moist openings and boggy areas within wet o'hia (*Metrosideros polymorpha*) forests, and in drier areas of smooth lava with a sparse soil layer within mesic, shrubby o'hia forests. | N (believed extirpated) | Y, Critical habitat at site. | Very low. Critical habitat at Pu'u Wa'awa'a is thought to be uninhabited. Move tower location if surveys indicate this species is within vegetation removal area. |
| Diamond spleenwort (*Asplenium fragile*) | FE, SE | Montane and subalpine dry forests | Yes | Yes | Low. Low density of individuals. Move tower location if surveys indicate this species is within vegetation removal area. |
| *Bonamia menziesii* | FE, SE | Lowland dry forest | N (believed extirpated) | Y, within 5 km | Very low. Unoccupied critical habitat is in forest reserve but outside of 5 km range. Move tower location if surveys indicate this species is within vegetation removal area. |

| Relocatable Site Name: R-39 &R-40, Pu‘u wa‘awa‘a Hawai‘i Experimental Tropical Forest | | | Mgmt. Agency: USDA Forest Service & Hawaii Department of Land and Natural Resources | | State: Hawaii |
|---|---|---|---|---|---|
| Uhiuhi (*Caesalpinia kavaiensis*) | FE, SE | Lowland dry forest | Yes | Yes | Very low. Less than 50 individuals left in wild. Move tower location if surveys indicate this species is within vegetation removal area. |
| Kauila (*Colubrina oppositifolia*) | FE, SE, CH | Dry to mesic forest, 240-920 m elevation in leeward Hawai‘i. | Y - Critical habitat exists at Pu‘u Wa‘awa‘a between 396 and 762 m elevation, and is occupied by several hundred individuals. | Y, within 5 km | Low. A small portion of the critical habitat for this species falls within the 5 km radius buffer of the Relocatable Site R-39. Move tower location if surveys indicate this species is within vegetation removal area. |
| Haha *(Cyanea stictophylla)* | FE, SE | Mesic to wet forest from 1,400 – 1,950 m elevation on the Kona coast and Ka‘u District, Hawai‘i | Y - 1 wild individual and outplanting of seedlings has occurred within fenced enclosures at Pu‘u Wa‘awa‘a and Ka‘u Forest Reserve | Yes | Low, most individuals occur within fenced enclosures. Move tower location if surveys indicate this species is within vegetation removal area. |
| *Delissea undulata* ssp. *undulata* | FE, SE, CH | Mesic to dry forest | Y. 1 individual currently present in the critical habitat | Two areas of critical habitat exist for this species at Pu‘u Wa‘awa‘a, in lowland dry forest and montane mesic forest . The critical habitat found in the mesic montane forest is within the 2.5 km buffer for the Relocatable Sites. | Low. Low number of individuals. Outplanting program in fenced areas. Move tower location if surveys indicate this species is within vegetation removal area. |
| Na‘u (*Gardenia brighamii*) | FE, SE | Lowland dry forest | N (believed extirpated) | Yes | None. Probably extirpated from region. |

| Relocatable Site Name: R-39 &R-40, Pu'u wa'awa'a Hawai'i Experimental Tropical Forest | | | Mgmt. Agency: USDA Forest Service & Hawaii Department of Land and Natural Resources | | State: Hawaii |
|---|---|---|---|---|---|
| Hau kuahiwi (*Hibiscadelphus hualalaiensis*) | FE, SE, CH | Dry to mesic forest and lava flows of Hualalai and Waihou | Y - 1 wild plant (deceased) and several outplantings | Y. Critical habitat is found within the 5 km buffer, extending from lowland dry forest (at approximately 610 m) up into the mesic montane forest (to approximately 1,128 m), and is currently occupied by the 12 outplanted individuals | Low. Low number of individuals. Outplanting program in fenced areas. Move tower location if surveys indicate this species is within vegetation removal area. |
| Ma'o hau hele (*Hibiscus brackenridgei)* | FE, SE | Lowland dry forest | Unknown | Y, critical habitat exists within Forest Unit, but is outside 5km buffer. | Very low. Low number of individuals, and critical habitat is outside 5km buffer. Move tower location if surveys indicate this species is within vegetation removal area. |
| Koki'o (*Kokia drynarioides*) | FE, SE, CH | Dry forests in leeward Hawai'i, on rough lava with thin, well drained soils from 455 – 1,915 m elevation | Y?. Six individuals known to exist in the wild; outplanting program is underway | Critical habitat occurs within 5 km buffer, but it is unknown whether any individuals occur within the 5 km buffers | Very low. Low number of individuals, mostly outplanted within enclosures. Move tower location if surveys indicate this species is within vegetation removal area. |
| Big Island ma'aloa (*Neraudia ovata*) | FE, SE, CH | Dry forests on lava flows | N (believed extirpated) | Yes - Critical habitat at site. | Very low to none. Species is thought to be extirpated at site, critical habitat is unoccupied. |
| 'Aiea (*Nothocestrum breviflorum*) | FE, SE, CH | Dry to mesic forests from 550 – 1,830 m | Y. Critical habitat is currently occupied by more than 165 individuals | Critical habitat occurs between approximately 396 – 1,158 m elevation in the lower mesic montane forest and lowland dry forest at Pu'u Wa'awa'a, within 5 km buffer | Low. Low density of individuals. Move tower location if surveys indicate this species is within vegetation removal area. |
| Holei (*Ochrosia kilaueaensis*) | FE, SE | Mesic forest at Pu'uwa'awa'a only | N (believed extirpated) | Yes | None. Probably extirpated from region. |
| Kiponapona (*Phyllostegia racemosa*) | FE, SE | Mesic to wet forests at 700-1650 m | N (believed extirpated) | Yes | None. Probably extirpated from region. |

| | | | | | |
|---|---|---|---|---|---|
| Mint (*Phyllostegia velutina*) | FE, SE | Mesic to wet forest, 1,460 – 1,920 m | Yes | Yes | Low. Low density of individuals. Move tower location if surveys indicate this species is within vegetation removal area. |
| **Relocatable Site Name: R-39 &R-40, Pu'u wa'awa'a Hawai'i Experimental Tropical Forest** | | | **Mgmt. Agency: USDA Forest Service & Hawaii Department of Land and Natural Resources** | | **State: Hawaii** |
| Laukahi kuahiwi (*Plantago hawaiiensis*) | FE, SE | Mesic to dry shrub lands between 1,800 to 1,950 m elevation on the leeward side of Hawai'i | Y - near the upper boundary of the forest bird sanctuary | Yes | Unknown. Density of individuals unknown, but not likely to be high in the proximity of the towers because they are not in preferred habitat. Move tower location if surveys indicate this species is within vegetation removal area. |
| Hala pepe (*Pleomele hawaiiensis* ) | FE, SE, CH | Lowland dry forests, 300-860 m, in leeward Hawai'i | Unknown | Y. Critical habitat occurs in the lowland dry forest at Pu'u Wa'awa'a, but is outside of the 5 km buffer. | Very low. Most likely occurs outside the 5 km buffer. Move tower location if surveys indicate this species is within vegetation removal area. |
| Po`e (*Portulaca sclerocarpa*) | FE, SE | Dry habitats such as subalpine woodlands, bare cinders and near steam vents, between 1,030 – 1,630 m on Hawai'i | Unknown - Occurs on nearby 1859 lava flow. | Yes | Low. Distribution not known, may not occur within 5 km of sites. Move tower location if surveys indicate this species is within vegetation removal area. |
| Popolo ku mai (*Solanum incompletum*) | FE, SE, CH | Dry to mesic and subalpine forest, 600 – 2,020 m | Y. 10 individuals of S. incompletum were discovered in Pu'u Wa'awa'a in 2007, and over 200 individuals have been outplanted at Pu'u Wa'awa'a over the last several years. | Critical habitat exists in the koa/'Ohi'a montane mesic forest within the 2.5 km buffer radius of the Relocatable Sites. | Moderate. As the critical habitat is occupied, it can be assumed that individuals of this species occur within the 2.5 km buffer of the Relocatable Sites, and may even occur at the sites themselves. Move tower location if surveys indicate this species is within vegetation removal area. |
| mint (*Stenogyne angustifolia*) | FE, SE | Dry subalpine shrub lands from 1,550 – 2,150 m | Unknown - Occurs on nearby 1859 lava flow. | Yes | Low. Distribution not known, may not occur within 5 km of sites. Move tower location if surveys indicate this species is within vegetation removal area. |
| Hawaiian vetch (*Vicia menziesii*) | FE, SE | Mesic to wet forests in Keauhou-Kilauea area and at Pu'u Wa'awa'a | Y. A colony was found in the Halepiula mauka Waimea paddock at 1,600 m elevation in a forest opening | Yes | Low. Low density of individuals. Move tower location if surveys indicate this species is within vegetation removal area. |

| Relocatable Site Name: R-39 &R-40, Pu'u wa'awa'a Hawai'i Experimental Tropical Forest | | | Mgmt. Agency: USDA Forest Service & Hawaii Department of Land and Natural Resources | | State: Hawaii |
|---|---|---|---|---|---|
| Kawa'u (*Zanthoxylum dipetalum var. tomentosum*) | FE, SE, CH | Dry to mesic forests and lava fields at Pu'u Wa'awa'a. | Y. Approximately 24 individuals found at Pu'u Wa'awa'a. | Crucial habitat occurs in montane mesic and lowland dry forest, within 2 to 5 km from the Relocatable Sites, and is currently occupied. | Low. Low density of individuals. Move tower location if surveys indicate this species is within vegetation removal area. |
| A'e (*Zanthoxylum hawaiiense*) | FE, SE | Dry forest and occasionally in mesic forest on lava flows, between 550 – 1,740 m | Y. A small number can be found on a'a lava flows in the montane dry forest zone at Pu'u Wa'awa'a. It is unknown whether any individuals are found within the 5 km buffer of the Relocatable Sites | Yes | Low. Distribution not known, may not occur within 5 km of sites. Move tower location if surveys indicate this species is within vegetation removal area. |
| 'Anunu (*Sicyos macrophyllus*) | FC | Wet and subalpine forest at 1,200 – 2,000 m, on the windward slopes of the Kohala Mountains, Mauna Kea, and the Mauna Loa-Mauna Kea saddle | Y. A few individuals can be found within the lower montane mesic forest | Yes | Low. Low density of individuals. Move tower location if surveys indicate this species is within vegetation removal area. |
| Picture-wing pomace fly (*Drosophila heteroneura*) | FE | Mesic to wet forest on island of Hawai'i. Primary host plants are *Clermontia, Cheirodendron,* and *Delissea undulata.* | Unknown. Last seen at Pu'uwa'awa'a in 1969. | Yes | Very low. Low density of individuals, may be extirpated. Move tower location if surveys indicate large number of host plants are within vegetation removal area. |
| Blackburn hawk moth (*Manduca blackburni*) | FE | Dry to mesic shrub land and forest from sea level to mid-elevations. Host plants include plants in the nightshade family (Solanaceae), including native trees in the genus Nothocestrum, and non-native solanacious plants such as commercial tobacco *(Nicotiana tabacum*), tree tobacco (*N. glauca*), eggplant (*Pseudomonas solanacearum*), tomato (*Lycopersicon esculentum*), and Jimson weed (*Datura stramonium*). | Yes | Yes | Moderate, as host plants are found in area. Move tower location if surveys indicate large numbers of host plants are within vegetation removal area. |
| 'Io or Hawaiian hawk (*Buteo solitarius*) | FE | Broad range of forest habitats from sea level to 2,600 m. | Yes | Yes | Possible, if nesting trees are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |

