National Park Service
U.S. Department of the Interior
Yellowstone National Park
Wyoming

National Ecological Observatory Network Northern Rockies, Domain 12 - Core Site Environmental Assessment

June 2017

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Environmental Assessment

Summary

Yellowstone National Park (referred to herein as "the Park") is located in the northwestern portion of Wyoming, with segments extending into southwest Montana and southeast Idaho. The Park was established by an act of Congress on March 1, 1872 and is managed by the National Park Service (NPS).

The Park received a proposal from the National Ecological Observatory Network, d/b/a Battelle Ecology, Inc. (NEON) to create an ecological research and monitoring site on Blacktail Deer Plateau, which would involve the installation of infrastructure, including a tower, soil sampling (array) plots, instrument hut, and aquatic monitoring equipment. Plots would also be established within a defined study area to collect data on biogeochemical cycles, infectious diseases, and a suite of local taxa to characterize patterns, dynamics, and linkages in terrestrial ecosystems. An annual flyover with small aircraft would collect airborne observations. This proposed site would be operational over a 30-year period. Please see *Chapter 2: Alternatives* for further details.

NEON is a continental-scale ecological observatory, funded by the National Science Foundation (NSF), which intends to provide data to understand ecological change over time, including the impacts of climate change, land-use change, and invasive species on ecological systems. NEON has been designed to collect instrumental and observational data over the next 30 years and make those data freely available. NEON is supported through the NSF Major Research Equipment and Facilities Construction Program. The National Science Board and Congress approved funds to create the national observatory in 2011.

In designing a continental scale ecological observatory, NEON partitioned the United States into 20 eco-climatic "domains," which represent a range of soils, vegetation, landforms, and climates. NEON would collect physical, chemical, and biological data at each terrestrial and/or aquatic site (streams, rivers, or lakes) within these domains. NEON plans to construct a total of 81 sites (47 terrestrial sites [20 core and 27 relocatable sites] and 34 aquatic sites [20 core and 14 relocatable sites]); "relocatable sites" would move approximately every five to ten years.

The Park has been proposed as the site for the Northern Rockies Domain (Domain 12). Under NEON's design framework, this would be a wildland site and in place within the observatory for 30 years. The Park was proposed due to its wild landscape and representativeness of the Northern Rockies landforms, vegetation, soils, climate, and ecosystem. Several potential core site locations were evaluated within Domain 12, both inside and outside of the Park; however, they were later dismissed for failing to meet the required ecological parameters necessary to carry out the mission of the program, such as feasible access for construction of the research infrastructure or operational activities, or were considered highly visible and posed viewshed concerns. Likewise, other sites within the Park were considered but dismissed from further evaluation; this detailed site selection history is provided in *Chapter 2: Alternatives* under the section *Alternatives Considered and Dismissed*.

NEON would collect site-based data about climate and atmosphere, soils, streams, infectious diseases, and a variety of organisms. Data that would be gathered at this proposed location are fundamental in understanding the connectivity of the ecology among NEON domains and in revealing immediate ecosystem responses to stressors.

The information and data collected would be available through NEON's online portal that would enable the Park, as well as scientists, educators, planners, decision makers, and other members of the public, to map, understand, and better predict the effects of human activities on ecological systems and effectively address critical ecological questions and issues.

This Environmental Assessment (EA) has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA) and implementing regulations, 40 Code of Federal Regulations Parts 1500 - 1508: NPS Director's Order #12 and Handbook, Conservation Planning, Environmental Impact Analysis, and Decision-making (NPS 2001), and the National Park Service NEPA Handbook (NPS 2015a).

The NPS is considering a no action alternative and one action alternative. The action alternative includes two options related to the tower height; all other physical and operational aspects of the action alternatives *(described in Chapter 2: Alternatives)* are the same.

No Action Alternative: The No Action Alternative presents the Park's current management. The No Action Alternative provides a basis for comparing the environmental consequences of the action alternatives. If the No Action Alternative is selected, the NEON site would not be installed.

Action Alternative Option 1: Tower Height of 70.5 feet. This option includes a 70.5-foot tower and associated infrastructure within the Frog Rock area of northern Yellowstone National Park. Coordinates for the proposed tower site are N 44° 57' 13.12" W 110° 32' 20.87"° (Figure 1).

If Option 1 is selected, the NEON tower would be installed with a maximum height of 70.5 feet and would include sensors that measure a suite of atmospheric variables. This height is designed to be above the maximum height of the tree canopy expected within the next 30 years in order to fully characterize the atmosphere and climate within the area utilizing the standard design and methods used throughout the nationwide observatory. This option represents the most optimal location for the tower with regard to topography, average tree canopy height, ecological variables, access, and proximity to electricity. Other key infrastructure directly associated with the tower would include a precipitation collection system with fencing, soil sampling (array) plots, and an instrument hut to house gas analyzer instruments. Aquatic monitoring equipment would be established at nearby Blacktail Deer Creek. Plots would be established within a defined study area to collect data on biogeochemical cycles, infectious diseases, and a suite of local taxa to characterize patterns, dynamics, and linkages in terrestrial ecosystems. Plot markers, tree tags, and equipment to monitor insects and plants would also be deployed within the NEON study area. An annual flyover with small aircraft would collect airborne observations.

Action Alternative Option 2: Tower Height of 59 feet (Preferred). Under this option, the NEON site would maintain the same location, site design and infrastructure, and operations as described under Option 1. The only difference between Options 1 and 2 is that Option 2 would have a tower height of 59 feet. A lower tower height would conform to the tower height threshold outlined in the Wireless Communications Services Plan that the Park adopted in 2009, which states that towers should not exceed heights greater than 20 feet above the surrounding tree height (NPS 2006). Applications for towers greater than this threshold are required to provide an explanation of why a shorter installation is not feasible. In this case, the lower tower height would reduce the number of environmental parameters that could be collected by NEON and thus fewer data available to the scientific community, decision makers, planners, the Park, and the public.

Public Comment

We welcome your comments on this EA. Your comments must be received in writing within 30 days. The following describes the methods by which you may submit a comment.

Online:

NPS Planning, Environment and Public Comment website:
http://parkplanning.nps.gov/YNPNeon

Hand Delivery *(during business hours):*

Mail Room in Administration Building at Mammoth Hot Springs, Wyoming, Attention: NEON Core Site Proposed Project

Mail:

Yellowstone National Park, Compliance Office
Attention: NEON Proposed Core Site Project
P.O. Box 168
Yellowstone National Park, Wyoming 82190

Comments will not be accepted by fax, e-mail, or in any other way than those specified above. Bulk comments in any format (hard copy or electronic) submitted on behalf of others will not be accepted.

Before including your address, telephone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you may request that any personal information be withheld from public review, we cannot guarantee that we can do so.

All public comments would be carefully reviewed prior to the completion of the Final EA. A determination would then be made whether to approve a Finding of No Significant Impact or additional NEPA compliance is required. The final decision will be made by the Regional Director of the NPS Intermountain Region.

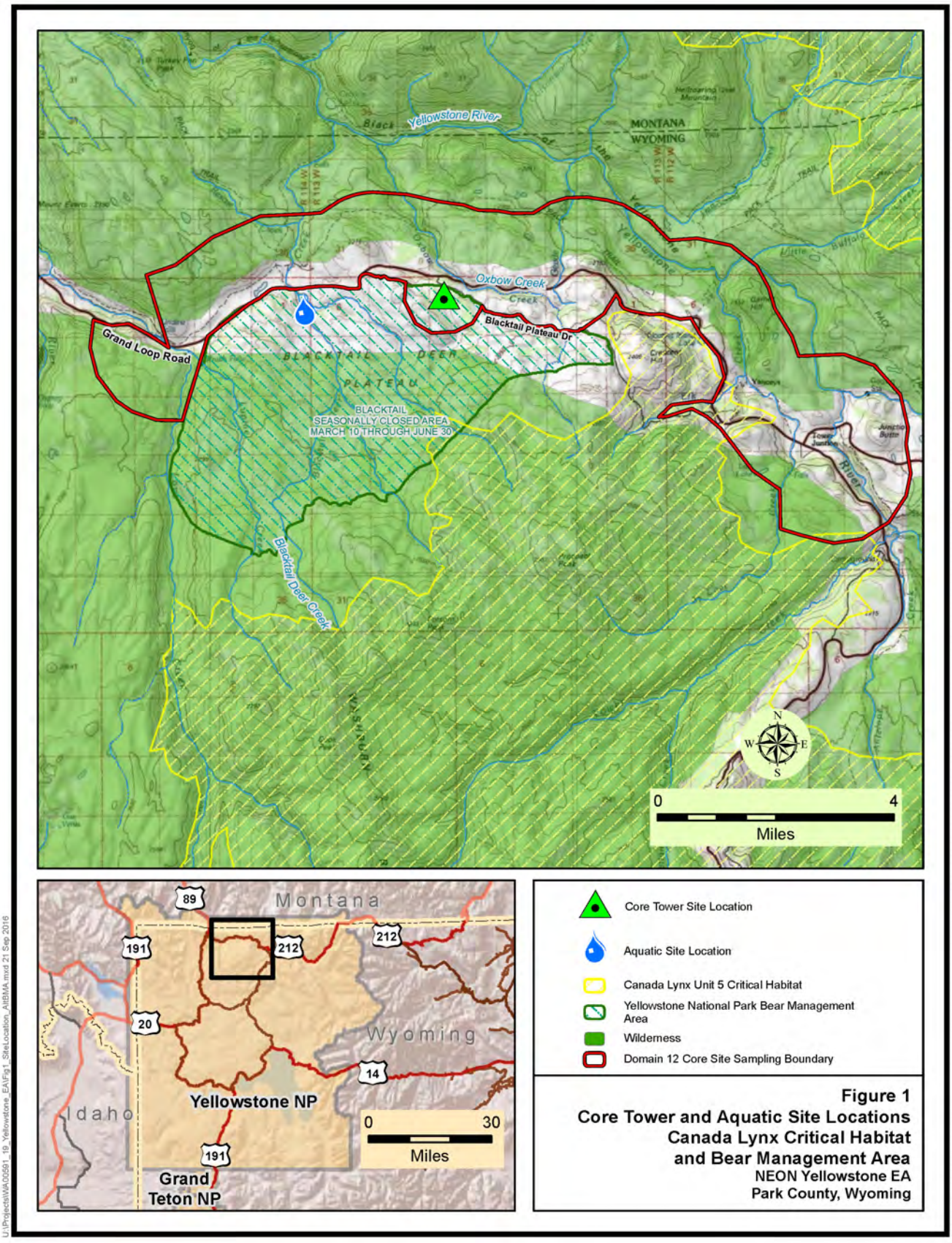

Figure 1
Core Tower and Aquatic Site Locations
Canada Lynx Critical Habitat
and Bear Management Area
NEON Yellowstone EA
Park County, Wyoming

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°F	degrees Fahrenheit
amsl	above mean sea level
AOP	Airborne Observation Platform
AOS	Aquatic Observation System
APE	Area of Potential Effects
BA	Biological Assessment
BMA	Bear Management Area
BMP	best management practice
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic foot per second
dBa	decibel
DFIR	Double Fence Intercomparison Reference
Domain 12	Northern Rockies Domain
EA	Environmental Assessment
ESA	Endangered Species Act
fDOM	fluorescent dissolved organic matter
FONSI	Finding of No Significant Impact
FR	Federal Register
GIS	geographic information system
GPS	Global Positioning System
GYE	Greater Yellowstone Ecosystem
IACUC	Institutional Animal Care and Use Committee
ID Team	Interdisciplinary Team
MOU	Memorandum of Understanding
MRA	minimum requirements analysis
MRDG	Minimum Requirements Decision Guide
NaBr	sodium bromide
NaCl	salt
NEON	National Ecological Observatory Network, d/b/a Battelle Ecology, Inc.
NEPA	National Environmental Policy Act of 1969
NFPA	National Fire Protection Association

NPS	National Park Service
NRHP	National Register of Historic Places
NSF	National Science Foundation
NSS	Native Species Status
PAR	Photosynthetically Active Radiation
Park	Yellowstone National Park
PEPC	Planning, Environment and Public Comment
PVC	polyvinyl chloride
RPO	Research Permit Office
SHPO	State Historic Preservation Office
SOP	standard operating procedure
TOS	Terrestrial Observation System
U.S.	United States
U.S.C.	United States Code
µS/cm	micromhos
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTV	Utility Task Vehicle
WGFD	Wyoming Game and Fish Department
YCT	Yellowstone cutthroat trout

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CHAPTER 1: PURPOSE AND NEED

Introduction

Yellowstone National Park (referred to herein as "the Park") received a proposal from the National Ecological Observatory Network, d/b/a Battelle Ecology, Inc. (NEON) to install an ecological research and monitoring site on Blacktail Deer Plateau for a period of 30 years. The project would involve the installation of infrastructure, including a tower, soil sampling (array) plots, instrument hut, and aquatic monitoring equipment at nearby Blacktail Deer Creek. Plots would also be established within a defined study area to collect data on biogeochemical cycles, infectious diseases, and a suite of local taxa to characterize patterns, dynamics, and linkages in terrestrial ecosystems. An annual flyover with small aircraft would collect airborne observations (see *Chapter 2: Alternatives* for further details).