| Relocatable Site Name: R-39 &R-40, Pu'u wa'awa'a Hawai'i Experimental Tropical Forest | | | Mgmt. Agency: USDA Forest Service & Hawaii Department of Land and Natural Resources | | State: Hawaii |
|---|---|---|---|---|---|
| Nene (*Branta sandwicensis*) | FE | Water bodies, grasslands, grassy shrub lands, and dryland forest, from sea level to the subalpine and alpine zones. | Yes | Yes | Low. Nesting occurs within 5 km but is mainly found around reservoirs. Conduct nest surveys in proximity of Relocatable Sites, and delay activities if any discovered. |
| 'Alala or Hawaiian crow (*Corvus hawaiiensis*) | FE | Dry and seasonally wet 'ohi'a and 'ohi'a/koa (*Acacia koa*) forests | N (Extirpated from region) | Yes | None. Species is considered to be extinct in the wild. |
| Hawai'i 'akepa (*Loxops coccineus coccineus*) | FE | Montane 'ohi'a (*Metrosideros polymorpha*) and koa (*Acacia koa*) forests. Cavity nesters. | Yes | Yes | Possible, if nesting trees are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |
| Hawai'i creeper (*Oreomystis mana)* | FE | Mesic and wet 'ohi'a (*Metrosideros polymorpha*) and koa (*Acacia koa*) forests above 1,493 m | Yes | Yes | Possible, if nesting trees are impacted by vegetation removal activity. Conduct nest surveys and delay activities until fledging. |
| Dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*) | FE | Pelagic seabird that feeds primarily on squid, fish, and crustaceans caught near the sea surface at night. Variety of nests ranging from rain forests to sub-alpine rocky cliffs. | Unknown | Yes | Very low. Potential to encounter bird at sites during breeding season. Spends most of the time at sea. |
| 'Ope'ape'a or Hawaiian hoary bat (*Lasiurus cinereus semotus*) | FE | Sea level to 4,115 m on Hawai'i, utilize a variety of both native and non-native vegetation types. Solitary roosters in trees and shrubs. | Yes | Yes | Possible, if roosting trees are impacted by vegetation removal activity. Trees and large shrubs to be removed during vegetation clearing activities should be inspected for Hawaiian hoary bats prior to removal. If bats are found, vegetation clearing activities should be delayed until the individuals have left the area, or tower placement should be shifted so as to not impact the species. |
| | | | | | |
| Notes | | | | | |
| [a]= Data from Hawaii Office of Planning 2008, Giffin 2003, and USDA 2007 | | | | | |
| [b] = Species Status Codes | | | | | |

| **Federal Status:** | **State:** | **Natural Heritage Program: S1, S2, or S3 rank from Heritage Program** |
|---|---|---|
| Endangered Species Act status as published in the *Federal Register*: | Hawaii plant species status as designated from Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife webpage (http://www.state.hi.us/dlnr/dofaw/pubs/TEplant.html). No list is available for wildlife. | S1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences. |
| FE = Federal Endangered | SE = State Endangered | S2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6-20 occurrences. |
| FT = Federal Threatened | ST = State Threatened | S3 = Rare, uncommon, or threatened, but not immediately imperiled, typically with 21-100 occurrences. |
| FC = Federal Candidate | SS = State Species of Special Concern | |
| FP = Federal Proposed | | |
| CH= Critical Habitat exists at site | | |

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# Appendix C
# Colorado State University Extension Fact Sheet on Mountain Pine Beetle

I N S E C T S E R I E S

# TREES & SHRUBS

## Mountain Pine Beetle no. 5.528

*by D.A. Leatherman, I. Aguayo, and T.M. Mehall*[1]

### Quick Facts...

Mountain pine beetles (MPB) are the most important insect pest of Colorado's pine forests. MPB often kill large numbers of trees annually during outbreaks.

Trees that are not growing vigorously due to old age, crowding, poor growing conditions, drought, fire or mechanical damage, root disease and other causes are most likely to be attacked.

For a long-term remedy, thin susceptible stands. Leave well-spaced, healthy trees.

For short-term controls, spray, cover, burn or peel attacked trees to kill the beetles. Preventive sprays can protect green, unattacked trees.

Colorado State University

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Mountain pine beetle (MPB), *Dendroctonus ponderosae*, is native to the forests of western North America. Periodic outbreaks of the insect, previously called the Black Hills beetle or Rocky Mountain pine beetle, can result in losses of millions of trees. Outbreaks develop irrespective of property lines, being equally evident in wilderness areas, mountain subdivisions and back yards. Even windbreak or landscape pines many miles from the mountains can succumb to beetles imported in infested firewood.

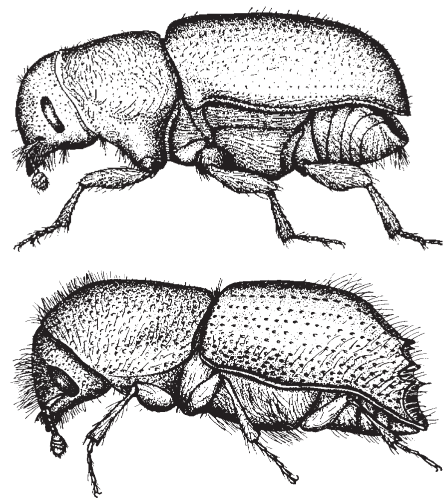

Figure 1: Adult *Dendroctonus* (top) versus *Ips* (bottom). Note gradually curved wing of *Dendroctonus*. Actual size of *Dendroctonus* from 1/8 to 1/3 inch, *Ips* 1/3 to 1/4 inch.

Mountain pine beetles develop in pines, particularly ponderosa, lodgepole, Scotch and limber pine. Bristlecone and pinyon pine are less commonly attacked. During early stages of an outbreak, attacks are limited largely to trees under stress from injury, poor site conditions, fire damage, overcrowding, root disease or old age. However, as beetle populations increase, MPB attacks may involve most large trees in the outbreak area.

A related insect, the Douglas-fir beetle (*D. pseudotsugae*), occasionally damages Douglas-fir. Most often, outbreaks are associated with previous injury by fire or western spruce budworm. (See fact sheet 5.543, *Western Spruce Budworms*). Spruce beetle (*D. rufipennis*) is a pest of Engelmann and Colorado blue spruce in Colorado. Injured pines also can be attacked by the red turpentine beetle (*D. valens*).

Mountain pine beetles and related bark beetles in the genus *Dendroctonus* can be distinguished from other large bark beetles in pines by the shape of the hind wing cover (Figure 1, top). In side view, it is gradually curved. The wing cover of *Ips* or engraver beetles, another common group of bark beetles attacking conifers, is sharply spined (Figure 1, bottom).

### Signs and Symptoms of MPB Attack

- Popcorn-shaped masses of resin, called "pitch tubes," on the trunk where beetle tunneling begins. Pitch tubes may be brown, pink or white (Figures 2 and 6).
- Boring dust in bark crevices and on the ground immediately adjacent to the tree base.

- Evidence of woodpecker feeding on trunk. Patches of bark are removed and bark flakes lie on the ground or snow below tree.
- Foliage turning yellowish to reddish throughout the entire tree crown. This usually occurs eight to 10 months after a successful MPB attack.
- Presence of live MPB (eggs, larvae, pupae and/or adults) as well as galleries under bark. This is the most certain indicator of infestation. A hatchet for removal of bark is needed to check trees correctly (Figures 3, 5 and 8).
- Bluestained sapwood (Figure 9). Check at more than one point around the tree's circumference.

Figure 2: "Pitch tubes" indicating trunk attacks by MPB. Success of the attacks is confirmed by looking under the bark with a hatchet for beetles, their tunnels and/or bluestaining.

## Life History and Habits

Mountain pine beetle has a one-year life cycle in Colorado. In late summer, adults leave the dead, yellow- to red-needled trees in which they developed. In general, females seek out large diameter, living, green trees that they attack by tunneling under the bark. However, under epidemic or outbreak conditions, small diameter trees may also be infested. Coordinated mass attacks by many beetles are common. If successful, each beetle pair mates, forms a vertical tunnel (egg gallery) under the bark and produces about 75 eggs. Following egg hatch, larvae (grubs) tunnel away from the egg gallery, producing a characteristic feeding pattern.

Figure 3: Top view of adult MPB (actual size, 1/8 to 1/3 inch).

Figure 4: Mountain area infested by MPB, showing three years of mortality. Old, dead trees are gray; newly killed trees are straw yellow or orange. Some trees may also be infested but do not turn color until nine months or so under attack.

MPB larvae spend the winter under the bark. Larvae are able to survive the winter by metabolizing an alcohol called glycerol that acts as an antifreeze. They continue to feed in the spring and transform into pupae in June and July. Emergence of new adults can begin in mid-June and continue through September. However, the great majority of beetles exit trees during late July (lodgepole pine) and mid-August (ponderosa pine).

A key part of this cycle is the ability of MPB (and other bark beetles) to transmit bluestain fungi. Spores of these fungi contaminate the bodies of adult beetles and are introduced into the tree during attack. Fungi grow within the tree and assist the beetle in killing the tree. The fungi give a blue-gray appearance to the sapwood.

Figure 6: Not all pitch tubes indicate successful attacks. Note the beetle trapped in this large pitch tube. If the majority of tubes look like this, the tree may have survived the current year's attack.

Figure 5: Larva of MPB (actual size, 1/8 to 1/4 inch). They are found under the bark in tunnels.

## Infested Trees

- Once MPB infests a tree, nothing practical can be done to save that tree.
- Under epidemic or outbreak conditions, enough beetles can emerge from an infested tree to kill at least two, and possibly more, trees the following year.
- *Ips* and related beetles that emerge early in summer often are mistaken for mountain

Figure 7: Checking beneath the bark for MPB. This attack was successful (note tunnels and stain).

pine beetle, leading to early reports that "MPB is flying." Be sure to properly identify the beetles you find associated with your trees.

- Trees from which MPB have already emerged (look for numerous round, pitch-free exit holes in bark) do not need to be treated.
- The direction and spread rate of a beetle infestation is impossible to predict. However, attacked trees usually are adjacent to or near previously killed trees.

Figure 8: Characteristic tunnels (galleries) of mountain pine beetle made by the adults and larvae. The underbark area looks like this in late spring. Bluestained wood is caused by fungi the beetles introduce.

## Control

Natural controls of mountain pine beetle include woodpeckers and insects such as clerid beetles that feed on adults and larvae under the bark. However, during outbreaks these natural controls often fail to prevent additional attacks.

Extreme cold temperatures also can reduce MPB populations. For winter mortality to be a significant factor, a severe freeze is necessary while the insect is in its most vulnerable stage; i.e., in the fall before the larvae have metabolized glycerols, or in late spring when the insect is molting into the pupal stage. For freezing temperatures to affect a large number of larvae during the middle of winter, temperatures of at least 30 degrees below zero (Fahrenheit) must be sustained for at least five days.

Figure 9: Cut tree killed by MPB, showing the characteristic blue-staining pattern.

Logs infested with MPB can be treated in various ways to kill developing beetles before they emerge as adults in summer.

One very effective way to kill larvae developing under the bark (though very labor intensive) is by peeling away the bark, either by hand or mechanically; this exposes the larvae to unfavorable conditions—the larvae will dehydrate, starve and eventually die. Logs my also be burned or scorched in a pile—preferably when there is snow on the ground (contact your local forester for assistance). They can also be buried under at least eight inches of soil, or chipped. Following beetle emergence, wood can be used without threat to other trees.

Figure 10: Large, uninfested pine being preventively sprayed. This protects high-value trees and should be done annually between April 1 and July 1.

Chemical control options for MPB larvae have been greatly limited in recent years. At present, there are no labeled pesticides for use on MPB.

Solar treatments may be appropriate in some areas of Colorado to reduce beetle populations in infested trees. For the treatment to be effective, the temperature under the bark much reach 110 degrees Fahrenheit or more. Such treatments can be performed with or without plastic. This method is also labor intensive; contact your local forester for more details on solar treatments.

Figure 11: The appearance of a forest thinned to help prevent MPB. This can also improve mountain views and reduce fire hazard.

## Prevention

An important method of prevention involves forest management. In general, MPB prefers forests that are old and dense. Managing the forest by creating diversity in age and structure with result in a healthy forest that will be more resilient and, thus, less vulnerable to MPB. Most mature Colorado forests have about twice as many trees per acre as those forests which are more resistent to MPB. Contact your local forester for more information on forest management practices.

Certain formulations of carbaryl (Sevin and others) permethrin (Astro, Dragnet and others), and bifenthrin (Onyx) are registered for use to prevent attacks on individual trees. These sprays are applied to living green trees in early summer to kill or deter attacking beetles. This preventive spray is generally quite effective through one MPB flight (one year). During epidemic conditions, the pressure from beetle populations may result in less satisfactory results due to several factors:

*Always carefully read and follow all label precautions before applying insecticides for MPB prevention.*

- Misidentification of healthy trees: Under dry conditions, trees may not produce pitch tubes when infested, therefore healthy trees are not as obvious. Time may need to be spent looking for sawdust around a tree's circumference and at the base of the tree.
- Timing of application: Trees sprayed after June may already have been attacked.
- Improper coverage: Spray may not have been applied high enough (up to where the trunk tapers to less that six inches), or spray coverage of the tree did not begin at ground level, or was not applied to the entire circumference of the tree (thus creating "windows" for beetle attack).
- Improper dosage/mixing of chemical: Low dosage—effective dosages for bark beetles are higher than the percent used for other insects. Mixture—the carbaryl and water were not fully mixed.
- Environmental conditions: Significant rain or moisture within two hours of application may wash off the insecticide. Very high temperatures may break down the chemical (this can occur when treated trees are near forest fires).
- Chemical shelf life/storage: Manufacturers guarantee stable chemical properties for at least two years after manufacturing date, if stored properly. Chemical properties of carbaryl may be altered if stored at very high or very low temperatures.
- Improper volume/formulation: Not enough spray is used to cover the bark area susceptible to beetle attack; lodgepole pine has "flaky" bark which may require more spray. The label on the chemical does not indicate bark beetle prevention (if using Sevin, SL or XLR is recommended).

Always carefully read and follow all label precautions before applying insecticides for MPB prevention.

## Related Fact Sheets

5.543, *Western Spruce Budworms*
5.558, *Ips Beetles*

Contact the Colorado State Forest Service for additional information related to mountain pine beetles.

This fact sheet was produced in cooperation with the Colorado State Forest Service.

*[1]D.A. Leatherman, Colorado State Forest Service entomologist (retired); I. Aguayo, Colorado State Forest Service entomologist; and T.M. Mehall, Colorado State Forest Service forester.*

# Addendum A
# Matrix of Public Comments and Responses to Comments

## MATRIX OF PUBLIC COMMENTS AND RESPONSES TO COMMENTS

| **Janis Reichstadt** |
|---|
| **Received from:**<br>Janis Reichstadt, 09-15-09 |
| **Comment:**<br>1. Letter to Vaughn L. Baker: Dear Mr. Baker, I live year-round in the Valley of the proposed Highway 7 Neon site in Rocky Mt. National Park. I am **Totally opposed** to this site and its 49 foot lattice Tower being planted in this area. This valley and the views it offers of the legendary East face of Long's Peak should be Totally protected from all man-made obstructions except for the ones that are currently grandfathered. The Tower is not wanted, it would obstruct this beautiful view of the East face of Longs AND whatever 'frequencies' and experiments this NEON Plan contains is also NOT WANTED. Your Tower, et al is not welcomed HERE! |
| **Response:**<br>The text regarding the impacts from the tower proposed for the area (R-20) was revised to clarify its visual impacts. Text in the aesthetics and visual resources environmental consequences section was revised as follows:<br><br>"The R-20 tower would be near other man-made infrastructure located along SH -7 in Tahosa Valley and would not greatly alter the visual quality of the general area. The tower would be visible to varying degrees from much of the surrounding area (Figure 3.D10-5). However, most homes in the area are approximately 60 to 75 m above the proposed tower location and would be above the top of the tower by approximately 40 to 55 m. When looking at the peaks that dominate the viewshed, Long's Peak to the west and Twin Sisters to the east, the tower would not extend into the view but would be part of the floor of the view, along with the nearby Salvation Army camp and conference center. There are trees around much of the proposed tower location that would provide visual screening to homes at lower elevations, and the exterior of the infrastructure would feature non-reflective materials and paint to further reduce visual impacts. There would be no night-time lighting at the tower and no change from the current night visual environment. Because the change in the viewshed would be minimal, any direct impacts to aesthetic and visual resources would be minor." |

| **Central Utah Water Conservancy District** |
|---|
| **Received from:**<br>Sarah Sutherland, 09-28-09 |
| **Comment:**<br><br>Our comments are focused on Domain 15, specifically Relocatable Tower R-30 and Aquatic Array A-35 located in the Red Butte Canyon Research Natural Area.<br><br>**Access**<br>Access to the proposed site for R-30 and A-35 requires crossing property that is owned and managed by CUWCD. The U.S. Forest Service coordinates closely with CUWCD to provide access to the Natural Research Area for approved permittees. Red Butte Reservoir is a gated, |

secure area, closely monitored for public safety. Coordination with the U.S. Forest Service and CUWCD would need to take place for construction periods, including equipment removal at the end of the project, and during the time when scientist and technicians would be accessing the area to complete sampling efforts.

**Electrical**

Page 3-498 discusses the closest source of power for the Red Butte facilities being the USGS Station 1017220. The USGS station runs off of solar power and may not be an adequate source of power for this project.

Page 2-67 describes the electrical and communication services for the Relocatable Tower (R-30). The existing electrical and communication lines in the vicinity of Red Butte Reservoir, are the property of CUWCD. We lease power from the University of Utah. Coordination with the University would need to take place and an agreement would need to be reached in order to connect to their electrical services. We may or may not have the capacity in our power line to provide the additional capacity that may be required for this project. Power needs would need to be determined and coordinated. It is possible that a separate trench would need to be constructed for power lines to site R-30 and A-35.

The existing communications line to the CUWCD facilities is a small fiber line. There are no spare fibers available on that line. A separate line would need to be put in place to serve site R-30 and A-35. Connecting and passing through the CUWCD system would not be allowed due to the Supervisory Control and Data Acquisition system (SCADA) and other security issues.

Any new trench that would need to be established to provide the necessary power and communication capability to site R-30 and A-35, that crosses CUWCD property, would need an easement and lease agreement in place before construction would be permitted.

**Streon**

Page 2-12 describes the addition of phosphorus and nitrogen to streams at STREON sites. Red Butte Reservoir, located downstream of the Red Butte STREON site, serves as the primary refuge population for the endangered June sucker. The reservoir is managed to ensure the long term viability of this population and to encourage natural reproduction/recruitment. The addition of nutrients to the water supply is not consistent with the management plan for Red Butte Reservoir and the potential effects of such actions raise concerns regarding impacts to the reservoir's June sucker population. The CUWCD is strongly opposed to having a STREON site located in Red Butte Creek.

On page 5-12, in the NPDES Permit write-up, Sycamore Creek was referred to. This is an error. For Domain 15, the creek that work is proposed to take place in is Red Butte Creek. Site-specific determinations of the appropriate permitting requirements would need to be made by the Utah Department of Environmental Quality, with input from the U.S. Forest Service, U.S. Fish and Wildlife Service and the Utah Division of Wildlife Resources, on account of the location within the National Forest and the endangered and sensitive species in the creek and reservoir.

**Response:**

**Access**

NSF and NEON Inc., appreciate the additional information regarding access to the proposed site for R-30 and A-35. NEON Inc. would coordinate with the U.S. Forest Service and CUWCD regarding access during construction, including the movement of equipment and material to and from the site and removal of equipment at the completion of the program. Coordination would also occur during operation when access would be required for monitoring and maintenance activities.

**Electrical**
Page 3-498: NEON has identified alternative grid power sources located near the reservoir. NEON would investigate the use of the single phase power that is available. NSF and NEON, Inc. concur that the USGS solar power source would likely be inadequate.

Page 2-67: A recent visit to the site has revealed that there may be space in the existing conduit for data lines. NEON would investigate the potential for running additional data lines in the existing infrastructure. If this approach is not feasible or possible due to permitting constraints, NEON would investigate separate trenching.

CUWCD States: *The existing communications line to the CUWCD facilities is a small fiber line. There are no spare fibers available on that line. A separate line would need to be put in place to serve site R-30 and A-35. Connecting and passing through the CUWCD system would not be allowed due to the Supervisory Control and Data Acquisition System (SCADA) and other security issues.*

This is understood and NEON would be responsible to provide a separate line as described in the above response.

CUWCD States: *Any new trench that would need to be established to provide the necessary power and communication capability to site R-30 and A-35, that crosses CUWCD property, would need an easement and lease agreement in place before construction would be permitted.*

NEON acknowledges the need for easements and any lease agreements and would seek to obtain these prior to construction.

**STREON**
No STREON site is proposed for Domain 15, including Red Butte Creek, and none are planned for Domain 15.

A STREON site is planned for Sycamore Creek, in Arizona. The error was in placing the discussion of the permitting for that stream under Domain 15 rather than Domain 14. As noted above, no STREON site is proposed for Domain 15. The Sycamore Creek permitting discussion has been moved to the correct location under Domain 14.

| National Park Service Comments - General |
|---|
| **Received from:**<br>National Park Service, 09-25-09 |
| **Comment:**<br>1. **Maps:** The maps provided in the report, mostly reductions of 7 1/2 minute quads, are of limited use for locating the project sites in relationship to nearby towns, roads, and county lines. Not all the project descriptions give county locations, nor nearby towns. In at least one case (Domain |

6 site) and in Alaska, reviewers found no way to verify the study stations on more general state maps. We suggest that insets of larger scale maps be included to show the study site in relation to well-known landmarks such as towns, roads, and county lines.

2. **Proximity to national trails:**

We appreciate that the Appalachian NST is addressed in the text for Domain 2. Below we provide a list of other national trails that are in the vicinity of other study locations. Depending on the proximity and geography, you may need to consider potential impact on these other trails. As noted in the comment for p. 1-6, Executive Order 13195 requires federal agencies to protect trails of all types.