NEON is a large facility project funded by the National Science Foundation (NSF) Major Research Equipment and Facilities Construction Program. In designing a continental scale ecological observatory, NEON partitioned the United States (U.S.) into 20 eco-climatic "domains," which represent a range of soils, vegetation, landforms, and climates. NEON intends to collect physical, chemical, and biological data at each terrestrial and aquatic site. NEON currently plans to construct a total of 81 sites (47 terrestrial sites [20 core and 27 relocatable sites]) and 34 aquatic sites (20 core and 14 relocatable sites); "core sites" would collect data for 30 years; "relocatable sites" are planned to move either within domains or across domains every five to ten years. Research "themes" for each site were selected through a process involving input from members of the scientific community and through public engagement, which are described in more detail herein.

The Park was initially discussed as a potential location for NEON's Northern Rockies Domain (Domain 12) core (wildland) site because the Yellowstone Northern Range and surrounding Greater Yellowstone Ecosystem (GYE) comprise the largest intact wildland ecosystem in the lower 48 states. All native vertebrates are present on Park property and natural disturbances, native species, and ecological processes interact with relatively little human intervention. The Park offers a rare opportunity to understand interactions among climate, natural disturbance, ecosystem processes, and community structure in integrated terrestrial and aquatic systems that are representative of intact wildlands across the domain.

In August 2009, the NSF announced the availability of a programmatic Environmental Assessment (EA) (NSF 2009) that included the subject site and other sites across the U.S., and invited public comment on the NEON proposal in general and on specific NEON sites. The NSF also conducted two public meetings to provide information regarding the proposed project. Those meetings were held on September 15, 2009, in Arlington, Virginia, and September 17, 2009, at the NEON Headquarters Office located in Boulder, Colorado. After reviewing and considering the input received from the public and the National Park Service (NPS), the NSF signed a Finding of No Significant Impact (FONSI) on December 9, 2009 (NPS 2009). However, as part of ongoing communication and coordination with the Park regarding the proposed site, the Park determined that a separate site-specific EA (this analysis) would be required in addition to the programmatic EA.

As part of the NEON design framework, the core site selection parameters are fundamental to understanding the connectivity of the ecology among the NEON domains in revealing immediate ecosystem responses to stressors. Several potential core site locations were evaluated within the GYE; however, these sites were dismissed for failing to meet the required ecological parameters necessary to carry out the mission of the program or did not afford feasible access

for construction of the research infrastructure or operational activities. Sites outside the Park are not included in this impact analysis; however, other sites within the Park considered but dismissed from further evaluation and detailed site selection history and rational are provided in *Chapter 2: Alternatives*.

Why is Yellowstone National Park Proposed for the Domain 12 Core Site?

The proposed core site location within the Park (project area) represents an ideal wildland site for this domain because it is highly representative of continental ecoregions within the Northern Rockies. The region 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, including the Beartooth, Gallatin, Madison, and Teton ranges. This expansive area of mountains and valleys, including the 7,874-foot-high Yellowstone Plateau, intercepts winter storms from the west and becomes progressively drier to the east. Soils resulting from this geology influence the distribution and character of different communities within the GYE.

The pattern of movement of energy and matter through the ecosystem, associated vegetation, and wildlife community interactions are probably more representative of those that were widespread in the region before Euro-American influence than any other place in the Northern Rockies region.

All known native species of plants and animals are present and strong links exist between terrestrial and aquatic systems within the proposed site (Wise 2009; Das et al. 2009; Hildago et al. 2009), which includes first-order watersheds and the higher order Yellowstone River. Fire, predation, herbivory, parasitism, and succession in uplands strongly influence aquatic nutrient cycling and food webs. Aquatic invertebrates and native fishes provide major food sources to terrestrial predators.

A well-established tradition of scientific research exists within the Park as it offers a rare opportunity to understand interactions among climate, natural disturbance, ecosystem processes, and community structure in integrated terrestrial and aquatic systems that are representative of those of intact wildlands across the region, as well as, educational and outreach opportunities. Additionally, the Park provides proximity to existing roads and electrical infrastructure necessary to construct the infrastructure at the site to carry out operational activities. Information collected by NEON would be made available to Park planners and decision makers and enable them to map, understand, and better predict the effects of human activities on ecological systems and effectively address critical ecological questions and issues.

Key research “themes" for the proposed core site include:

- Infectious disease and invasive species; and
- Ecological connectivity with secondary links to ecohydrology, biodiversity, and biochemistry.

Questions that would be investigated at this site include:

- How are surface water, ground water, and the timing and volume of runoff influenced by climate variability and change, and what are the likely patterns of these under future climate change scenarios?
- What habitat and ecosystem types are especially sensitive to climate change and variability?
- How resilient are GYE ecosystems to climate change and variability, and are there thresholds in climate change leading to new states in ecological systems?

NEON would provide the Park with freely available data (including site-based and remotely sensed data) and analysis packages that can provide additional resources in the land management and conservation strategies of the Park. NEON data would provide the Park with baseline data that can be used to evaluate the effects of land-use, climate change, and invasive species on the ecology and hydrology of the Park. For example, it has been hypothesized that, due to climate change, the abundance of ticks and prevalence of tick-borne disease would increase; this has negative implications for the health of visitors to the Park. NEON's data would help Park managers monitor and react in a timely fashion to increases in tick-borne diseases. Tracking the abundance of tick-, mosquito-, and small mammal-borne diseases would also provide the Park the capability to set up an early warning system for other diseases moving into the Park. By co-locating measurements of soils, plant, insects, small mammals, and birds, NEON data can provide information that can inform hypotheses on how ecosystem impacts, such as climate change and atmospheric deposition, cascade through trophic levels. Location of sampling within the Park also expands the scientific coverage and utility of the NPS Natural Resource Inventory and Monitoring Program.

The Park would have access to all of the information collected to support management of resources (e.g., wildlife populations, ecosystem process information within the context of the GYE, landscape perspective on productivity and species composition, invasive species, and wildland fire ecology, among other results of research conducted by NEON). NEON would benefit the Park's interpretation and education program by providing access to data products that may be utilized in educational activities.

Overview of NEON

Research at the scale described above requires standardized infrastructure that integrates frequent and intermittent sensing, broad scale remote sensing, and observations conducted across gradients of change. The infrastructure must be able to collect multiple types of data for short periods of time over large and diverse geographical areas while also being optimized to collect specific data at fixed locations over longer time intervals. The standardized infrastructure and measurements of the NEON approach is what provides a comprehensive picture of current conditions and changes over time, across ecosystems.

NEON 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 a variable is measured using standardized methods over time in all 20 domains a continental picture of the quantity, changes in, and spatial heterogeneity (composition from dissimilar parts) of that variable would be obtained.

Locations selected for deployment of NEON infrastructure across the continental U.S., Alaska, Hawaii, and Puerto Rico were chosen using a statistically determined design stratified by climate and land use (Hargrove and Hoffman 1999, 2004; Keller et al. 2008). NEON's design objectives are based on the National Research Council's eight *Grand Challenges* (or *research priorities*) in Environmental Science for the coming decades (NRC 2001, 2003; PCAST 2011, 2013); NEON's proposal would explore seven of the eight as follows:

1. Biodiversity;
2. Biogeochemistry;
3. Ecohydrology;
4. Invasive species;
5. Infectious disease;

6. Land use (which encompasses both the major causes of change associated with the wildland-agriculture-urban interface and effects on ecosystems); and
7. Climate change.

In some instances, other research themes would be investigated because they are ecologically important in large regions of the continent, for example:

- Dust generation, transport, and deposition;
- Nitrogen deposition;
- Regional climate information; and
- Ecological connectivity.

Several high-level requirements provide the foundation for the observatory:

- Observe the causes and consequences of environmental change to establish the link between ecological cause and effect;
- Detect and quantify ecological responses to and interactions between climate, land use, and biological invasions, which unfold over decades;
- Provide information on seven of the eight Grand Challenge areas in environmental science: biodiversity, biogeochemistry, ecohydrology, infectious diseases, biological invasion, land use change, and climate change;
- Address ecological processes at the continental scale and the integration of local behavior to the continent and observe transport processes that couple ecosystems across continental scales;
- Develop infrastructure to support community driven experiments that accelerate changes toward anticipated future conditions;
- Provide usable information to scientists, educators, students, the general public, and governmental and non-governmental decision makers; and
- Provide infrastructure to scientific and educational communities, by supplying long-term, continental-scale information for research and education, and by supplying resources so that the community can deploy additional sensors, measurements, experiments, and learning opportunities.

Funding for the Yellowstone site-specific EA, construction, and initial operations of the observatory has been secured and allocated by the NSF and other construction activities are currently underway throughout the continental U.S. with 18 domains currently collecting preliminary data. Updates can be viewed at data.neonscience.org.

1. D01: Northeast
2. D02: Mid-Atlantic
3. D03: Southeast
4. D04: Atlantic Neotropical
5. D05: Great Lakes
6. D06: Prairie Peninsula
7. D07: Appalachians and Cumberland Plateau
8. D08: Ozarks Complex
9. D09: Northern Plains
10. D10: Central Plains

11. D11: Southern Plains
12. D13: Southern Rockies and Colorado Plateau
13. D14: Desert Southwest
14. D15: Great Basin
15. D16: Pacific Northwest
16. D17: Pacific Southwest
17. D18: Tundra
18. D19: Taiga

Construction, operations, and decommissioning of the project (including the tower, instrument hut and aquatic monitoring equipment) are the sole responsibility of NEON.

This continental-scale ecological observatory seeks to facilitate scientific research and achieve a better understanding of the biosphere and processes operating at large scales. NEON would establish and sustain the scientific infrastructure needed to address critical questions about the effects of land use and climate change on ecological systems and to evaluate the impacts of those changes on the environment.

This large-scale, long-term observatory seeks to collect and provide a diverse suite of comparable and consistent ecological data at multiple spatial and temporal scales, of which none of its kind exist today. Long-term observations across all domains would provide the opportunity to achieve continental scale comparisons and for insight and understanding not previously available from traditional ecological approaches.

Many complex ecological processes and relationships manifest at time scales that exceed classic funding cycles, and site-specific investigations often prove to be case studies with little power to contribute to a generalized understanding of factors and mechanisms that govern large-scale patterns. Co-locating consistent measures of the drivers of change, biogeochemical cycling, and population and community responses across a variety of environments would expand our current understanding of ecological processes and improve our ability to forecast ecological change at continental scales and over decades (Schimel et al. 2011).

The data collected would be available to the public through an online portal that would enable scientists, educators, Park planners, and other decision makers to map, understand, and better predict the effects of human activities on ecological systems and effectively address critical ecological questions and issues.

Purpose and Need

The Park is undertaking this EA because NEON has proposed to construct and operate an ecological research and monitoring site on federal lands administered by the NPS.

Legislation mandates that NPS resources are to be managed in such a manner and by such means as would leave them unimpaired for the enjoyment of future generations (NPS Organic Act of August 25, 1916). The mission of the NPS at the Park is the care, protection, management, improvement, understanding, and interpretation of park resources while maintaining positive visitor experiences. In the Organic Act of 1916, which established the NPS, Congress directed the Department of the Interior and the NPS to manage units “to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations” (Title 16 United States Code [U.S.C.], section 1). Management Policies (NPS 2006) establishes service-wide policies for the preservation, management, and use of NPS resources and facilities. These policies provide guidelines and direction for resource and park management.