NHT = national historic trail, NST = national scenic trail

| Domain | Location | Nearby Trail |
|---|---|---|
| 1 | Harvard Forest, MA | About 10 mi. E of the newly established New England NST |
| 2 | Smithsonian Environmental Research Center | Captain John Smith Chesapeake NHT; Star-Spangled Banner NHT |
| 3 | Ordway-Swisher Biol. Sta., FL | About 10 miles west of the Florida NST |
| 13 | Niwot Ridge, CO | May be close to the Continental Divide NST |
| 14 | Santa Rita Exp. Range, AZ | May adjoin the newly established Arizona NST south of Tucson |
| 15 | Ouaqui-Benmore Exp. Station, UT | 2.5 km or less from the route of the Pony Express NHT |
| 16 | Wind River Exp. Forest, Pinchot NF, WA | Very close to the Pacific Crest NST, somewhat close to the Lewis & Clark NHT and Oregon NHT (in the water-route section of the trails on the Columbia River south of the project area) |
| 17 | Sierra NF, CA | 15-20 miles west of the Pacific Crest NST |

3. **Proximity to Wild and Scenic Rivers and Rivers Designated on the National River Inventory:** Throughout the document and beginning with the overview of impact topics on p. ES-4, please add 1) the potential for NEON development to impact listed Rivers on the Nationwide Rivers Inventory and those rivers potentially eligible for designation as National Wild and Scenic Rivers, and 2) the potential for NEON development to impact designated National Wild and Scenic Rivers as required by the National Wild and Scenic Rivers Act. As also required by the Act, NEON should consider mitigation of potential impacts of the NEON program to all designated rivers and their immediate environments. Such designated rivers possess scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values, and are in free-flowing condition.

4. **Historic Preservation Compliance:** We found a "caveat" statement about the need to conduct site-specific surveys and Section 106 compliance appropriately occurs in the five Domain sections spot-checked—2, 7, 10, 12, 13 (pages pages 3-41 lines 29-31; 3-71 lines 4-6; 3-238 lines 7-10; 3-324 lines 10-13; 3-390 lines 17-20; and 3-427 lines 20-23). This statement clearly lets the reader know that additional information is needed before making final construction decisions for NEON facilities. Unfortunately, text preceding the "caveat" statement was not changed, so the "caveat" stands in direct contradiction of the preceding, very clear-cut and unambiguous statements that "the literature review...did not identify any significant known historic properties" and "based on the...archival analysis, no significant impacts to any known significant cultural resources would be expected." In this context, the reader could wonder why, if there are no historic properties and no

significant impact, is it necessary to conduct site-specific survey and analysis.

We recommend revising these two statements, wherever they occur throughout the document, so they more accurately reflect the conditional nature of the conclusions drawn on partial information (archival only), as follows:

---"The literature review of the proposed NEON locations in Domain XX suggests that there may be no adverse effects on historic properties within or adjacent to areas where NEON infrastructure would be placed." Use this text in place of sentences on page 3-41 lines 18-20; page 3-324 lines 2-4; page 3-390 lines 9-11; and in other Domain sections where the "Environmental Consequences" text begins with this sentence structure (not all of them do).

---"Based on the results of archival analysis, there may be no adverse effects on historic properties from installation of NEON facilities in Domain XX." This revised sentence should replace the sentence immediately preceding the "caveat" language on page 3-41 lines 27-28; page 3-238 lines 5-7; page 3-324 lines 9-10; page 3-390 lines 16-17; page 3-427 lines 18-20; and in other Domain sections where the last paragraph of the "Environmental Consequences" text begins with this sentence structure (not all of them do).

In addition, in the Section 3.3.14 discussion of the method for assessing impacts on cultural resources, the sentence on page 3-14 lines 9-12 should be similarly revised. The following is recommended: "The collected body of knowledge presented in this EA provides sufficient information to suggest that NEON features identified to date may not have adverse effects on cultural resources reported from the literature and related other archival data reviewed for this EA. Additional site-specific information, however, will be needed to make final determinations of effect, as discussed below." The following paragraphs describe the phased approach to Section 106 compliance in accord with 36 CFR 800.4.

The Executive Summary paragraph on cultural resources (page ES-14 lines 11-18) should also be revised for consistency with the above revisions; line 13 should read -- "...determined that NEON would most likely have no adverse effect on cultural resources." Note the use of terminology consistent with Section 106 and 36 CFR 800 instead of NEPA and CEQ regulations.

Further, the last sentence of this paragraph (page ES-14 lines 16-18) is not entirely correct -- the SHPO has no authority to "require" a federal agency to mitigate adverse effects, and minimizing the intensity of impact through mitigation is a NEPA concept, not used in Section 106 compliance process. The last part of this sentence should be revised, as follows -- "...avoid impacts to significant cultural resources, mitigation of impacts, as determined in consultation with the SHPO and others, would be implemented."

Finally, it is important to mention in the relevant Domain sections the presence of the Appalachian National Scenic Trail, which is eligible for listing on the National Register. In addition to the existing discussion in Domain 2, it may need to be mentioned in Domains 1 and 7 depending on the proximity of the Trail to the NEON site locations.

5. **Review of Public Meeting and Review Comments:** We request that Rocky Mountain National Park staff have the opportunity to review and react to comments that were received at the public hearings and during the EA public review and comment period that pertain to relocatable sites R-20 and A-25 in Domain 10. The public comments will influence how we proceed with the permitting process for the two relocatable sites in Rocky Mountain National Park.

6. **Level of detail of analysis:** In general, we still find the information provided to be general and basic, yet understand that the details of placement will dictate further environmental review.

**Response:**

1. **Maps:** The maps in Section 2 of the NEON EA were revised to include better location information including inset maps, road names, and locations/directions to nearby towns. The scale on the Section 2 maps was changed to show a larger geographic area.

2. **Proximity to national trails:** A discussion of NSTs and NHTs was added to the general recreation background section, along with criteria for determining whether potential impacts would be evaluated. Each trail or nearby components of driving/water trails were located relative to the closest proposed NEON infrastructure. NSTs and NHTs that met the evaluation criteria were then added to the affected environment section of the appropriate domains and evaluated with regard to potential impacts. The rationale for excluding the other trails is provided in the table below.

| Domain | Location | Nearby Trail |
|---|---|---|
| 1 | Harvard Forest, MA | *About 10 mi. E of the newly established New England NST* - The New England NST is sufficient distance from the project location that it does not warrant detailed evaluation in the EA. |
| 2 | Smithsonian Environmental Research Center | *Captain John Smith Chesapeake NHT* - The Captain John Smith represents waterways mapped by John Smith and his men of the Chesapeake area in the early 1600s; it is also the first national water trail. This trail is not noted in the literature search as it is located outside of the literature search area for cultural resources.<br><br>*Star-Spangled Banner NHT* - The Star-Spangled Banner NHT is actually a recently established trail which connects four historic sites where important events of the War of 1812 occurred. None of these four locations were noted in the literature search area for cultural resources and, as the trail itself is not actually historic, it also would not have been noted in the literature search for cultural resources. |
| 3 | Ordway-Swisher Biol. Sta., FL | *About 10 miles west of the Florida NST* - The Florida NST is sufficient distance from the project location that it does not warrant detailed evaluation in the EA. |
| 13 | Niwot Ridge, CO | *May be close to the Continental Divide NST* - The Continental Divide NST is sufficient distance from the project location that it does not warrant detailed evaluation in the EA. |
| 14 | Santa Rita Exp. Range, AZ | *May adjoin the newly established Arizona NST south of Tucson –* |

| | | |
|---|---|---|
| | | The Arizona NST is sufficient distance from the project location that it does not warrant detailed evaluation in the EA. |
| 15 | Ouaqui-Benmore Exp. Station, UT | *2.5 km or less from the route of the Pony Express NHT* - The Pony Express Trail is historic; however, it is not located within the literature search area for cultural resources. |
| 16 | Wind River Exp. Forest, Pinchot NF, WA | *Very close to the Pacific Crest NST* – The Pacific Crest NST is sufficient distance from the project location that it does not warrant detailed evaluation in the EA.<br><br>*Somewhat close to the Lewis & Clark NHT* – The Lewis and Clark NHT sufficient distance from the project location that it does not warrant detailed evaluation in the EA.<br><br>*Oregon NHT in the water-route section of the trails on the Columbia River south of the project area* – The Oregon NHT is sufficient distance from the project location that it does not warrant detailed evaluation in the EA. |
| 17 | Sierra NF, CA | *15-20 miles west of the Pacific Crest NST* – The Pacific Crest NST is sufficient distance from the project location that it does not warrant detailed evaluation in the EA. |

3. **Proximity to Wild and Scenic Rivers and Rivers Designated on the National River Inventory:** Wild and Scenic Rivers have been added as a resource category. No proposed NEON site is near enough to a designated or proposed Wild and Scenic River for there to be impacts from the installation and operation of NEON. This resource category is briefly discussed in Section 3.2.1.4.

4. **Historic Preservation Compliance:** NPS Stated: *We found a "caveat" statement about the need to conduct site-specific surveys and Section 106 compliance appropriately occurs in the five Domain sections spot-checked—2, 7, 10, 12, 13 (pages 3-41 lines 29-31; 3-71 lines 4-6; 3-238 lines 7-10; 3-324 lines 10-13; 3-390 lines 17-20; and 3-427 lines 20-23). This statement clearly lets the reader know that additional information is needed before making final construction decisions for NEON facilities. Unfortunately, text preceding the "caveat" statement was not changed, so the "caveat" stands in direct contradiction of the preceding, very clear-cut and unambiguous statements that "the literature review...did not identify any significant known historic properties" and "based on the...archival analysis, no significant impacts to any known significant cultural resources would be expected." In this context, the reader could wonder why, if there are no historic properties and no significant impact, is it necessary to conduct site-specific survey and analysis.*

   The statement for the first domain listed above (page 3-41 lines 29-31) reads: “Based on the results of the archival analysis, no significant impacts to any known significant cultural resources would be expected for NEON facilities in Domain 1. Prior to construction, NEON, Inc. would complete Section 106 coordination and analysis with regard to the site-specific footprints proposed for Domain 1. NEON, Inc. would use micrositing, as necessary, to avoid impacts to historic properties."

NSF believes this particular statement (and considered in conjunction with the overview to the analysis presented in Section 3.3.1.4) is clearly worded and factually correct in describing results based on archival analysis. NSF also believes the methodology is entirely compatible with Section 106. Further, the statement clearly communicates three points: (1) while both actual archival research and predictive elements were used to produce results, further analysis may be required to complete the Section 106 process, (2) NSF is committed to avoiding impacts to historic properties using micrositing, and (3) NSF would complete its Section 106 obligations with regard to micrositing the facilities.

NPS Stated: *We recommend revising these two statements, wherever they occur throughout the document, so they more accurately reflect the conditional nature of the conclusions drawn on partial information (archival only), as follows:*

*--"The literature review of the proposed NEON locations in Domain XX suggests that there may be no adverse effects on historic properties within or adjacent to areas where NEON infrastructure would be placed." Use this text in place of sentences on page 3-41 lines 18-20; page 3-324 lines 2-4; page 3-390 lines 9-11; and in other Domain sections where the "Environmental Consequences" text begins with this sentence structure (not all of them do).*

In many cases, the literature search indicated only that no studies or limited studies have been conducted within the proposed NEON locations. Although there are no significant resources currently known within the proposed NEON locations, these locations have not been completely studied or subject to the Section 106 process. As such, there is no basis to make the above statements, as there is not enough information regarding the possibility of significant cultural resources within any of the proposed areas.