The Park’s purpose in evaluating NEON’s proposal is to analyze impacts of the NEON proposal

to ensure consistency with the management policies outlined above. The goals and objectives of the NPS Management Policies (NPS 2006) state that studies, research, and collection activities by non-NPS personnel involving natural and cultural resources will be encouraged and facilitated when they otherwise comport with NPS policies. Scientific research is an acceptable use and provides public benefits therefore, NPS is considering the NEON proposal to determine whether, how, and under what conditions this project (NEON's proposal to develop an ecological research and monitoring site) is consistent with Park policy.

This EA analyzes the proposed action and alternatives and their impacts on the environment. This EA has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA) regulations of the Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] 1508.9), and the NPS Director's Order #12: Conservation Planning, Environmental Impact Analysis, and Decision-making and Handbook (NPS 2001); and the National Park Service NEPA Handbook (NPS 2015a). Objectives for this project are:

- The project would seek to continue the well-established tradition of scientific research that exists within the Park.
- The site would facilitate the creation of a continental-scale ecological observatory to enable scientific research and achieve a better understanding of the biosphere and processes operating at large scales.
- The site would facilitate the creation of a long-term ecological observatory that collects and provides a diverse suite of comparable and consistent ecological data at multiple spatial and temporal scales, of which none of its kind exists today.
- The site would enable a long-term set of Yellowstone-specific ecosystem data to be made available for tracking changes within the Park.
- The project would seek to conform to the Wireless Communications Services Plan that the Park adopted in 2009 (NPS 2009), which states that towers should not exceed heights greater than 20 feet above the surrounding tree height.
- The project would seek to provide consistency with regard to towers at other NEON sites across the country that are designed and constructed and to allow for the best correlation of data as the data at various domains was collected using the same parameters, e.g., sensor heights are standardized across all NEON sites and to ensure consistency of quality data for comparisons across ecosystems and domains.
- The site would address science questions based on coordination with the scientific community within the domain.
- The site would provide representative ecosystems, landscapes, and aquatic processes to best address the key research themes for the domain.
- The site would meet local topographical constraints and climatic conditions to allow for state-of-the-art measurement techniques to best address the key research themes for the domain (i.e., site would be relatively flat to accommodate the tower, etc.).
- The site would provide opportunities for education and outreach i.e., afford opportunity and proximity to scientific community, citizen scientists, school groups, and the public, among other groups.
- The site would provide data that would be made freely and openly available to researchers, educators, decision makers within the Park, and the public.

- The site would avoid sensitive viewshed areas or areas where the tower and infrastructure could be easily seen by the public/visitors.
- The site would be easily accessed for construction and operational activities with minimum impact to existing soils, vegetation, water resources, and wildlife, etc.
- The project would implement best management practices (BMPs) and mitigation measures to reduce and minimize impacts to Park resources and visitor's experience.

All research conducted in the Park is vetted through the Park's Research Permit Office (RPO). This EA focuses on the construction and operational aspects of the proposed work and does not cover any future proposed research. All additional research requests associated with the proposed NEON site would be submitted through the RPO for proper approvals and permits prior to conducting work. Information is available at: http://www.nps.gov/yell/naturescience/howtoapply.htm.

In addition to obtaining a research permit, the Park would require NEON to follow all research permit conditions and provide the necessary information to the Park so that proper review could be conducted. The Park would require a separate Memorandum of Understanding (MOU) (agreement between the Park and NEON) that would articulate the responsibilities of each party for the duration of the project, including but not limited to communication and decision making protocols.

Impact Topics Retained For Further Analysis

The impact topics discussed in this EA were developed using internal (NPS specialists) and public scoping. The following eight impact topics were carried forward for further analysis in this EA:

1. Geology;
2. Soils;
3. Water Resources;
4. Vegetation;
5. Wildlife;
6. Special Status Species;
7. Visual Resources/Visitor Experience; and
8. Wilderness.

Impact Topics Dismissed from Further Analysis

Table 1 indicates which impact topics were dismissed from further analysis with a brief explanation why. The table also includes the laws, regulations, and/or policies that govern the compliance for that particular impact topic and a brief description of the affected environment, or baseline conditions, in the project area. For additional information, please refer to the programmatic NEPA EA (NSF 2009).

Table 1: Impact Topics Dismissed from Further Analysis

Topic	Law, Regulation, Policy	Reason for Dismissal
Geothermal	NPS Management Policies 2006, 4.8.2.3 - (Geothermal and Hydrothermal Resources)	Geothermal resources are not known to occur within the vicinity of the proposed project.
Wetlands	Executive Order 11990 Protection of Wetlands; Director's Order 77-1: Wetland Protection and Director's Order 77-2: Floodplain Management	The project would be exempt from this requirement as the impacts to wetlands and floodplains would be less than 0.1 acre, and due to the following as per the National Park Service #77-1: Wetland Protection, Procedural Manual, Section 4.2.1 Number (6)."Installation of scientific measuring devices such as water level recorders, water quality monitoring stations, small weirs or flumes, or similar devices necessary for monitoring of or research on wetland resources." Impacts to Blacktail Deer Creek at the proposed aquatic site are expected to be negligible if any, as a result of infrastructure or operational activities at the proposed aquatic site because wetlands are not the targeted hydrologic conditions required for proposed groundwater monitoring. The proposed project seeks to monitor shallow groundwater and hydrologic conditions across the site; proposed infrastructure and instrumentation would be located within the stream corridor. Additionally, the action has little likelihood of impacting human health, capital investment, of natural floodplain values. The proposed project would not adversely affect the functions of wetlands, as there are no wetlands in the immediate area of the proposed tower site. The U.S. Army Corps of Engineers in Wyoming has indicated that a Section 404 permit would not be required.

Table 1: Impact Topics Dismissed from Further Analysis

Topic	Law, Regulation, Policy	Reason for Dismissal
Floodplains	Executive Order 11988, Floodplain Management (NPS 2003); Director's Order 77-2 Floodplain Management	The project would be exempt from this requirement as the impacts to wetlands and floodplains would be less than 0.1 acre, and due to the following as per the National Park Service #77-1: Wetland Protection, Procedural Manual, Section 4.2.1 Number (6)."Installation of scientific measuring devices such as water level recorders, water quality monitoring stations, small weirs or flumes, or similar devices necessary for monitoring of or research on wetland resources." Short-term impacts associated with groundwater well monitoring (installation, maintenance, and operation activities) would include trampling of floodplain vegetation but engineered controls, best management practices, and mitigation measures would be in place to prevent directly impacting the stream or exacerbating erosion. Long term impacts would be the permanent removal of vegetation as a result of the groundwater well footprint (dimensions total). Surface water intrusion would not occur as a result of a concrete and bentonite seal at the base of the well head. The proposed project would not adversely affect the functions of floodplains, and would not pose any increased risk of flooding. Additionally, the action has little likelihood of impacting human health, capital investment, of natural floodplain values.
Air Quality	Clean Air Act; NPS Director's Order 77: Natural Resource Protection	Construction related activities may stir up dust while constructing the tower and associated infrastructure. This activity would be temporary (approximately five months) and the impact on air quality would be short-term during the construction phase and negligible during the operational phase.

Table 1: Impact Topics Dismissed from Further Analysis

Topic	Law, Regulation, Policy	Reason for Dismissal
Soundscapes	NPS Director's Order 47: Soundscape Preservation and Noise Management	Sounds in the project area are a mix of natural and man-made, including those generated from wildlife, humans, vehicular traffic, moving water in Blacktail Deer Creek, and wind. Human-caused sounds would temporarily and noticeably increase during the construction phase (approximately four to six months) as a result of equipment, vehicular traffic, and construction crews. Short-term noise disturbance is expected during construction (approximately three months). Long-term changes to the soundscape are not expected to occur as a result of NEON personnel hiking within the sampling boundary during operations while conducting ecological monitoring activities. Sounds from operations equipment would not be allowed to exceed 60 decibels (dBa) at a distance of 50 feet. If equipment will exceed the dBa limit, NEON will be required to mitigate noise.
Lightscapes	2006 NPS Management Policies	No exterior lighting is proposed for this project and no impacts to the lightscape are expected.
Wild and Scenic Rivers	Wild and Scenic Rivers Act, NPS Director's Order 46: Wild and Scenic Rivers	There are no Wild and Scenic Rivers in the project area.
Paleontological Resources	NPS Director's Order 77: Natural Resource Protection	There are no known paleontological resources in the project area.

Table 1: Impact Topics Dismissed from Further Analysis

Topic	Law, Regulation, Policy	Reason for Dismissal
Historic Structures, Cultural Landscapes, and Archeological Resources	National Historic Preservation Act (NHPA); NPS Director's Order 28: Cultural Resources Management	In accordance with Section 106 of the NHPA, and its implementing regulations, a cultural resource records and literature review was conducted in November of 2008 for the proposed undertaking, including reviewing archival records and prehistoric and historic records, historic maps, geomorphologic history, settlement history, and aerial photographs. The review identified three cultural resource properties near the proposed tower location within the Area of Potential Effects (APE); the Grand Loop Road, Blacktail Plateau Road, and one archaeological site (48YE313). A cultural resources pedestrian survey was conducted for the APE in July of 2011 (Wright and Gray 2011). In 2012, additional evaluation of 48YE313 was carried out (Wright et al. 2012) after additional consultation with the Wyoming State Historic Preservation Office. Based on this collective work, the NPS determined that the portion of the archeological site within the APE was not eligible for listing on the National Register of Historic Places (NRHP), and two historic structures (Grand Loop Road and Blacktail Plateau Road) are eligible for listing on the NRHP. The Park determined that the project as proposed would have no adverse effects on the two NRHP-eligible properties. The Wyoming State Historic Preservation Office concurred with this determination of effect on May 27, 2015 (see Appendix 1). Therefore, this topic has been dismissed from further consideration. However, if any cultural materials are discovered during construction or operational activities proposed at the site work would be halted immediately and the Park Archeologist and the Wyoming State Historic Preservation Office (SHPO) will be contacted to document and assess the NRHP-eligibility of those resources, and if necessary develop an appropriate mitigation strategy in accordance with pertinent laws and regulations.

Table 1: Impact Topics Dismissed from Further Analysis

Topic	Law, Regulation, Policy	Reason for Dismissal
Ethnographic Resources	NHPA; NPS Director's Order 28: Cultural Resources Management; NPS Director's Order 71B: Indian Sacred Sites	Tribal Consultation for the NEON project was conducted with 26 Associated Tribes during scoping and is on-going. The Park did engage with one Tribe on project specifics during the project but the Tribes did not provide any concerns over the project. Some associated Tribes were briefed on the project at a Tribal Consultation meeting in 2013 and did not raise any concerns at that time. Consultation with the 26 Associated Tribes will continue with the release of this EA and additional engagement. If consultation with Tribes during the release of the EA raises any concerns, additional consultation may be undertaken prior to a decision document depending on the nature of those concerns.
Indian Trust Resources and Sacred Sites	Secretarial Order 3175 ECM 97-2 Executive Order 13007	Indian Trust Resources would not be affected by the alternatives in this plan because there are no known resources in the project area, and none of the 26 associated tribes raised this as a concern.
Socioeconomics	NPS Management Policies	The proposed action would not change local or regional land use or have a significant impact on local businesses or populations.
Environmental Justice	Executive Order 12898 General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	Nearby stakeholders were notified by mail and public scoping meeting held in December 2014. Because data gathered at the proposed core site would ultimately be available to all public users, regardless of race or income; and because the construction workforce and visiting scientists would not be hired based on their race or income, the proposed core site would not have disproportionate health or environmental effects on minorities or low-income populations or communities as non-governmental employees do not reside in the Park.
Climate Change	NPS Management Policies	Neither proposed activities nor infrastructure at the proposed site would produce greenhouse gas emissions during the operational phase of the project; however, some carbon dioxide emissions would be produced by on-road motor vehicles and small construction equipment during the construction phase (approximately four to six months), these impacts would be temporary and intermittent. Travel to and from the site by NEON personnel would require the use of on-road vehicles during the operational phase of the project; however, due to the limited numbers of vehicles and frequency of trips; no impacts are expected.

CHAPTER 2: ALTERNATIVES

Introduction

This EA has been prepared in compliance with NEPA to provide a decision making framework that: 1) provides a reasonable range of alternatives to meet the purpose and need; 2) evaluates the consequences of each alternative on the natural and human environment; and 3) identifies mitigation measures to ensure protection of Park resources and values throughout installation and operation of the proposed NEON core site. Rationale for the proposed location within the Park has been discussed in *Chapter 1: Purpose and Need*. The NPS does not have management authority for lands outside the Park; therefore, no alternatives within other jurisdictions have been proposed. Alternatives were discussed by the Interdisciplinary Team (ID Team) during the EA kick-off meeting in September of 2014. These discussions, and subsequent discussions after receiving comments from the public, resulted in a list of alternatives that could potentially meet these objectives.

A no-action and action alternative with options are summarized and analyzed. The action alternative includes two options related to the tower height; all other physical and operational aspects of the action alternatives are the same.

All applicable Park requirements for this project have been considered or applied to the action alternative and mitigation measures have been integrated into the action alternative (for both options outlined below) to avoid or minimize impacts to the natural and human environment as a result of installation of the NEON core site. These mitigation measures have been integrated into the design aspects of the project, while others would be incorporated during project construction, operation, and decommissioning.

Alternatives Carried Forward

No Action Alternative

The No Action Alternative represents the Park's current management practices for the site, i.e., to continue to manage the site as it is currently being managed. The No Action Alternative provides a basis for comparing the environmental consequences of the action alternative(s). If the No Action Alternative is selected, the NEON site would not be installed.

Action Alternative Option 1 – Tower Height 70.5 Feet

The proposed NEON Domain 12 core site would be installed in the Northern Range of Yellowstone National Park, approximately 70 miles south of Livingston, Montana, 9 miles east of Mammoth Hot Springs, and 0.3 miles south of Grand Loop Road near the intersection of the entrance of the Blacktail Plateau Drive (Figure 1). Coordinates for the proposed tower site are N 44° 57' 13.12" W 110° 32' 20.87"°. Aquatic observations would be collected at nearby Blacktail Deer Creek approximately 2.5 miles west of the proposed tower location (Figure 1). Data associated with aquatic and terrestrial biota, including soils, would also be collected in the vicinity of the tower and aquatic sites. An annual flyover would be conducted to collect ecological data remotely.

Under Option 1, the tower would be 70.5 feet tall, extending approximately 30 feet above mean tree canopy. The tree canopy at present is approximately 40 feet at the site. This tower height would be most consistent with how towers at other NEON sites across the country are designed and constructed and would allow for the best correlation of data as the data at various domains was collected using the same parameters.

Tower heights are calculated for each site using mathematical equations that consider physical factors that influence the turbulent wind flows across the landscape. Sensor heights are standardized across all NEON sites and to ensure consistency of quality data for comparisons across ecosystems and domains. This standardization ensures consistent constructability and interchangeability with all other NEON towers across the country and is designed to provide accurate scientific ecosystem measurements. Tower heights outside of the acceptable range, particularly closer to the measurement surface, introduce numerous flow distortions and flow induced measurement errors that decrease the accuracy and quality of the eddy covariance (a key atmospheric measurement technique to measure and calculate vertical turbulent fluxes within atmosphere) measurements and the scientific inferences that can be made with this data (e.g., ecosystem sequestration or release of Carbon).

This alternative includes the tower height that would allow NEON to collect the complete range of environmental parameters (more than 200 measurements) associated with abiotic environmental data at the micro scale (immediate microclimate through vertical profiling), the incident environment—simultaneous weather conditions over a large area (migratory high and low pressure systems of the lower troposphere) climate (drivers of change incident to the environment [i.e., chemical climate, precipitation, and radiation]), and the flux scale that measures the biotic influence on the exchanges of carbon dioxide, water, and energy that are described in Chapter 1: Purpose and Need and in detail herein.

Construction

Construction would take approximately four to six months for a crew of six to ten workers plus oversight by NEON personnel, mainly during the snow-free period within the Park. Construction personnel would be housed offsite and would travel to and from the site together to minimize the number of vehicles; approximately two to four pick-up truck vehicles would be required. All work would be carried-out during daylight hours.

At the tower site, the electric utility line/unimproved footpath illustrated on Figure 2A would serve as a temporary construction access corridor; a width of 8 feet would be strictly adhered to by NEON. This temporary corridor would be rehabilitated after construction. An unimproved footpath on this alignment would remain for the operations phase. Equipment and materials would be hand-carried or brought to the site by small vehicles such as all-terrain vehicles using the existing road access (Frog Rock Pit Road) to reduce erosion, compaction, and overall disturbance at the site. Approximately 100 all-terrain vehicle trips per week for approximately four months would be required to transport materials to the project area, primarily for the construction of the tower and instrument hut. Construction equipment would also include mini-excavators and a skid-steer for hauling material (e.g., concrete, larger pieces of infrastructure) and could be utilized for the duration of the construction phase.

It is anticipated that 1,600 trips could be required to complete the construction. All fueling activities would occur in the staging/parking areas (Figures 2A and 2B) and crews would be required to utilize spill containment during these activities. Parking may be allowed at the Upper Blacktail Cabin during construction only in coordination with the Park. A number of mitigation measures, standard operating procedures (SOPs), and BMPs would be integrated into design and construction to minimize the degree and/or severity of adverse effects; these are described later in this chapter under *Mitigation Measures*.

Operations

All site structures and equipment are proposed to be constructed and installed in 2017 and would remain in place for 30 years. Once constructed, the tower would be visited by two NEON personnel, approximately every two weeks to ensure computers, sensors, and other equipment

is functioning properly and to conduct routine maintenance. A Domain Manager based in Salt Lake City, Utah, would oversee all activities at the core site. An Assistant Manager and all other NEON personnel would be based out of Bozeman, Montana. Operations at the site would include the followings categories or subsystems:

- Maintenance of Atmospheric and Soil Instrumentation,
- Aquatic Observations and Maintenance of Aquatic Instrumentation,
- Airborne Observations; and
- Terrestrial Observations.

A number of mitigation measures, SOPs, and BMPs would be integrated into operations to minimize the degree and/or severity of adverse effects; these are described later in this chapter under Mitigation Measures.

Access

Access paths onsite would be designed to direct NEON personnel along preferred access routes for construction and operational use. The access to the proposed site would be signed, designating the area for administrative use only, to deter unauthorized access by visitors. An unimproved footpath for operations and long-term use would maintained to 18 inches (1.5 feet). The unimproved footpath would be approximately 2,396 feet long. A previously cleared area near the Frog Rock gravel pit, west of the proposed tower site, would become the long-term parking area for operations personnel and reduce new disturbance at the site, i.e., reduce impacts to vegetation and soil and minimize post-construction rehabilitation efforts (Figure 2A). The tower and associated infrastructure would be accessed from the west via Frog Rock Pit Road from the designated parking area (Figure 2A).

Tower Site

Proposed infrastructure and project components at the tower site would include:

- Access;
    - Unimproved access road;
    - Electric utility line/unimproved footpath *(co-located);*
    - Construction staging and parking area *(co-located);*
- Tower with sensors and communications satellite dish;
- Electrical service conduit;
- Auxiliary portal;
- Instrument hut;
- Precipitation Collection System with fencing, known as a Double Fence Intercomparison Reference (DFIR);
- Soil Array Plots; and
    - Power distribution via five device posts that would support power/communication
- Soil horizon (temporary pit).

A conceptual design layout of the proposed tower site with proposed components is illustrated in Figure 2A.

Tower

Under Option 1, the tower would be 70.5 feet tall in addition to a 10-foot-tall lightning rod made of rigid galvanized steel mast designed to meet the following National Fire Protection Association (NFPA) codes: NFPA 780 for building/structural lightning protection and NFPA 70 for electrical systems grounding. The lightning rod would increase the overall height of the tower

by 10 feet, making the total tower height 80.5 feet with this appurtenance. The Federal Communications Commission and Federal Aviation Administration make this distinction in order to define the tower working height as opposed to the height of the appurtenances required to protect the tower.

This height is not consistent with the Park's Wireless Communications Services Plan, which states NPS would not install towers more than 20 feet above mean tree height without a justification as to why this deviation is needed. In this case, the deviation would be required because it would allow NEON to collect the complete range of environmental parameters (more than 200 measurements) associated with abiotic environmental data at the micro scale (immediate microclimate through vertical profiling), the incident environment—simultaneous weather conditions over a large area (migratory high and low pressure systems of the lower troposphere) climate (drivers of change incident to the environment [i.e., chemical climate, precipitation, and radiation]), and the flux scale that measures the biotic influence on the exchanges of carbon dioxide, water, and energy.

Digital communication and uploading and/or retrieval of data would be accomplished by mounting a small satellite dish (approximately 3 feet wide) to the tower (or Instrument Hut, described below) (Photo 1).

Photo 1: Representative Photo of Satellite Dish

The tower would have a dull galvanized finish or painted to blend in with surrounding trees and vegetation. An internal ship ladder system would be installed within the tower to provide access and increased safety for monitoring personnel (Photo 2). The tower foundation would utilize rock anchors with concrete caps. Each concrete cap would measure approximately 2 feet long x 2 feet wide x 27 inches deep. There would be one of these at each of the four anchors (4 square feet each, totaling 16 square feet) (Appendix 2). The total footprint for the tower foundation would be 72.3 square feet. The base of the tower would be gated to prevent entry from unauthorized persons. Photo 3 provides an image of a NEON tower for reference.

Photo 2: Representative Photo of Ladder System

Atmospheric and Soil Instrumentation

Once constructed, several pieces of monitoring equipment would be mounted on the lattice tower, including basic air quality monitors, soil respiration monitors, physical and canopy measurements, eddy covariance instruments (to measure and calculate vertical turbulent fluxes within atmospheric boundary layers), advanced air quality instruments, and dust sensors.

Photo 3: Representative Photo of Similar Tower

A camera mounted at the tower top would provide near-surface remote sensing of canopy phenology (cyclic and seasonal natural occurrences, especially in relation to climate and plant and animal life). This imagery, along with a nationwide network of phenology cameras would contribute to the efforts of scaling remotely sensed satellite-based data with ground-based cameras. Additionally, the imagery would be analyzed with a computer algorithm to calculate and various vegetation indices. Though the imagery would be published via the Internet, it would be focused mainly on the upper canopy and not directed at areas where Park visitors would frequent. There would be an additional camera mounted on tower at 9.8 feet above ground that would be directed at three snow stakes located between 16 feet to 33 feet of the tower; the imagery from this camera is used to determine snow depth; it would have a limited field of view. All photos would be streamed, stored, and archived at NEON to maintain a consistent approach to data collection across the observatory.

This equipment would collect more than 200 measurements related to meteorology, radiation, atmospheric chemistry and air quality, dust and aerosols, carbon dioxide, water, and energy fluxes, as well as canopy phenology and snow depth via the cameras described above.

Auxiliary Portal and Electrical Service

The auxiliary portal is the location where the power line transitions from public to private. This would be the location of the transformer, disconnect, and meter. The auxiliary portal (100 square feet) would be located along the Blacktail Plateau Drive, the nearest point of power to the core site, and would be used to supply power for the project. An electrical and communication service conduit would either be buried or placed (and anchored in some cases) on the ground surface and hidden within rocks and vegetation to reduce visual detection within the area. Power would be installed as well, using a trencher or a mini excavator (of less than 6 pounds per square inch). The trench work would entail excavating a 21-inch-deep and 12-inch-wide trench in which both power and communications conduit would be installed. Construction is anticipated to take approximately two weeks; total ground disturbance is anticipated to be less than 0.05 acres. At the tower site there would be approximately 2,450 feet of surface mounted conduit and approximately 725 feet of buried conduit. Electrical conduits would originate to the north of the tower and terminate at the soil sampling (array) plots.

Instrument Hut

An instrument hut would be located near the base of the tower to house electronic instrumentation and other equipment associated with the tower, as well as tools, safety equipment, and other items for use during operations (Photo 4). The instrument hut base would be 10 feet x 21 feet (210 square feet) supported by a foundational footing that the structure itself rests upon. The hut would be 10 feet in height, including the height of the foundation above grade (the hut itself is 9 feet tall plus 1 foot of foundation exposed, for a total of 10 feet). The foundational footing would be affixed to the underlying bedrock prior to being covered to a minimum of 50% of its height (i.e., maximum of 1 foot remaining exposed above the surface).