*---"Based on the results of archival analysis, there may be no adverse effects on historic properties from installation of NEON facilities in Domain XX." This revised sentence should replace the sentence immediately preceding the "caveat" language on page 3-41 lines 27-28; page 3-238 lines 5-7; page 3-324 lines 9-10; page 3-390 lines 16-17; page 3-427 lines 18-20; and in other Domain sections where the last paragraph of the "Environmental Consequences" text begins with this sentence structure (not all of them do).*

This statement appears to agree with the current statement in the document, which reads: "Based on the results of the archival analysis, no significant impacts to any known significant cultural resources would be expected for NEON facilities in Domain 1." Replacing one statement with the other does not appear to change the intent.

NPS Stated: *In addition, in the Section 3.3.14 discussion of the method for assessing impacts on cultural resources, the sentence on page 3-14 lines 9-12 should be similarly revised. The following is recommended: "The collected body of knowledge presented in this EA provides sufficient information to suggest that NEON features identified to date may not have adverse effects on cultural resources reported from the literature and related other archival data reviewed for this EA. Additional site-specific information, however, will be needed to make final determinations of effect, as discussed below." The following paragraphs describe the phased approach to Section 106 compliance in accord with 36 CFR 800.4.*

This statement also appears to agree with the original statement, which reads: "The collected body of knowledge presented in this EA provides sufficient information to determine that there are no NEON features identified to date that will have a significant impact on known cultural resources reported from the literature and related other archival data reviewed for this EA." Replacing one statement for the other does not appear to change the intent. The statement that "additional site-specific information…will be needed…" may not be accurate. The methodology used by NSF to determine effect to historic properties would reflect all reasonable and appropriate methods, whatever they may be (36CFR800.4(b)(1)).

NPS Stated: *The Executive Summary paragraph on cultural resources (page ES-14 lines 11-18) should also be revised for consistency with the above revisions; line 13 should read -- "...determined that NEON would most likely have no adverse effect on cultural resources." Note the use of terminology consistent with Section 106 and 36 CFR 800 instead of NEPA and CEQ regulations.*

To account for consistent terminology, the statement has been reworded as "according to the archival research, there are no NEON features that will have a significant impact on known cultural resources"; however, this represents only the currently known body of knowledge. Without the additional information which would be obtained during the Section 106 process, the statement that "NEON would most likely have no adverse effect on cultural resources" would be premature. The statement that "additional site-specific information…will be needed…" may not be accurate. The methodology used by NSF to determine effect to historic properties would reflect all reasonable and appropriate methods, whatever they may be (36CFR800.4(b)(1)).

NPS Stated: *Further, the last sentence of this paragraph (page ES-14 lines 16-18) is not entirely correct -- the SHPO has no authority to "require" a federal agency to mitigate adverse effects, and minimizing the intensity of impact through mitigation is a NEPA concept, not used in Section 106 compliance process. The last part of this sentence should be revised, as follows -- "...avoid impacts to significant cultural resources, mitigation of impacts, as determined in consultation with the SHPO and others, would be implemented."*

NSF and NEON Inc. agree with the proposed revision and the text has been modified accordingly.

NPS Stated: *Finally, it is important to mention in the relevant Domain sections the presence of the Appalachian National Scenic Trail, which is eligible for listing on the National Register. In addition to the existing discussion in Domain 2, it may need to be mentioned in Domains 1 and 7 depending on the proximity of the Trail to the NEON site locations.*

There is no potential conflict with the NEON Project and the AT in Domains 1 and 7. The proposed location is a sufficient distance from the AT that revision of the document as suggested in the comment is not warranted.

**5. Review of Public Meeting and Review Comments**

NSF has provided all comments to Mr. Larry Gamble of RMNP.

**6. Level of detail of analysis**

Comment noted. Additional, site-specific review would be conducted during the permitting phase of the project as specified in the EA.

| National Park Service Comments - Specific |
|---|
| **Received from:**<br>National Park Service, 09-25-09 |
| **<u>COMMENTS LISTED BY PAGE REFERENCE</u>:**<br><br>7. **p. 1-6**—Add an additional Executive Order, no. 13195, *Trails for the 21st Century,* which states, "Federal agencies . . . will protect . . . trails of all types . . ."<br><br>8. **p. 2-3 to 2-4, lines 39-42 and 1-2**--The text states in two places "The NPS proposed an alternate location that would meet the scientific needs of the project and where environmental impacts would be acceptable." We should avoid implying that impacts are acceptable before completion of further environmental review in conjunction with the permitting process. Please change the text in these two places to read: "The NPS proposed an alternate location that would meet the scientific needs of the project and where environmental impacts would be less."<br><br>9. **p. 2-14—**2.2.2 Project Design Features to Minimize or Avoid Impacts<br>Best Management Practices are needed to minimize visual impacts. For example choosing non-reflective materials or using paint so that infrastructure is less visible.<br><br>10. **Page 2-14, Line 5—**We do not see any reference to measures to reduce the introduction of exotic seed from movement of equipment from site to site. We would require equipment washing between sites to remove seed or insects. Also, we suggest some discussion of Best Management Practices that will protect archeological resources (i.e., minimize ground disturbance).<br><br>11. **Page 2-14, Line 26, also Page 2-15, Line 5—**Great Smoky Mountains National Park does not permit the use of straw as it has found that the weed free straw has not been reliable. We recommend stabilization with other natural fiber stabilizing mats and can provide specific specifications for that material.<br><br>12. **p. 2-51, Lines 7-10**—Please add the underlined text in the following sentence: Locations proposed for Relocatable Sites in Domain 10 include the Sterling Relocatable Site (R-19, Figure 2.D10-2), just west of the Kelly Community Center in the southeast corner of Logan County, <u>Colorado</u>, and the Tahosa Valley Site (R-20, Figure 2.D10-3) <u>in southwest Larimer County,</u> Colorado, at an elevation of approximately 2,750 m.<br><br>13. **p. 2-51, Line 33—**Please edit to read: R-20 would be in an open meadow in Tahosa Valley…<br><br>14. **p. 2-51, Line 36**—Please edit to read: …and the Twin Sisters Trailhead)…<br><br>15. **p. 2-51, Line 41**—Please edit to read: … would be approximately 18 m in height…<br><br>16. **p. 2-52, Lines 11-12**—Please edit to read: … that flows eastward before joining the Big Thompson River, which flows into the South Platte |

River in Domain 10.

17. p. 2-52, Lines 18-19—Please edit to read: …and co-located within the Sprague Lake Road shoulder. Service would be extend for approximately 497 m to the Aquatic Array and would be located within previously disturbed areas to the maximum extent possible.

18. p. 2-56, line 10—Public electric and telephone lines are near the site.

19. p. 2-56, line 11—Describe that only one tower, the advanced tower, would be constructed at the Domain 12 core site. Remove references to the two basic towers. Please update the document accordingly throughout the description and analysis of Domain 12.

20. p. 2-56, line 12—Add a statement that the AP building would be constructed so as not to be visible from the Blacktail Plateau Road.

21. p. 2-56 line 29—No boardwalks will be constructed for Ecological Domain 12 within Yellowstone National Park. Please update document throughout to delete references to constructing boardwalks in Yellowstone National Park.

22. p. 3-17, lines 1-8--We recommend rewriting this text under Aesthetics and Visual Resources to read:

    ...Federal agencies are responsible for ensuring that the visual and aesthetic values of public lands are considered before allowing uses that may have negative impacts (BLM, 2009; NPS, 2006). In addition, recognizing that activities proposed for adjacent lands may significantly affect park programs, resources, and values, NPS policies require park managers to work with managers of areas beyond park boundaries to seek solutions that protect park resources and values (specifically including scenic views, soundscapes, and lightscapes), provide for visitor enjoyment, and address mutual interests in maintaining the quality of life in the community, among traditionally associated peoples, and other interested groups. NPS views such cooperative conservation as essential to fostering decisions that are sustainable. Representatives from the NPS and BLM worked with NEON in siting or mitigating project facilities (for example, painting towers specified colors) in such a way as to minimize negative impact on aesthetic or visual resources at any of the NPS or BLM locations, and on adjacent NPS lands.

    Add the NPS citation above to the References in 3.3.22 as follows:

    National Park Service. 2006. Management Policies, 1.6 Cooperative Conservation Beyond Park Boundaries, 1.7 Civic Engagement, 4 Natural Resource Management Introduction, 4.1.4 Partnerships, 4.7 Air Resource Management, 4.9 Soundscape Management, 4.10 Lightscape Management, 4.11 Chemical Information and Odors, 5 Cultural Resource Management Introduction, 5.2.1 Consultation, 5.3.1.7 Cultural Soundscape Management, 5.3.5.2 Cultural Landscapes, 5.3.5.2.6 Land Use and Ethnographic Value. http://www.nps.gov/policy/MP2006.pdf and http://www.nps.gov/policy/mp/policies.html. Accessed 16 September 2009.

    Note that in the new wording, the BLM reference previously cited as 2007 is changed to 2009 as the document on visual resource management cited in References is 2009.

23. p. 3-17, line 8--Change "of" to "or" so that the phrase reads: "...at any of the NPS or BLM locations..."

24. p. 3-18, line 11--Insert reference to NPS Management Policies as noted in comment for p. 3-17, lines 1-8.

25. p. 3-73, line 38--Change SERC to SCRC. The AT goes through Shenandoah NP and is near SCRC. Change "Appalachian Trail" to "Appalachian National Scenic Trail."

26. p. 3-73, line 40—Change SCRC to SERC.

27. p. 3-74, lines 5, 6, 8--Change SERC to SCRC. The AT goes through Shenandoah NP and is near SCRC.

28. Page 3-219, Line 30—We are not sure of the rationale for this paragraph in the context of topic heading “Resource Areas Considered but Not Addressed for Domain 7.” We understand the potential to disclose the past land use but certainly Oak Ridge National Laboratory sites are just as suspect with regard to past land use practices as Great Smoky Mountains National Park. But the issue discussed in this paragraph is not a “resource area not addressed” as it is indeed the site being evaluated.

29. Page 3-219, Line 35 and 39—The correct spelling is Hemlock Woolly Adelgid.

30. Page 3-219 Line 37—Correct spelling is Imidacloprid.

31. Page 3-228, Line 16—In the discussion of the environmental consequences associated with floodplains, there is no information relative to whether a Statement of Finding for Protection of Floodplains (Executive Order 11988) is needed in association with the installation of the Aquatic Array or STREON sites. It seems to focus on the factors of the floodplain impacting the equipment but not the installation of the equipment impacting the floodplain. An estimate of the area of the floodplain that will be developed for this work is needed.

32. Page 3-229, Line 5—The description of the forest type is more characteristic of the ridge than the actual Relocatable Site. The area could be more accurately described as a cove hardwood system, dominated by red maple, tulip poplar, and oak. Table Mountain, pitch and white pine are more characteristic of the higher elevations on the ridge.

33. Page 3-229, Line 17—woolly, not wooly

34. Page 3-229, Line 19—Great Smoky Mountains National Park would also like protections afforded to dogwood as that population has displayed some resistance to dogwood anthracnose and thus the population in that area may be important in future efforts to protect the species park-wide.

35. Page 3-229, Line 15 and Page 3-232, Line 1—In these sections, we would prefer some reference to the fact that rare plant survey work will be done in the project area prior to excavation and devegetation. We have done some survey work but not a detailed evaluation of the actual “to be disturbed” area. Same is true for some animal species.