Photo 4: Representative photo of Instrument Hut

There would be a boardwalk around the hut for access to each doorway and an air conditioning unit condensation trench (1 foot x 6 feet); the boardwalk is 46 inches wide all the way around the hut, including ramps.

The design would utilize a high performance, foam insulated, steel face panel modular structure that can be delivered in pieces and bolted together providing a tight assembly capable of withstanding temperature, humidity, rain/snow, and wind conditions.

The instrument hut would be constructed with the overall goal of blending into the surroundings by painting the outer façade to blend in with the shadows under the trees per Park specifications (there is no reflectivity).

Precipitation Collection System with Fencing (Double Fence Intercomparison Reference)

A standard precipitation collection system or DFIR (Photo 5) would be deployed near the proposed core site tower location (Figure 1). This assembly contains a weighing-type precipitation collector, one metal “Alter” shield, and two double wooden octagonal fences following U.S. Climate Reference Network specifications. Deployment of wind shields and fences would improve the ability to measure both liquid and solid precipitation without contamination from horizontal winds. The fencing would measure 5.75 feet high and would be placed in a 26-foot-diameter circle (531 square feet). The fence material would be an untreated 2-inch x 4-inch cross members, untreated 4-inch x 4-inch posts, with untreated 1-inch x 2-inch slats

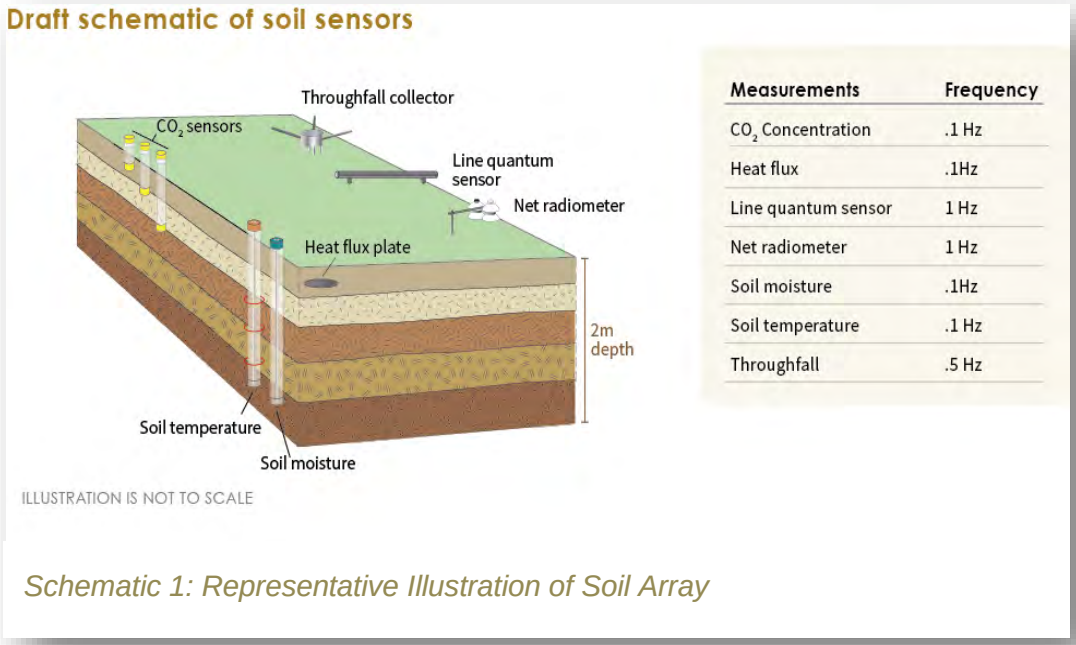
Photo 5: Representative photo of a Double Fence Intercomparison Reference (DFIR)

To conceal the infrastructure and reduce visual detection, the DFIR would be located within an area of trees (Figure 2A); however, approximately three trees would need to be removed to meet the open air requirements of the equipment.

The structure (shape and dimensions) of the DFIR fence would be designed to ensure accurate precipitation measurements. In this case, the fence would consist of 4-inch x 4-inch galvanized wire mesh that would attach to the outer DFIR fence and would be held off the ground by 3 inches. This would not add any additional fencing space around the DFIR, but ensure that no large mammal calves such as deer, elk, or bison could become trapped within the interior of the DFIR fencing. Alteration of the shape and dimensions of the DFIR fences would critically impact the accuracy of the measurements.

Soil Sampling (Array) Plots

The soil sampling (array) plots would extend southwest of the tower, there would be five soil sampling (array) plots arranged out from the tower generally in the direction of the prevailing wind (Figure 2A) to create an array. A total of five boreholes (Schematic 1) per plot would be dug. The size of each individual plot would be 16.4 feet square and spaced linearly approximately 102 feet apart. The total length of the entire soil array containing these five soil sampling (array) plots would be approximately 425 feet long. Each borehole would be vertically oriented and nominally 2.5 inches in diameter. Ideally boreholes would reach depths of approximately 6 feet or until bedrock is encountered. Each plot would have several in-ground and aboveground sensors installed that would continuously collect data related to temperature, moisture, carbon dioxide concentration (modeled to soil respiration), and radiation. The soil sampling boreholes would be constructed using a portable Utility Task Vehicle (UTV) mounted soil coring drill, which is a hydraulically powered direct push soil probing machine that utilizes both static force and percussion to drive steel boring rods into the sub-surface. The UTV is a six-wheeled, lightweight, all-terrain vehicle that has its weight dispersed across six wheels thereby minimizing impact to the vegetation. Other measures to minimize UTV disturbance are implemented (e.g., ramps for uneven terrain, and careful planning of access routes). The individual boreholes for sensors would be placed to avoid sensitive areas, as necessary.



Schematic 1: Representative Illustration of Soil Array

There would be a soil array device post adjacent to an unimproved footpath to delineate the location of each plot. These posts would support boxes in which the power and communications conduit is housed to the sensors and instrumentation for each soil plot. The conduits would specifically house the conducting wire and fiber optics cabling. The posts would measure 54 inches tall with two signpost mounts extended to a depth of 4 feet below grade. Disturbance associated with the soil sampling (array) plots would be approximately 1,346 square feet (Table 2).

Soil Horizon Pit

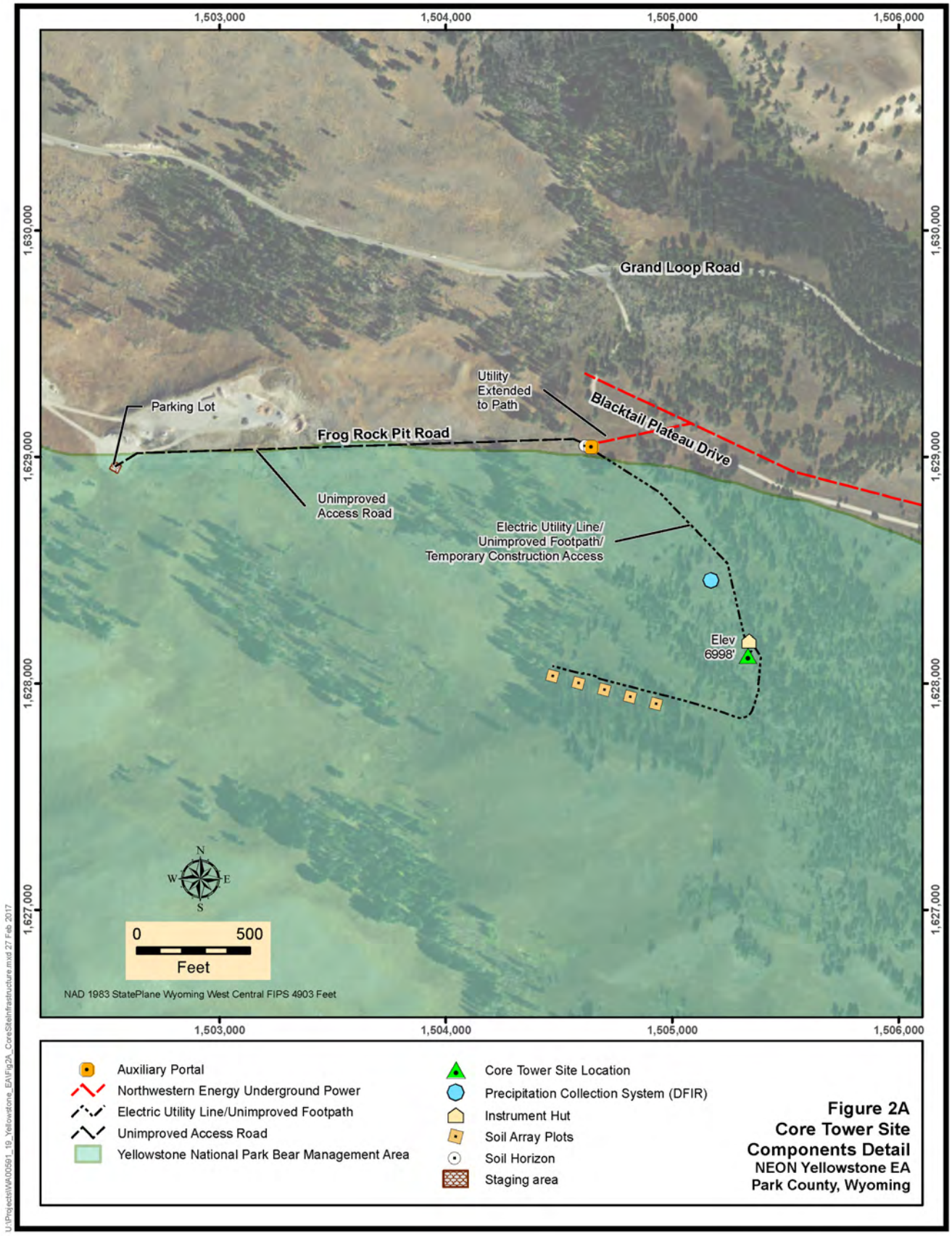
A soil horizon pit would be excavated, 6 feet x 6 feet (36 square feet) and up to a maximum depth of 7 feet. The pit would be reinforced with a safety trench box approved by the Occupational Safety and Health Administration, surrounded by signage with “do not enter” and/or barrier to prevent entry, and covered with plywood when not in use. The plywood will be secured to the top of the trench box and would prevent animals from entering. This pit would be open for approximately one week to collect soil samples and label the horizons. The soil horizon pit would be dug with a small rubber tracked excavator under the guidance of a scientist that would be on-site to monitor and guide the excavation. The excavated soil would be placed on tarped 0.75-inch plywood and surrounded by erosion fencing to minimize impacts to surrounding vegetation. Care would be taken to maintain topsoil and intact vegetative layer. Upon completion of the scientific work, the soil horizon pit would be backfilled and topsoil with the vegetative layer replaced on top.

Summary

The footprint of the site infrastructure would total 0.14 acres (Figure 2A), as follows in Table 2.

Table 2: Long-term Ground Disturbance by Infrastructure at Tower Site

Component	Area (Square Feet)
Tower Foundation	16.0
Electric Utility Line/Unimproved Footpath (co-located)	3,594.0
Instrument Hut	464.0
Auxiliary Portal	100.0
Soil Sampling Array (plots)	1,346
Precipitation Collection System [DFIR]	531.0
Soil Horizon (pit)	36.0
TOTAL	6,086 (0.14 acres)


1,503,000
1,504,000
1,505,000
1,506,000
1,630,000
1,629,000
1,628,000
1,627,000
Grand Loop Road
Utility
Extended
to Path
Blacktail Plateau Drive
Parking Lot
Frog Rock Pit Road
Unimproved
Access Road
Electric Utility Line/
Unimproved Footpath/
Temporary Construction Access
Elev
6998'
N
W
E
S
0
500
Feet
NAD 1983 StatePlane Wyoming West Central FIPS 4903 Feet
Auxiliary Portal
Northwestern Energy Underground Power
Electric Utility Line/Unimproved Footpath
Unimproved Access Road
Yellowstone National Park Bear Management Area
Core Tower Site Location
Precipitation Collection System (DFIR)
Instrument Hut
Soil Array Plots
Soil Horizon
Staging area
Figure 2A
Core Tower Site
Components Detail
NEON Yellowstone EA
Park County, Wyoming
U:\Projects\WA00591_19_Yellowstone_EA\Fig2A_CoreSiteInfrastructure.mxd 27 Feb 2017

Aquatic Site

Aquatic sites represent continental ecological variability, such as various geomorphologic and hydrologic regimes and land use types, and would provide data that capture variability and improve ecosystem-level understanding. NEON would use a standardized, consistent sampling strategy across field sites, time, and focal species. Field operations crews would collect observational data at regular intervals to complement data collected by automated in situ aquatic sensors.

Construction

Proposed construction access for the aquatic site would be via Grand Loop Road then south on an existing maintained road used to access the Blacktail Cabin. Equipment would be carried by hand to the installations sites or wheeled into the sites. Drilling for wells would be conducted using a hand drill and other portable equipment carried or wheeled into the site, no vehicle access would be allowed and no new construction (temporary) roads or footpaths would be established. All drilling equipment would be transported along the stream corridor (i.e., hand drill, tools and other equipment, including a portable drilling system) by hand or with a small cart or all-terrain vehicle, and pathways would be selected to achieve the objectives of the work, but with focus to minimize disturbance to the vegetation. The trench work associated with in-stream sensor and auxiliary portal and electrical service would entail excavating a 21-inch-deep and 12–inch-wide trench in which both power and communications conduit will be installed. Construction is anticipated to take approximately two weeks; total ground disturbance is anticipated to be less than 0.05 acres.

Access

Parking for NEON staff would occur in a small parking lot just off of Grand Loop Road and operational access would originate from Upper Blacktail Road; however, no established footpath(s) would be created. Operational crews would be advised to tread lightly in and around existing vegetation taking care not to create social trails.

Aquatic Instrumentation

Proposed infrastructure at the aquatic site would include:

- In-stream sensor suites containing two water quality sensors;
- Meteorological station;
- Groundwater observation wells; and
- Electrical power.

A conceptual design layout of the proposed aquatic site is illustrated in Figure 2B.

Schematic 2: Representative Schematic of Meteorological Station

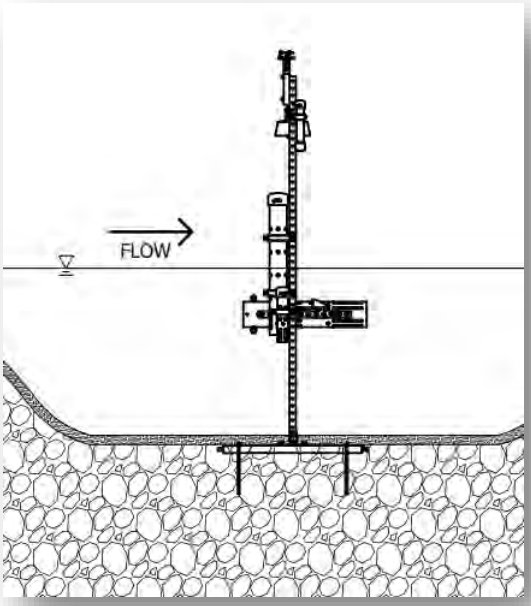
Meteorological Station

A meteorological station would be located in the near-stream environment to capture local climate representative of the stream. The meteorological sensors include temperature, relative humidity, barometric pressure, 2-D wind speed and direction, net radiometer, and *Photosynthetically Active Radiation* (PAR). The sensor suite would be mounted on a tripod frame (Schematic 2) that would be anchored to the ground by way of five guy wires, each guy wire would be anchored using a 0.5-inch x 30-inch galvanized ground anchors, and each foot of the tripod would have two 24-inch stainless steel rebar stakes to provide additional stability. The total above ground height of the met station will be 12 feet (10-foot mast plus a lightning rod). The feet of the supporting tripod would extend to a maximum of 3.5-foot radius from the mast. The boom that supports the sensors for radiation measurements would extend 6 feet from the mast.

Three primary guy wires would be installed at a height of just under 10 feet and extend to the ground anchors at 45 degrees. The remaining two guy wires would be installed at a height of about 9 feet and extend at 60 degrees or 12.25 feet perpendicularly from the boom to the ground anchors. These were designed to meet environmental requirements for wind and ice loading, while at the same time meeting the requirements for sensors. The sensors would be located at a height of approximately 9 feet from the ground. The total diameter of the meteorological station would be 90 inches.

In-stream Sensors

Two in-stream sensor suites *(sensor set 1 – S1 and sensor set 2 – S2)* would be mounted on a metal post with a maximum height of 7 feet above the stream bed and with a basket base of 2 inches x 6 inches (6 square feet total). The sensors measure temperature, conductivity, pH, chlorophyll, fluorescent dissolved organic matter (fDOM), dissolved oxygen, nitrate, and surface water level. In addition, a PAR sensor would be located at the top of the stream sensor infrastructure. The sensors and infrastructure would be installed by hand and may require the use of a hammer to secure the 18-inch stakes that would be required to secure the equipment. More specifically, a fence post pounder may be used, in addition to a long bar to drive in auger style ground anchors, and a sledge hammer for other anchors. Power would be installed as well using a mini excavator (of less than 6 pounds per square inch). The in-stream infrastructure used to mount the sensor equipment would remain in place year round for the 30-year life of the project and is expected to tolerate minor surface ice. However, to preserve the integrity the sensors they may be removed during the winter season if necessary. Additionally, sensors may be removed for routine maintenance, cleaning, calibration or repairs throughout the life of the project. An illustration of an in-stream sensor is provided in Schematic 3.



Schematic 3: Representative Schematic of In-Stream Sensor

Stream stage (water level) would be measured manually using a staff gauge. The staff gauge measurements would be used in combination with the automated measurements made by the pressure transducer located on the in-stream infrastructure (S1/S2) to provide near-continuous measurements of stream discharge. Staff gauge installation would utilize a metal post driven into the stream bed (up to 2 feet) and would have a metered ruler attached to the post. The overall above grade height of the staff gauge would be less than 6 feet.

A camera would be utilized to record photos of site conditions several times per day. The camera is positioned such that the field of view captures information about the water state in the channel (flowing, frozen) and secondarily the state of vegetation. A single camera system would be utilized and would be located very near one of the in-stream infrastructure locations (within 30 feet of either S1 or S2). Camera mounting infrastructure would utilize a small metal post driven in to the near-stream shore (approximately 5 to10 feet back from the stream edge) and set in a small concrete pedestal (Schematic 4). Power and communications for the camera would come from direct, wired connection to one of the field device posts for the in-stream infrastructure. Specifically, an armored Ethernet cable will run from the camera on grade to a power over Ethernet switch located in the environmental enclosure that houses the power and communication systems for the downstream sensor station (S2), referred to as a field device post.

Schematic 4: Representative Schematic of Camera

Groundwater Well Observation Network

The groundwater observation well network at the site would consist of eight wells. A set of groundwater wells will be installed in the stream riparian corridor and concentrated near in-stream sensor sets S1 and S2 (Figure 2B). The groundwater well locations would be selected to provide a spatial geometry suitable for the examination of hydrologic exchange processes between the stream surface water and surrounding groundwater. Six wells would be located near the stream, within 20 feet of the streams edge, and two wells would be located approximately 50 to 100 feet from the stream's edge. This would allow for observations of both *near stream* and *far stream* water chemistry and hydrologic gradients. The wells would be drilled to a few feet below the season low water table elevation; anticipated well depths range from 8 to 15 feet below ground surface. Wells closer to the stream would generally be on the shallower end of the range, and the further ones will likely be deeper.

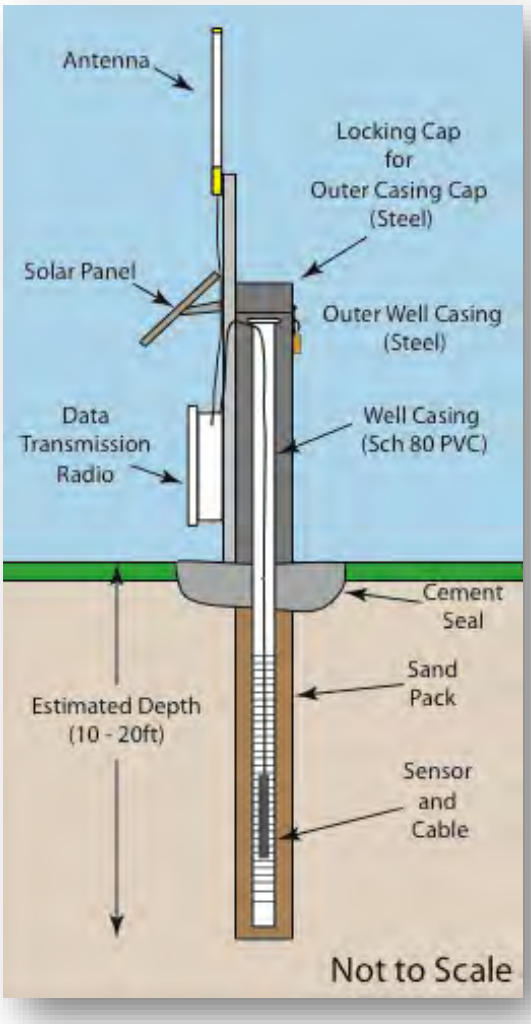
Access to the site would be via the existing gravel road directly to the west of the stream to access lands near where the wells would be installed, and then overland travel would occur to reach each well location. Travel between wells would be via nearly direct paths between each well site, with care taken to avoid damage to vegetation.

The locations of the groundwater wells would be selected based on the predominant groundwater flow in the area and determined by the location of the instream sensors. Minor adjustments to the exact locations of the wells may occur during the drilling process due to the potential for hitting rocks in the subsurface. Groundwater well drill cuttings shall be collected and

hauled off site to a facility or location that is certified to receive these materials or the native material shall be relocated and spread within a designated location determined by the Park. Should the drilling equipment encounter refusal before the intended drill depth is achieved, the abandoned well hole will be backfilled with the native cuttings. The drilling equipment would move within 32 feet of the abandoned well and attempt to drill to the desired depth. The Park would be notified and a request would be issued if a modification to the well locations needs to be considered. Hand tools and portable drilling equipment (such as a small track mounted drill rig) would be used to drill the wells, and then sensors placed by hand during the course of approximately one week; trails would not be established and care would be taken not to trample existing vegetation. Wells would be developed within zero to three days of construction. Purge water would be discharged onto the ground surface in the uplands within 16 feet of the well.

The general well design is shown in Schematic 5, and the well design meets the construction requirements for groundwater observation wells in the State of Wyoming. Neither permits nor a licensed well driller are required for installation/construction of the observation wells in the State of Wyoming; however, for safety, a locking metal outer protective shell, surrounding the polyvinyl chloride well, set in a small concrete pad would be utilized.

Protection for the well and groundwater comes from a few above grade components. Each well would have a small (15 inches square x 6 inches thick) cement pad poured at grade surrounding an outer metal casing that is used to provide impact protection to the polyvinyl chloride well casing and security for restricting well access through a lockable lid. The outer metal casing would be made of an aluminum shell (4 inches x 4 inches x 5 feet tall) which would be partially buried (2 feet) in the well bore and stabilized by the cement pad. The overall height of the outer casing would be 36 inches above grade. NEON would assume all risk to equipment if damaged by wildlife.



Schematic 5: Representative Schematic of General Well Design

Data transmission and power supply for the wells would come from a solar powered radio system, which would provide power to the sensor and send the data back to the NEON Aquatic power and communications portal at the site. Each of the eight wells would be outfitted with a power/radio

system. A battery would be included, capable of supplying power to the system for two to three months between recharges. A small solar panel (27 inches x 20 inches) would be attached to the well casing and used to provide additional power to the battery. Sensor maintenance will occur roughly two times per month for the first few months and then will likely be reduced to one time per month

The total overall height of each groundwater well radio system would be up to 69 inches above grade. The main portion (outer casing/radio) of the above ground infrastructure would be kept below 36 inches above grade and only a metal support and antenna would extend above this, to minimize visual impacts to Park visitors.

The outer casing would be a metal tube 6 inches in diameter. Water would be extracted two times per year from four of the eight wells using a pump that can be hand carried to the well for each sampling event. A detailed illustration of the well design is provided as Appendix 3.

Well installation would follow procedures to reduce visibility by Park visitors, e.g., equipment would be painted to blend with surrounding vegetation, non-reflective finishes would be used, and installations would be kept as low as possible, screened from view by using existing vegetation.

The Park would also require that decommissioning wells include all observation wells be plugged and capped upon conclusion of the project.