36. Page 3-237, Line 5—This paragraph misrepresents the information and implies only one of the 11 resources is eligible. All 11 are potentially eligible for nomination. Since no real surveys have been done in the proposed area this table does not represent the issue well.

37. Page 3-237, Line 21—There should be reference to the fact that archeological sampling and monitoring will occur as part of the installation of

the facilities. Consultation not just coordination is required with the SHPO.

38. Page 3-238, Line 29—Archeological surveys along any trenched lines may be required and should be included beyond the Best Management Practice discussion.

39. Page 3-240, Line 3—There are many reasons for visitors to pull into the Twin Creeks area and they do. It should be noted that the sites are remote enough from the Science Center therefore not likely to be detected by the common passerby.

40. Page 3-240, Line 19—Great Smoky Mountains National Park would appreciate consideration of timing of NEON construction outside peak use of the Cherokee Orchard/Roaring Fork Motor Nature Trail. Peak use is usually summer (July) and fall (mid October to mid November, fall color viewing).

41. p. 3-307, Line24—Please edit to read: R-20 would be in an open meadow in Tahosa Valley…

42. p. 3-307, Line 27—Please edit to read: …and the Twin Sisters Trailhead).

43. p. 3-307, Line 30—Please edit to read: …from the Rocky Mountains and joins the Big Thompson River…

44. p. 3-314, Lines 2-3—We do not agree with the statement that "There would be no potential for direct impacts to water quality during construction of NEON infrastructure." The aquatic array will be placed in Glacier Creek, and calibration will be done using propane and/or other chemicals. There is the potential for direct impacts to water quality.

45. p. 3-317, Lines 5-10—There is no mention of vegetation loss due to installation of boardwalks. Is the vegetation under the boardwalks expected to remain unchanged?

46. p. 3-327, Line 32—Please edit to read: …within the main part of RMNP and from surrounding private properties which are occupied by single family residences, camps and lodges.

47. p. 3-371, line 6—…on the Wyoming and Montana border (add within Yellowstone National Park) and encompasses…

48. p. 3-373, line 29—It is unlikely that soil disturbance would be limited to 1,079 square feet at each site. The tower slab foundations, building footprints, trails or boardwalks, and utilities described have impacts to soils that vastly exceed the 0.01 ha described.

49. p. 3-383, line 30—Describe any reasonably foreseeable mortality associated with small mammal trapping.

50. p. 3-383, line 40—Describe the frequency and duration of overflights planned for a given year, and the seasons in which they are likely to occur.

51. p. 3-385, line 7—Add a statement that a wolf den was located within one-mile of the site during the winter of 2008-2009.

52. p. 3-385, line 14—A federal judge recently restored protections for the grizzly bears in and around Yellowstone National Park.

53. p. 3-391, line 4—Discuss Nordic skiing as a wintertime use on the Blacktail Plateau Road and the Frog Rock Pit road. These roads are groomed regularly for this use during the winter months, and many visitors and local residents use them.

54. p. 3-391, line 23—impact on recreation would be negligible. (likely the impact would be higher – minimal to moderate)

55. p. 3-395, line 34-35—Change the statement, by deleting “not an important park vista, but the towers would be,” to: The area where the Core Site towers would be located is visible…

56. p. 3-396, line 6—…some short stretches of Blacktail Plateau Drive (add: and the Grand Loop Road) the tops of towers would be visible.

57. p. 3-442, line 10--This paragraph on Aesthetics and Visual Resources, should have a bullet, as it is part of the list above.

58. p. 4-7, line 32 – Please replace “impairment of” with “adverse impacts on”.

59. p. 5-6, line 5--Delete "and" before "Research" and add "and" after Research so that the title of the permit reads "NPS Scientific Research and Collecting Permit."

60. p. 5-8, lines 23-25--Delete the entire section entitled "Aquatic Research Permit." Aquatic research is permitted under the NPS Scientific Research and Collecting Permit and is already covered in the previous paragraph.

61. **p. 5-8, lines 1-6**--Delete the entire section entitled "Resource Activity Permit." Infrastructure will be covered under the NPS Scientific Research and Collecting Permit. It is addressed at lines 17-22.

62. **p. 7-1, line 13**--Add "AT Appalachian National Scenic Trail"

**Response:** Text was changed as requested except for the following comments:

11. NPS Stated: *Page 2-14, Line 26, also Page 2-15, Line 5—Great Smoky Mountains National Park does not permit the use of straw as it has found that the weed free straw has not been reliable. We recommend stabilization with other natural fiber stabilizing mats and can provide specific specifications for that material.*

    NEON would only re-vegetate with locally approved materials and seed selection. Unapproved straw would not be used for stabilization. NEON would work with the local authorities to determine BMPs for the Great Smoky Mountains site.

19. NPS Stated: *Page 2-56, line 11—Describe that only one tower, the advanced tower, would be constructed at the Domain 12 core site. Remove references to the two basic towers. Please update the document accordingly throughout the description and analysis of Domain 12.*

Although only one tower is currently planned for construction, the additional towers may be constructed if additional funds become available. Construction of any additional towers would go through the same rigorous permitting and approval process with the site owner in any case. Therefore, the analysis of all three towers remains as written in the EA.

21. NPS Stated: *Page 2-56 line 29—No boardwalks will be constructed for Ecological Domain 12 within Yellowstone National Park. Please update document throughout to delete references to constructing boardwalks in Yellowstone National Park.*

    NEON would avoid the use of boardwalks in the Yellowstone National Park. In general, NEON would only utilize boardwalks for the protection of the environment or for safety of personnel. NEON would work with the local authorities and in accordance with permitting requirements where boardwalks may be deemed necessary.

28. NPS Stated: *Page 3-219, Line 30—We are not sure of the rationale for this paragraph in the context of topic heading "Resource Areas Considered but Not Addressed for Domain 7." We understand the potential to disclose the past land use but certainly Oak Ridge National Laboratory sites are just as suspect with regard to past land use practices as Great Smoky Mountains National Park. But the issue discussed in this paragraph is not a "resource area not addressed" as it is indeed the site being evaluated.*

    The paragraph was bulleted. A lead-in phrase "Hazardous Materials – application of pesticides and fungicides" was added to clarify the portion of the hazardous materials resource area that is not being carried forward in the analysis. The second to last sentence in the paragraph was re-worded to better explain why the resource area is not being considered further. It now states "Chemicals (such as Imidachloprid) are applied directly to the trees or the soil immediately around trees and would neither affect nor be affected by proposed NEON studies."

31. NPS Stated: *Page 3-228, Line 16—In the discussion of the environmental consequences associated with floodplains, there is no information relative to whether a Statement of Finding for Protection of Floodplains (Executive Order 11988) is needed in association with the installation of the Aquatic Array or STREON sites. It seems to focus on the factors of the floodplain impacting the equipment but not the installation of the equipment impacting the floodplain. An estimate of the area of the floodplain that will be developed for this work is needed.*

    The EA contains the following text regarding impacts to floodplains: "NEON infrastructure placed in the floodplain would include sensors and dataloggers associated with the Aquatic Array. This equipment would result in a negligible amount of material added to the floodplain. Placement of NEON infrastructure would not result in increases in flood elevations, flood conveyance, or flood storage at any of the proposed locations. No indirect or cumulative impacts to flood prone areas would be expected."

    The installation of sensor and dataloggers would not change flood elevations. Support equipment and material would be located outside of the floodplain during operation.

34. NPS Stated: *Page 3-229, Line 19—Great Smoky Mountains National Park would also like protections afforded to dogwood as that population has displayed some resistance to dogwood anthracnose and thus the population in that area may be important in future efforts to protect the species park-wide.*

The following text was added: "The population of dogwoods in GSMNP has displayed some resistance to dogwood anthracnose. This population near the site may be important in future efforts to protect the species park-wide. Utility routes and locations would be adjusted slightly when feasible, to avoid impacts to this species."

35. NPS Stated: *Page 3-229, Line 15 and Page 3-232, Line 1—In these sections, we would prefer some reference to the fact that rare plant survey work will be done in the project area prior to excavation and devegetation. We have done some survey work but not a detailed evaluation of the actual "to be disturbed" area. Same is true for some animal species.*

Where rare plants are known or suspected to exist, NEON would conduct a rare plant survey in the vicinity of the proposed site construction and disturbance locations to ensure that the project does not impact rare plants.

Text in the environmental consequences portion of the sensitive species section was re-worded to read: "In some situations, a sensitive species or its required habitat is known to occur at a site or surveys for such species may be incomplete in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted. In such situations, NEON, Inc. would conduct surveys in advance of any ground disturbance."

36. NPS Stated: *Page 3-237, Line 5—This paragraph misrepresents the information and implies only one of the 11 resources is eligible. All 11 are potentially eligible for nomination. Since no real surveys have been done in the proposed area this table does not represent the issue well.*

The current document reads, "The study areas for the proposed NEON locations within GSMNP overlap due to the proximity of R-14 and A-17. A total of 11 resources are located within the combined study area of R-14 and A-17, as the same 11 resources were identified for each location. Of these 11 resources, only 1 has been evaluated for the NRHP." This text was reworded to read, "<u>The study areas for the proposed NEON locations within GSMNP overlap due to the proximity of R-14 and A-17. A total of 11 resources are located within the combined study area of R-14 and A-17, as the same 11 resources were identified for each location. Of these 11 resources, only 1 has been evaluated for the NRHP. The remaining ten resources have not yet been evaluated for inclusion on the NRHP.</u>" Without evaluating these resources, it is not known whether these resources are eligible.

37. NPS Stated: *Page 3-237, Line 21—There should be reference to the fact that archeological sampling and monitoring will occur as part of the installation of the facilities. Consultation not just coordination is required with the SHPO.*

Currently the document reads: "A total of 11 cultural resources have been documented outside the area of disturbance, but within the 1.6-km study areas, of R-14 and A-17. One of these sites is listed on the NRHP; however, this site is well outside of the area of potential impact. There are several cultural resources that contribute to GSMNP in the area near the proposed Relocatable Tower, including the historical apple orchard area. However, none of the known historic properties are at the proposed Relocatable Tower location and none are visible from this location. Coordination with the SHPO would be required in advance of construction to ensure that these resources are properly protected."

The last statement was changed to read, "<u>Coordination and consultation with the SHPO would be required in advance of construction to ensure that these resources are properly protected</u>."

38. NPS Stated: *Page 3-238, Line 29—Archeological surveys along any trenched lines may be required and should be included beyond the Best*

*Management Practice discussion.*

The following sentences were added to the Best Management Practice discussion. "Trenching to place buried lines would be completed with a standard walk-behind trencher to minimize impacts. These areas will be included as part of the area of potential effect for cultural resources analysis. If the area has been determined to be sensitive for archaeological resources, a cultural resources monitor will be present during trenching."

40. NPS Stated: *Page 3-240, Line 19—Great Smoky Mountains National Park would appreciate consideration of timing of NEON construction outside peak use of the Cherokee Orchard/Roaring Fork Motor Nature Trail. Peak use is usually summer (July) and fall (mid October to mid November, fall color viewing)*.

The construction of the NEON project would include local considerations, including avoidance of construction activities during peak use periods at the park sites.