Auxiliary Portal and Electrical Service

The auxiliary portal is the location where the electric power line transitions from public to private. This would be the location of the transformer, disconnect, and electric meter. The auxiliary portal (100 square feet) would be located in between the Upper Blacktail Road and the creek corridor (Figure 2B) and would be used to supply power for the aquatic site (Figure 2B).

An electric utility line would be buried from a Northwest Energy connection box south of Grand Loop Road to the Axillary Portal within the existing roadbed or adjacent to the road. From the axillary portal, power would either be placed into a secured conduit at ground level or placed in a shallow trench and buried to the in-stream sensors. After installation of the power and communications conduit, the area would be reclaimed. Even though the conduit would be buried, there would not be any long-term surface disturbance. The meteorological station would be wired directly to the electrical power supply.

Digital communication and uploading and/or retrieval of data would be accomplished by mounting a small satellite dish (approximately 3 feet wide) on a 13-foot standalone pole to the power and communications portal located near the access road.

Summary

The footprint of the aquatic site infrastructure would total 0.004 acres as follows in Table 3 below. Because the electric power and communications conduit would be reclaimed, there would be no long-term surface disturbance from the conduit.

Table 3: Long-term Ground Disturbance by Infrastructure at Aquatic Site

Component	Area (Square Feet)
In-stream Sensors	16.0
Meteorological Station	28.0
Groundwater Wells (8 wells)	13.0
Auxiliary Portal	100.0
TOTAL	157 (0.004 acres)

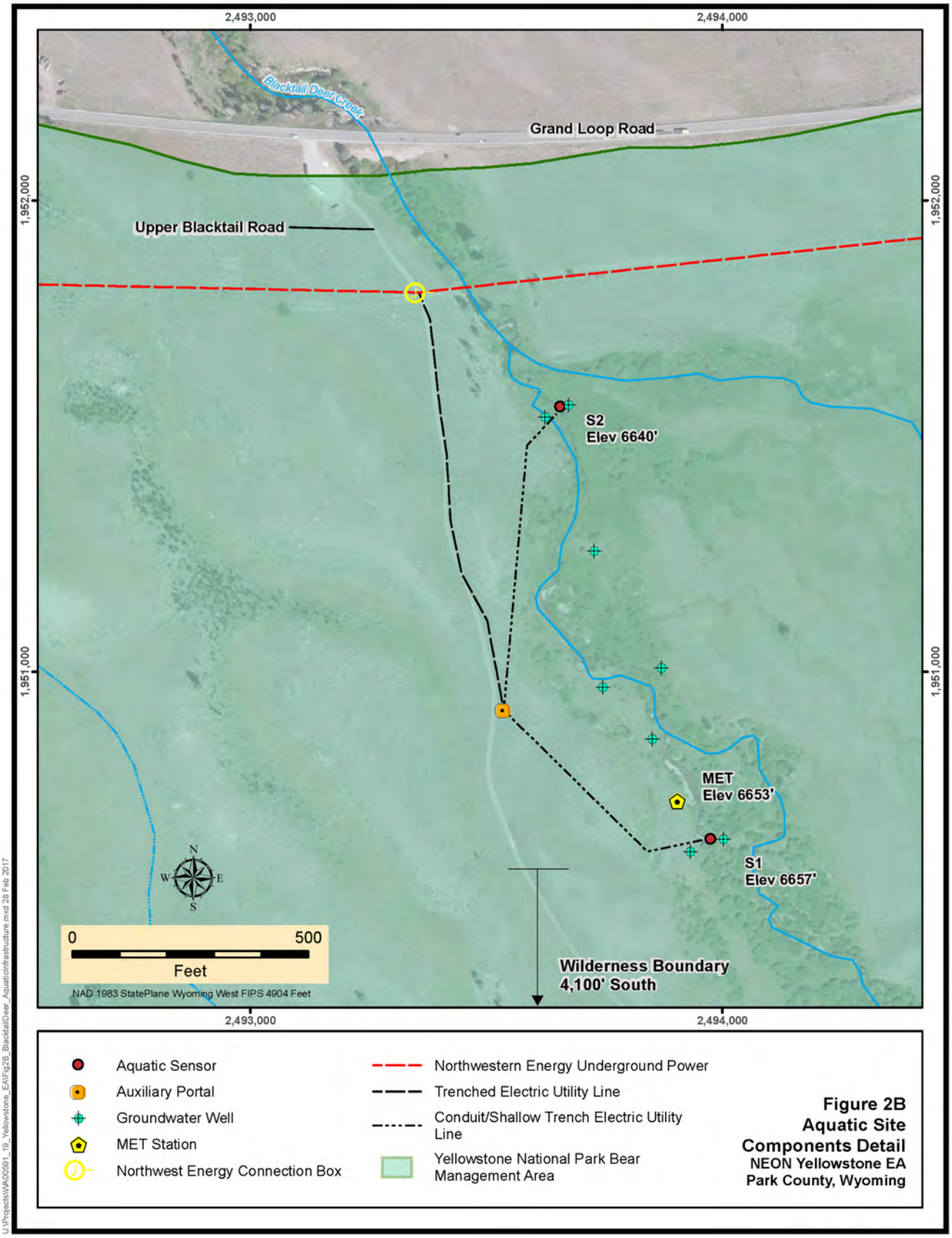
Maintenance of Atmospheric and Soil Instrumentation

Once constructed, the tower would be visited by two NEON personnel, approximately every two weeks to ensure computers, sensors, and other equipment is functioning properly and to conduct routine maintenance as necessary. The sensors on the tower would collect more than 200 measurements related to meteorology, radiation, atmospheric chemistry and air quality, dust and aerosols, carbon dioxide, water, and energy fluxes. Sensors in each of the five soil array plots would continuously collect data related to temperature, moisture, carbon dioxide concentration (modeled to soil respiration), radiation, and possibly root growth. Field crews would be instructed to stay on the unimproved footpath to access the tower, instrument hut, and soils array plots.

Aquatic Observations

The Aquatic Observation System (AOS) would include data collection of the following: algae, aquatic macrophytes, bryophytes and lichens, aquatic microbes, aquatic invertebrates, fish, sediment chemistry, and water chemistry. The in-stream instrumentation discussed previously would monitor water temperature, dissolved oxygen, turbidity, pH, conductivity, fDOM, nitrate, and PAR. Near-stream instrumentation would monitor groundwater temperature, level, and conductivity; air temperature; precipitation; barometric pressure; PAR; net radiation; wind speed and direction and would also be fitted with a camera. During the growing season, access to the sensors and infrastructure would be required every two weeks to perform maintenance procedures (Appendix 4).

A subset of four of the eight groundwater wells would be sampled for groundwater chemistry twice per year (spring, fall) to examine seasonal variation. The same wells will be sampled each time, unless a well becomes damaged or is dry, and then a different well would be selected and sampled. In general two wells furthest from the stream and two of the near stream wells would be sampled. Groundwater sampling would also occur within a day of surface water chemistry sampling to provide a snapshot of water chemistry concentrations spanning from the stream channel, through the hyporheic zone (transition zone between surface and groundwater), and out to the groundwater zone. Extraction of groundwater for obtaining samples would follow low flow methods and total extraction of water from each well will be 4 to 8 gallons; for a total groundwater extraction of 30 to 60 gallons per year from the full well network.


2,493,000
2,494,000
1,952,000
1,951,000
Blacktail Deer Creek
Grand Loop Road
Upper Blacktail Road
S2
Elev 6640'
MET
Elev 6653'
S1
Elev 6657'
N
W
E
S
0
500
Feet
NAD 1983 StatePlane Wyoming West FIPS 4904 Feet
Wilderness Boundary
4,100' South
Aquatic Sensor
Auxiliary Portal
Groundwater Well
MET Station
Northwest Energy Connection Box
Northwestern Energy Underground Power
Trenched Electric Utility Line
Conduit/Shallow Trench Electric Utility Line
Yellowstone National Park Bear Management Area
Figure 2B
Aquatic Site Components Detail
NEON Yellowstone EA
Park County, Wyoming
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Surface water chemistry would be measured throughout the year at each site, up to 26 times per year in streams. Sediment chemistry would be measured up to three times per year. Composited sediment samples would be collected from multiple depositional zones within a 1,640-foot section of the aquatic site. Target grain size is < 0.08 inches and up to 2.4 gallons would be collected during one bout. Three bouts are proposed with a maximum annual yield of up to 7.2 gallons of sediment. Collected sediment would be analyzed for chemical constituents, including inorganics, organics, and nutrients as well as physical grain size. Samples would be collected by domain personnel or seasonal field personnel and shipped to a NEON outsourced facility for analysis. Water samples would be shipped to a NEON outsourced facility for measurement of nutrients, basic water parameters, dissolved gases, and stable isotopes. Reaeration (i.e., gas exchange), a key parameter in the measurement of stream metabolism, is the movement of oxygen from the atmosphere into the water, and is measured as the net rate (i.e., gain and loss of oxygen) at which gas exchanges across the air-water interface. During each reaeration sample date (up to 10 times per year), two to three NEON personnel would collect data for the reaeration rating curves using a simultaneous and continuous injection of both an inert gas (sulfur hexafluoride, when possible) and a conservative tracer ($Chlorine^-$ or $Bromine^-$). Sulfur hexafluoride has minimal bio-uptake and is deemed safe for aquatic life (Wilson and Mackay 1993; Harden et al. 2003; Busenberg and Plummer 2010). The conservative tracer is dripped into the stream at a known rate (based on discharge). The inert gas is bubbled into the stream water at the same location and time at a rate of 100 to 200 ml/min. NEON staff would collect water and dissolved gas samples at four locations downstream of the tracer input. Water travel time from the most upstream site to the most downstream site would be approximately 15 to 45 minutes, but is site specific. Discharge is the volume of water moving down a stream or river per unit of time would be measured by using a handheld flow meter. The development of discharge rating curve is completed biweekly (up to 26 times per year).

Fish would be sampled two times per year during the growing season, roughly spring and autumn (Appendix 4). The stream reach is approximately 3,280 feet in length and would be sampled with a direct current or pulsed direct current backpack electrofisher. Up to 10 subreaches would be established and each subreach would be sampled with one to three passes. Passes would be separated by no less than 30-minute intermissions. The data collected from fish sampling would provide biodiversity information indicating ecosystem health, as well as length and weight, which can indicate fish condition or the health of the fish population. Captured fish would be anesthetized (if needed), identified, weighed, measured, photographed, and then released. Respiration would be monitored, and fish would be returned to the stream and all other guidelines and protocols associated with the Institutional Animal Care and Use Committee (IACUC) approved fish protocol would be followed. Fish would be anesthetized at the discretion of the field scientist with AQUI-S 20E (10% eugenol). Up to 0.08 ounces (oz.) would be mixed in one to two buckets of native stream water for a maximum concentration of 30 parts per million. Fish sampling occurs twice annually. Total expected amount of AQUI-S20E to be used annually would be approximately 0.34 oz. Fish treated and released following exposure to AQUI-S 20E are safe for human consumption. This is an experimental drug approved for trial use through the United States Fish and Wildlife Service (USFWS) Aquatic Animal Drug Approval Partnership Program Investigational New Animal Drug program #11-741.

Benthic macroinvertebrate samples would be collected using standard methods most appropriate to the substratum and habitat type sampled. Habitats would be determined based on a rapid habitat assessment performed early in sampling. Probable methods include a *Surber sampler* (1 square foot per sample) and hand corer (0.06 square feet per sample) or Hess

sampler (9.25 square feet per sample). A maximum of eight samples would be collected on each sampling date, three times per year for a total of 24 samples per year.

Aquatic invertebrates would also be sampled at the aquatic site. Stream benthic invertebrate communities are strongly affected by environmental disturbances. Benthic invertebrates would be sampled from riffles, runs, snags, and pools. Invertebrate sampling would occur three times per year: spring, summer, and autumn (Appendix 4) at or near base-flow conditions at eight locations throughout the stream reach. Collected specimens would be preserved in 95% ethanol (diluted to 70% in-sample) and sent to a laboratory for analysis.

Periphyton (algae, cyanobacteria, heterotrophic microbes, and detritus) would be sampled three times per year from eight locations throughout the stream reach. These communities represent the base of the food web in aquatic systems. Sampling methods would include rock or wood scrubs, sand or silt sampling, or plant collection. Samples would be processed at the domain support facility before sending to an external laboratory for analysis.