44. NPS Stated: *Page 3-314, Lines 2-3—We do not agree with the statement that "There would be no potential for direct impacts to water quality during construction of NEON infrastructure." The aquatic array will be placed in Glacier Creek, and calibration will be done using propane and/or other chemicals. There is the potential for direct impacts to water quality.*

NSF does not anticipate that the calibration of instruments (including bubbling of gases) would cause impacts to water quality. Gas used in the calibration process would volatilize into the air. The technique of bubbling propane in streams in similar studies is a standard technique and well documented. Two examples from the available literature documenting this technique are provided below. Calibration of instruments would follow standard practices and no impacts would be anticipated.

1. Mulholland, Marzolf, Webster, Hart and Hendricks, 1997. "Evidence that hyporheic zones increase heterotrophic metabolism and phosphorus uptake in forest streams." Limnol. Oceanogr.:, 42(3), 1997, 443-45 I.
2. Stroud Water Research Center, 2008. "Water Quality Monitoring in the Source Water Areas for New York City: An Integrative Watershed Approach - A Final Report on Monitoring Activities, 2000-2005." Stroud Water Research Center, Contribution No. 2008006, Avondale, PA.

45. NPS Stated: *Page 3-317, Lines 5-10—There is no mention of vegetation loss due to installation of boardwalks. Is the vegetation under the boardwalks expected to remain unchanged?*

The boardwalks would be narrow (1.52 m) and would likely have minor impacts on the ability of small forbs and grasses to grow.

48. NPS Stated: *Page 3-373, line 29—It is unlikely that soil disturbance would be limited to 1,079 square feet at each site. The tower slab foundations, building footprints, trails or boardwalks, and utilities described have impacts to soils that vastly exceed the 0.01 ha described.*

The NEON project would have a minimum footprint that includes the tower, the instrument hut, access trails, supporting infrastructure, and soil array as described in the EA. The area of potential soil impact was updated in the text for each location to reflect the correct area of impact that would occur from towers, huts, and installation of utility lines. NEON would take appropriate steps to ensure that unplanned expansion of the project footprint does not occur.

49. NPS Stated: *Page 3-383, line 30—Describe any reasonably foreseeable mortality associated with small mammal trapping.*

    It is difficult to predict incidental capture and mortality. A small mammal trapping plan would be developed for each location where trapping would occur and would include information on the traps to be used and the steps that would be taken to limit mortality. The plan would be submitted for approval to the appropriate university ethics boards prior to implementation. Coordination would also occur with the appropriate land management agencies and state and federal agencies prior to implementation.

50. NPS Stated: *Page. 3-383, line 40—Describe the frequency and duration of overflights planned for a given year, and the seasons in which they are likely to occur.*

    The Airborne Observation Platform and its planned frequency are described in Section 2.2.1.6. One flight per year would occur during the growing season (typically April through October).

| **Dr. Skip van Bloem** |
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| **Received from:**<br>Skip van Bloem, 10/05/09 |
| **Comment:**<br><br>Resource Areas Considered but Not Addressed for Catholic University (R-08)<br>18 Floodplains: This NEON site is within a highly developed, urbanized area. There are no known floodplains within or near the proposed site.<br><br>**This is completely false. The entire Ponce Playa neighborhood, within which the NEON urban site is located, was developed in an old mangrove forest >100 years ago. It's only a few m above sea level and it floods with severe rainstorm, usually associated with hurricanes, but not necessarily. It isn't a river floodplain, but it is a coastal floodplain. This is noted in your soil analysis that follows on Page 3-128.**<br><br>19 Sensitive Ecological Communities: The proposed NEON site would be located in a<br>20 woodlot within an urban area which is highly developed. There are no ecologically<br>21 sensitive communities within the vicinity of this site.<br>22 Sensitive Species: The proposed NEON site would be placed within an urban<br>23 Catholic University campus, which is highly developed. There are no known<br>24 occurrences of protected or sensitive species at or adjacent to the proposed location.<br>25 Environmental Justice: The proposed NEON site would be located on private land<br>26 owned by the University. The site would have restricted access by means of fences or<br>27 gates. All potential impacts would be confined to lands that would not pose a |

28 potential to disproportionately impact minority or low-income populations.

**In fact, the community currently uses part of this land a baseball field and to graze/tie up horses. The NEON instruments would be in the forest adjacent to the ball field. The area is not currently fenced and I suspect that fencing the entire woodlot, though feasible, would be very bad public relations. The local community is poor, and they have a history of being ignored and taken advantage of, and they are very sensitive to new transgressions (ask the engineering team about how quickly we were approached when we toured the site). However, presence of the NEON facility in Ponce, specifically in this neighborhood, has the potential to help the community better understand the environmental and atmospheric (i.e. pollution) stresses that they face. So we are very excited about this location as a place where we can engage and inspire the local community. The tower facility will need to be fenced to minimize vandalism, and we'll have to make it flood resistant, but it is a super place for NEON work.**

Geology/Seismicity - Affected Environment

35 A karst landscape forms in Puerto Rico when the limestone bedrock dissolves
36 underneath the surface of the Earth. Karst is present across approximately 27 percent of
37 Puerto Rico (Miller, 2004) and all proposed sites associated with Domain 4 are likely
38 underlain with karst topography (USFWS, date unknown). Karst landscapes host the
39 largest aquifers on Puerto Rico (Miller, 2004)

**The Rio Cupeyes is not underlain by karst and while it drains a relatively undisturbed watershed that is primarily composed of the Maricao Commonwealth Forest, it is not pristine in terms of "untouched". 97% of PR was deforested by 1950 for agricultural production, including much of the Cupeyes watershed. Lasting evidence of prior land use includes high concentrations of mango and bamboo in the area and along the river. LAES and Ponce are on alluvial sites.**

Page 3-129, line 4. There are NO natural wildfires in Puerto Rico. We do not have dry lightning as is found in much of the continental US. There are multiple literature sources which discuss this, but in general, tropical dry forests do not have natural wild fires associated with them. Savannas and open woodlands do because of grass understory, but dry forests do not have a grass understory.

Page 3-135. See comment on floodplains, above. Trees at the Ponce site are obligate (mangrove) or facultative wetland species. The Rio Cupeyes (line 33) is moist forest and the vegetation is typical of moist forest, including mango, bamboo, rose apple, and native species such as Guarea guidonia, royal palm, and Cecropia. The vegetation in the urban site is typical of shoreward mangrove forests, with non-native species introduced.

**Response:**

Floodplains: The evaluation of Floodplains has been moved to resource areas addressed. The text has been revised to reflect potential for flooding from storm surge and potential impacts assessed.

Environmental Justice: The evaluation of Environmental Justice has been moved to resource areas addressed. Text was revised to reflect recreational and livestock use of general area by local residents and potential impacts assessed. The only items that would be fenced would be the tower and its associated support buildings.

Geology/Seismicity: Text has been revised to indicate only the Core Site would be underlain by karst.

The term "Pristine" has been removed from description of Rio Cupeyes watershed and incidence of exotic species was added.

Lightning-caused fires were removed from the discussion and vegetation descriptions were revised as recommended.

| Pi'i Laeha |
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| **Received from:**<br>Pi'i Laeha, 9/28/09 |
| **Comment: RE Domain 20**<br>Your EA draft was lacking in many aspects. It appeared that the report was made up of other reports and parts used suited your needs. Many more questions:<br>- where is the community? the community that actually live in the area, the people that for generations were the stewards of the land. They seem to be absent in your study???<br>- what is your actual process of your study? what is measured? what does your tower and other machines do? does sounds come out? how much??<br>- electricity !! where is it coming from? Power lines must pass through miles of agriculture lands and enter into a forest reserve. Development usually follows electricity, development means higher taxes. What's your exit plan for this??? Alternative energy??<br>- invasive species....humans are the worst....25 people a day is obscene and destructive.<br>- endangered species...Hawaii has the highest count and you would be added stress to their environment. What is your "non-significant" threshold??...one dead animal, two crushed plants....???<br>- culture....little archaeological artifacts were found because Hawaiians considered the forest area as 'wao akua', the domain of the gods. People did not live with the gods. Hawaiians had 400,00 [sic] gods were manifest as parts of nature. The forest itself is the archaeological artifact. A 2 day walk in the forest is not a valid quest to represent of Hawaiian culture.<br><br>Yes I do have many more puzzling thoughts. A more comprehensive study is needed. Do your homework. You should not send a spokesperson for your project a couple of months ago, you should of sent him from the beginning. |
| **Response:**<br>In an effort to make the NEON EA as comprehensive as possible, NSF used a variety of sources to develop the EA. With respect to Domain 20 (Hawaii), local consultants who understand the community and culture were hired to collect data to support the NEON EA on Cultural Resources and Biological Resources. As part of NSF's public involvement process to obtain public input on the NEON EA, nearly 100 groups and organizations in Hawaii were notified about the public meetings and the availability of the NEON EA. Press releases were also prepared for local newspapers in an effort to notify residents. |

Section 2.2 of the EA describes the components of the NEON Project, including detail on the monitors and sensors that would be used, the location and physical characteristics of the monitors and sensors, and the data that would be collected. Impacts resulting from the Project are described in Section 3.0. Impacts related to noise are specifically addressed in Section 3.5.20.3 of the NEON EA. During the 6-month construction period, noise from workers and equipment operation may be noticeable to nearby recreational users. Elevated noise levels would be short in duration and overall construction noise would be a minor nuisance. During the operational phase of the Project, noise impacts would be limited to vehicle traffic traveling to and from the sites and scientists and technicians who would collect data on the site. Noise impacts would be intermittent and minor during operation.

Section 2.2.3.20 of the NEON EA describes each component of the NEON Project proposed for Domain 20, including the plan to supply electricity to the Project. Generally, electricity would be supplied to the NEON Project through either buried lines or above-ground surface conduits. Solar power would be utilized to supply power to the weather stations proposed at the Relocatable Sites. Solar power and other renewable sources were evaluated, but were determined not to be suitable for the power requirements at this preliminary stage of the project design. Further evaluation would occur as the design is finalized. Section 2.2.4 of the EA provides further detail regarding project closure. Infrastructure associated with the Project, including surface and buried conduits for electricity, would be removed and resulting trenches would be stabilized. It is not anticipated that any further development would result from the infrastructure installed as part of the NEON Project.

Concern regarding ecological impacts is fully recognized and shared by NSF and NEON Inc. The fundamental design of the NEON Project depends on the ability to prevent significant disturbance to existing ecological conditions in the selected project locations. Efforts would be made to avoid and minimize disturbance on the existing environment. In situations where impacts cannot be avoided, mitigation measures would be implemented as appropriate.

The potential for impacts to Endangered Species in Domain 20 is presented in Section 3.5.20.3 of the NEON EA. As stated above, NSF and NEON are committed to minimizing impacts on ecological receptors, including Threatened and Endangered Species and designated critical habitat during construction and operation of the NEON Project. Critical habitat for federally protected species occurs at both the Laupāhoehoe Experimental Tropical Forest (LETF) and the Pu'u Wa'awa'a Experimental Tropical Forest (PWETF). Prior to any habitat disturbance or construction in designated critical habitat, consultation with USFWS would occur to request authorization for modification or alteration of designated critical habitat. Appropriate mitigation actions would be implemented, as specified through the consultation process, prior to or concurrent with construction, including avoiding disturbance to host trees and roost sites and to otherwise minimize disturbance within designated critical habitat. Coordination would also be carried out with DLNR-DOFAW and property site managers.

In situations where a sensitive species or its required habitat is known to occur in the vicinity of proposed NEON infrastructure and the available data lack the specificity to determine whether the species or its required habitat is near enough to the site to be impacted, NEON, Inc. would conduct surveys in advance of any ground disturbance. These sensitive species surveys would follow accepted protocols for each species that may occur near that site. If surveys indicate that an impact is likely, NEON, Inc. would relocate the facility a short distance to avoid impacts to the species or its required habitat. For additional detail on individual species, please refer to Section 3.5.20.3 of the NEON EA.

The potential for impact on Cultural Resources in the NEON Project area is also evaluated in Section 3.5.20.3 of the EA under the heading "Cultural Resources." A local firm that understands the traditions and cultural resources of the Native Hawaii people was hired to collect and interpret information on cultural resources within Domain 20. Based on the results of the archival analysis, no significant impacts to any known historic properties would be expected for NEON facilities in Domain 20.

NSF appreciates the comments provided. Through the combined processes of direct mailing and e-mailing public notices, publishing press releases, and conducting two web accessible public meetings, NSF has made a significant effort to provide individuals and organizations in each domain an opportunity to participate and provide comments on the NEON EA. NSF and NEON Inc. would continue to interface with stakeholders in the individual domains and make information available as planning and design of the Project move forward.

| James H. Braun |
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| **Received from:**<br>James H. Braun, 9/28/08 |
| **Comment: RE Domain 20**<br>It is interesting that the first page of your EA shows pristine environments without any utility poles. Yet NEON would run utility poles to many of these sites including the pristine mountainside and forest of Laupahoehoe. In the same nation that has men and women orbiting the earth in a space station in an extreme environment that relies on generating it's own power for their survival, we also have a governmental organization that despite all the advances in technology and instrumentation won't give up the power umbilical cord. Under site selection page 4 of the EA, it states it will have a minimal impact. How does NEON justify running miles of power poles as minimal impact? NEON will burn more oil and coal to transmit power to these remote sites because of loss of power in transmission. Yet NEON claims it will have a small carbon footprint. What is wrong with NEON? And NEON wants to do this for thirty years !! NEON wants to place a tower in an area of an endangered species, the Hawaiian hoary bat. Yet the Forest Service rejected putting up a wind turbine in this same area to power it's new Forest Lab because of the possible ill effect on the species. Go somewhere else !! NEON couldn't even present itself to this community, to hold a public meeting, to discuss the EA. If NEON couldn't do that then how can this community expect them to be good neighbors. NEON is supposed to monitor climate change. As well used saying states, if your not part of the solution you are part of problem. You can do better. |
| **Response:**<br>There are no plans to install utility poles to supply power to the NEON Project within Domain 20. Underground conduit would be used to extend electric lines to meet NEON Project needs. There are no existing electric power or telecommunications utilities available in the LETF where the Core Site Tower is proposed and lines would have to be extended through the LETF to provide electric power and communications to the tower. Existing utilities near the proposed Relocatable Sites (R-39, R-40) within the Pu'u Wa'awa'a Experimental Tropical Forest (PWETF) are located down a dirt road approximately 5.2 km from the furthest proposed Relocatable Site.<br><br>NEON, Inc. would extend power and telecommunication lines from the existing grid terminus through concrete-encased conduit buried in the road to the proposed location of the Core Site Tower (C-58) as possible. A portal would be placed at the point where the road would no longer be used and electric power and telecommunications would be extended beneath a new boardwalk to C-58. The weather stations placed at the proposed Relocatable Sites would be solar powered and no utility lines would be extended to these sites. Erosion control BMPs, as discussed in Section 2.2.2, would be implemented to minimize the potential for environmental impacts. NEON, Inc. would coordinate with Hawai'i Electric Light Company regarding extension of utility lines to C-58. |

| **Tom and Debbie Ryan** |
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| **Received from:**<br>Tom and Debbie Ryan, 9/22/09 |
| **Comment:**<br>We have reviewed the NEON EA in relation to the Rocky Mountain National Park site on Highway 7. As a landowner in close proximity to this site, we *object* to this location since it would have a negative impact on our view, and it would affect the access road to our property. Also, Highway 7 is a scenic route, and this installation would affect the view of Long's Peak. |
| **Response:**<br>The text regarding the impacts from the tower proposed for the area (R-20) was revised to clarify its visual impacts. Text in the aesthetics and visual resources environmental consequences section was revised as follows:<br><br>The R-20 tower would be near other man-made infrastructure located along SH -7 in Tahosa Valley and would not greatly alter the visual quality of the general area. The tower would be visible to varying degrees from much of the surrounding area (Figure 3.D10-5). However, most homes in the area are approximately 60 to 75 m above the proposed tower location and would be above the top of the tower by approximately 40 to 55 m. When looking at the peaks that dominate the viewshed, Long's Peak to the west and Twin Sisters to the east, the tower would not extend into the view but would be part of the floor of the view, along with the nearby Salvation Army camp and conference center. There are trees around much of the proposed tower location that would provide visual screening to homes at lower elevations, and the exterior of the infrastructure would feature non-reflective materials and paint to further reduce visual impacts. There would be no night-time lighting at the tower and no change from the current night visual environment. Because the change in the viewshed would be minimal, any direct impacts to aesthetic and visual resources would be minor. |

| **Rocky Mountain National Park** |
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| **Received from:**<br>Larry Gamble, 9/19/09 |
| **Comment:**<br>In the EA page 2-51, line 41, the tower is listed as 42m in height. Per discussions with CH2M Hill and NEON, this should be around 18m (15 feet above canopy). |
| **Response:** Tower height was changed to the correct figure of 18 m, which was the height used in the analysis in Section 3. |

| **USDA-ARS** |
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| **Received from:**<br>Rebecca L. Phillips, 9/14/09 |
| **Comment**: RE Domain 9<br>I am the contact for the NEON relocatable Site 2 at the NGPRL. After reviewing the EA, I suggested a couple of minor issues NEON might want to consider. One, the gated entrance to the cattle enclosure could be changed from barbed wire to an easy-access metal gate. This would also provide for safer operation. Second, the dirt road (<100 meters) leading west to the gated entrance could be graveled to avoid problems driving on slick dirt roads in spring. |
| **Response:** NSF and NEON Inc., appreciate the suggestions. These issues would be resolved by NEON, Inc. during the final site design. Minor road improvements, such as addition of gravel to existing unpaved roads, are included in the analysis and this particular action is considered to have a negligible impact on resources. |

| **Dr. Doria R. Gordon** |
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| **Received from:**<br>Doria R. Gordon, 8/29/09 |
| **Comment: RE Domain 3**<br>A couple of small points: we have reintroduced the endangered red-cockaded woodpecker at Disney Wilderness Preserve and are closely monitoring population dynamics. Additionally, while the area of the tower isn't open to the public, the preserve is and the tower will be visible to visitors. This would be a great opportunity for some interpretation if NEON is interested. |
| **Response:** The red-cockaded woodpecker (RCW) introduction was added to the existing conditions of the DWP site. The impacts analysis states: At DWP, proposed NEON infrastructure and access routes to R-05 would not be placed in or adjacent to RCW nesting or foraging habitat. No impacts to the reintroduced RCW population on DWP would be expected.<br><br>Visual resources discussion was modified to reflect tower visibility. |

| **Jones Ecological Research Center** |
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| **Received from:**<br>Lindsay Boring, 8/27/09 |
| **Comment: RE Domain 3**<br>I have just three brief comments to pass along for better accuracy. They should not require major revisions.<br><br>1) Page 3-85 & 86. Section 3.5.3.2 Resource Areas Considered but not addressed for Domain 3:<br><br>Recreation: (It is not true that no recreational activities occur on these properties.) At the Jones Center the following would be the accurate |

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| statement:<br><br>At the Jones Center, private recreational activities include quail and deer hunting as well as fishing from the riverbanks, but these activities are not provided to the general public. The additional research will not be a problem fitting in with these activities.<br><br>2) Aesthetics (next page): (Aesthetics are important to private landownership as well as public facilities.) For the Jones Center the following would be the accurate statement:<br><br>Private landowners view the land base for aesthetic qualities, but at these research sites provision is made within reason to accommodate research facilities and activities. Impacts are minimized through a site use request system and planning.<br><br>3) Page 2-30, 31. In describing the FIU location and distances, errors that were found with the site visit last spring were not corrected. The distances described between the AP and IH and the boardwalk are excessive and are spread beyond the site and down a steep slope to the creek. I understand that we will soon review the construction design for our site and I will correct it there. However if you want this to be correct in the EA the distances should be reduced by about 150m. |
| **Response:** Recreation and Aesthetics text was modified as recommended.<br><br>The stated boardwalk lengths are retained in the analysis. Final site design could reduce the total length of the boardwalk, but analysis of a longer boardwalk is a more conservative approach to considering potential impacts. |

| **Patrick J. Mulholland** |
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| **Received from:**<br>Patrick J. Mulholland, 8/27/09 |
| **Comment:**<br>Just a minor comment, but in a couple of places in the EA where it describes the states making up Domain 7 it doesn't mention Tennessee. |
| **Response:** Eastern and central Tennessee were added to the description of Domain 7. |

| **Hawaii DOT** |
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| **Received from:**<br>Brennon T. Morioka, 9/28/09 |
| **Comment:**<br>Given the project's location, DOT does not anticipate any significant adverse impacts to DOT. |
| **Response:**<br>Comment noted. |

| **Questions/Comments from September 15, 2009 Public Meeting in Arlington, VA.** |
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| **Received from:**<br>Question submitted via webcast. |
| **Comment:**<br>1. Are most agencies going to do further analysis using site specific environmental assessments?<br><br>2. What was the process for choosing the locations for the NEON Sites? |
| **Response:**<br><br>1. The decision to do further analysis would rest with the specific agency and would likely depend on their analysis of the Final Environmental Assessment. Each agency has specific requirements (e.g., Special Use Permits for the Forest Service) and would have to make their own determination on whether their specific requirements have been met. The agency would have to evaluate what NSF has done once NSF has completed its process, and determine if that meets the agency's environmental assessment requirements. At this point in the process, it would be premature to answer that and NSF would not want to speak on behalf of the other agencies who have the authority to issue permits.<br><br>2. The distribution of the 20 domains across the United States was determined through a scientific process using variables of climate and ecology to identify 20 ecologically distinct domains. Once the 20 domains were identified, there was a call of interest to researchers in each of the domains to help identify the potential locations of the Core, Relocatable and Aquatic Sites. Options for each site were analyzed and a national panel was convened to make a preliminary recommendation regarding specific site locations. The process for selecting locations for the proposed NEON sites is provided in Section 2.1 of the EA and detailed descriptions are provided in the NEON Design Documents (www.neoninc.org/documents/design). |

| **Questions/Comments from September 15, 2009 Public Meeting in Arlington, VA.** |
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| **Received from:**<br>Norman Bourg – Smithsonian Institution |
| **Comment:**<br>1. Page 2-25, Lines 29-30, should read, "…Smithsonian Institution Conservation and Research Center in Virginia."<br><br>2. Was the notice of the release of the Draft EA and the occurrence of this public meeting sent to all of the contacts that each Domain provided to Kira Zender at CH2M HILL? |
| **Response:**<br><br>1. The correction has been incorporated into the text of the EA.<br><br>2. Yes. Notices were sent via e-mail and regular mail to all persons and organizations that were identified in each domain. Approximately 2,000 notices were sent via e-mail and 680 were sent via regular mail. Every effort was made to send a notice to each contact provided to CH2M HILL. In very limited cases, e-mails were "bounced back" and could not be resolved prior to the public meeting. |