Microbes would be sampled in wadeable streams in surface water and benthic habitats. Linking microbial activity and community composition to chemistry and periphyton measurements would enable a mechanistic understanding of ecosystem function. Surface water microbes would be collected along with monthly water chemistry samples. Benthic microbes would be collected three times (roughly spring, summer, and fall) per year along with periphyton samples using a rock or wood scrub technique, or small sediment or plant collection technique. Scrub samples would be filtered through a capsule filter, while sediment or plant samples would be collected in tubes or small sampling bags. A total of eight benthic microbe samples would be collected per sampling date. Microbe samples would be sent to an external laboratory for analysis

Aquatic plants and algae would be sampled using a combination of point-transect and quadrat sampling methods to determine changes in community structure, abundance, and biodiversity over time, as well as changes in biogeochemical cycles. Aquatic plants, bryophytes, and lichens would be identified in-situ where possible. However, plants and bryophytes would also be collected in a 0.25-square-meter quadrat for biomass determination. Additional voucher specimens could be collected if a field technician is unable to make a positive identification in the field. Aquatic plant and algae sampling would occur three times per year: spring, summer, and autumn (Appendix 4) at 10 locations along the reach. Sampling would not occur directly following stream flooding.

AOS observations and sampling would occur along Blacktail Deer Creek between Grand Loop Road and the Upper Blacktail Cabin within an area of 96 acres (approximately 3,280 feet in length up to approximately 650 feet on either side of the creek corridor). The AOS would lie approximately 2,000 feet north of recommended wilderness (Figure 2B). No trails would be created to access the AOS and crews would be encouraged to tread lightly in and around existing vegetation avoiding the creation of social trails. Appendix 4 provides a proposed schedule for aquatic observations described above.

Maintenance of Aquatic Instrumentation

The in-stream instrumentation discussed previously would monitor water temperature, dissolved oxygen, turbidity, pH, conductivity, fDOM, nitrate, and PAR. Near-stream instrumentation would monitor groundwater temperature, level, and conductivity; air temperature; precipitation; barometric pressure; PAR; net radiation; wind speed and direction and would also be fitted with a camera. During the growing season, access to the sensors and infrastructure would be required every two weeks to perform maintenance procedures.

Airborne Operations

NEON's Airborne Observation Platform (AOP) would use small aircraft outfitted with remote sensing equipment (including a hyperspectral imager, LiDAR sensor, and high-resolution camera) to fly over sites annually. Derived data products would provide high resolution (meter-scale) information on the structure and biogeochemical properties of vegetation. Data collected by the AOP would facilitate scaling up site-based data streams. The NEON AOP would fly, on average, 3,280 feet above ground level, once per year, at or close to the time of peak vegetation greenness. The NEON airborne survey at Yellowstone Northern Range would typically last eight days, with a maximum of four hours per flight day, which includes three flight days and five additional days set aside as contingency in case of bad weather. The Yellowstone Northern Range is adequately covered by a network of Global Positioning System (GPS) base stations operated by the National Oceanic and Atmospheric Administration's National Geodetic Survey, which means no field personnel are necessary to support the flights, which will be based out of Gallatin Field airport in Bozeman, Montana. Additionally, Federal Aviation Administration recommendations to fly at altitudes that always exceed 2,000 feet above the ground to ensure noise abatement procedures are adhered to. Ground activities include setting up calibration tarps, a solar radiometer, and a differential GPS base station and collection of the reflectance spectra of leaves in coordination with foliar sampling (AOP ground activities may not occur every year at every site).

Terrestrial Observations

The Terrestrial Observation System (TOS) would utilize field staff to collect data to characterize organisms and soil to investigate biogeochemical cycles, infectious diseases, and characterize local patterns, dynamics, and linkages in terrestrial ecosystems. Figure 3 provides a map of the distribution of candidate TOS observation/sampling plots across the proposed project site. TOS plots would be distributed throughout a non-contiguous 17,934-acre area.

The majority of the candidate plots are outside of the Bear Management Area (BMA). NEON personnel conducting on-the-ground observations would not be permitted to enter any area(s) within the BMAs during restricted periods (see *Mitigation Measures*) without prior coordination with the Park. Likewise, the Park would require that sampling sites not be visited if special status species are currently using the immediate area or if other wildlife related issues arise, as these could be exacerbated by the presence of humans in the area. If a special status species is encountered, the observation would be recorded and the Park would be notified; special status species would not be collected.

The selected taxa are designed to capture a wide range of turnover time, and diverse evolution histories. Specifically, the TOS observations and sampling would consists of:

- Plant biodiversity;
- Plant biomass, leaf area, and chemical composition;
- Plant phenology;
- Bird composition and abundance;
- Ground beetle abundance and diversity;
- Mosquito phenology, diversity, abundance, and pathogens;
- Small mammal abundance, demography, and pathogens;
- Tick diversity, abundance, and pathogens; and
- Soil microbe abundance, diversity, and function; and soil biogeochemistry.

TOS involves a combination of observations and physical sample collection. All TOS protocols involve physical sample collection in addition to observations, except for the breeding landbird sampling. No physical collections are planned for the breeding landbird sampling; the protocol is restricted to point counts. NEON personnel conducting on-the-ground observations would minimize disturbance by working with the Park to identify the most appropriate measures for the sample design and foot travel. Ecologically sensitive areas identified by the Park would be avoided and plot-specific protections such as small sections of “geoblock” or 2-inch x 2-inch wood could be left seasonally or placed with each sampling event as needed and requested by the Park. Social trails would be minimized by reducing the amount of recurring traffic that occurs in undisturbed areas; this would be accomplished by approaching sampling plots and grids from different locations along established roads or trails and tracking each route with GPS technology to guide subsequent trips to new areas. Field staff would not walk to single file to plots and will take care to avoid trampling vegetation (please see other applicable BMPs at the end of this chapter).

Prior to the first year of field observations, NEON personnel would visit potential areas where observations and sampling would occur. The proposed locations that meet NEON scientific and logistical criteria and would be delineated with a combination of permanent primary (one to two per plot, point, or grid) and secondary markers (three to seven per plot or grid) that would facilitate repeat visits to the plots over time. The type of marker used would be determined through consultation between NEON and the Park, though would be kept as small as possible to reduce visibility, while still allowing plots to be found and identified by NEON staff during operations.

Observations of plant diversity would enable an understanding of local (i.e., plot) and regional (i.e., NEON site representing the Northern Rockies) temporal patterns of native and invasive plant species diversity. NEON personnel would observe the presence and percent cover of species in 3.2-foot x 3.2-foot subplots, and presence of plant species at larger scales within designated plots one time each year (Figure 3). A subset of species encountered would be collected. Some specimens would be used for training and quality purposes; others archived as a resource for scientists, the Park, and the general public. Plant biomass and productivity would measure plant biomass pools and fluxes using a variety of standardized methods. Herbaceous biomass and vegetation structure will be measured directly by field personnel at 30 to 40 plots, and litterfall would be measured at 20 plots by installing elevated (two 5.38-square-foot polyvinyl chloride [PVC] or wood frames standing 2.6 feet off the ground per plot) and ground (two 16.15-square-foot delineated areas at grade per plot) litterfall traps. Herbaceous biomass would be sampled one to two times per year, litterfall four to 12 times per year, and vegetation structure one time per year to every three years at some locations (Appendix 5). Additionally, below-ground biomass of roots and the chemical composition of leaves would be measured once every five years, while coarse downed wood (e.g., logs on the ground) would be evaluated every three to five years. Patterns of plant phenology would also be evaluated to monitor the timing, duration, and seasonal progression of biological processes.

NEON would target beetles, mosquitoes and ticks for invertebrate sampling. Ground beetle diversity and abundance would be sampled to capture variation throughout the seasons and from year to year. Shifts in ground beetle distribution and populations can indicate significant changes in the local ecological community. Beetles would be collected using four pitfall traps embedded in the ground at 10 plots (totaling approximately 4 square feet across each plot). The traps are made from cups that are 2.7 inches in depth and 4.3 inches in diameter. The traps would use a diluted solution of non-toxic propylene glycol to preserve the samples for DNA analysis; this is non-toxic and odorless so as not to attract wildlife. The traps would be checked bi-weekly throughout the growing season (typically April through October) (Appendix 5). At the

end of the sampling period, all trap equipment would be removed, and NEON personnel would backfill the holes in the field. Each pitfall trap is covered with a low clearance 7.9-inch x 7.9-inch cover (approximately 0.6 inches above the lip of the cup) to reduce non-target species collection. The cover denies access to all but the smallest vertebrates; however, it is possible for very small amphibians, reptiles, and mammals to still enter the trap. As an added precaution, a threshold of 15 individuals per vertebrate species, per plot, per season has been established. When 15 cumulative individuals of any given vertebrate species are captured at a single plot in one sampling season, mitigating measures based on the ecology of that vertebrate species would be considered. Depending on the outcome of such an analysis, various mitigation measures may be employed and may result in actions such as small-scale temporary halts in sampling, relocations of sampling plots to alternative areas, or halts in sampling for the remainder of the season. Decisions regarding appropriate mitigation are reviewed by the IACUC panel for the NEON project before implementation, as discussed below and in *Mitigation Measures*. NEON would seek authorization through a scientific collection application to cover the potential bycatch of small amphibians, reptiles, and mammals that may enter the pitfall traps. A copy of NEON's IACUC protocols, along with a list of possible bycatch species and estimated capture numbers would be available upon request.

Mosquitoes are sensitive to climate variation and they are important as disease vectors (e.g., West Nile virus and Dengue virus). Mosquitoes would be collected using carbon dioxide baited traps. These traps operate by slowly releasing carbon dioxide, mimicking the exhaled breath of an animal. The carbon dioxide attracts mosquitoes, which are drawn into the trap by a fan. Mosquito traps would be located near roads or access paths in each of the major vegetation types. Traps would be set at 10 plot locations for approximately 40 consecutive hours every other week during the field season (Appendix 5). During the off-season, a reduced number of traps (three) would be sampled weekly for less than 24 hours and only when temperatures exceed 39.2°F.

Ticks would be collected to improve understanding of how the presence of infectious agents (e.g., Lyme disease) changes over time within ecosystems. Ticks of all life stages would be collected April through September using a drag sampling method, pulling a 3.2-foot x 3.2-foot cloth across the ground. Sampling would occur at up to six different plot locations at each site. Sampling would occur once every three weeks or once every six weeks, depending on whether or not ticks have been detected in the past year.

Small mammals and breeding landbirds are important components of virtually all ecosystems in North America. Sampling would provide consistent, comparable measures of species diversity, composition, abundance, and density, as they relate to climate, productivity, and insect abundance. For breeding landbirds, NEON would use the passive, observational point count sampling technique, with sampling occurring in the early morning within a five- to 20-day window in the breeding season (Appendix 5). Each sampling point would be observed for six minutes, once per year.

In order to study small mammals and mammal-borne diseases, NEON would employ a mark-recapture approach following an approved IACUC sampling protocol. Sampling would occur monthly at six Distributed Plots (grids) of 100 Sherman live-traps each (Figure 3). Between three and four sampling periods are expected each year when temperatures are above freezing and less than 6 inches of snow is present. Each sampling period would consist of three nights of trapping at three of the grids (pathogen grids) and one night of trapping at the remaining three grids (diversity grids). Traps will be set as the sun sets and checked each consecutive morning as soon as it is light enough to work. Sunflower seed and millet, heat-sterilized to prevent germination, would be used to bait small mammal traps. Freeze-dried mealworms would also be added to the bait, if shrews comprise more than 20% of all captures (not expected).

Upon capture, individual small mammals will be processed in one of three ways, according to their classification as target, opportunistic, or non-target. All processing will take place in the field, to allow for quick release of captured individuals at the point of capture and to provide adequate ventilation. Handling time per individual will be 15 minutes or less. At Yellowstone, target species are all small mammals (weighing less than 600 grams) in the family Cricetidae, including the southern red-backed vole *(Myodes gapperi)* and the North American deermouse (*Peromyscus maniculatus*). Capture rates for target species are variable, with an average of 10% capture rate expected across all species. Opportunistic species are not expected to be captured frequently, with no more than 20 individuals captured per species per year. These include shrews (*Sorex* spp.) and small ground squirrels (e.g., least chipmunk [*Tamias minimus*], golden-manted ground squirrel [*Spermophilus lateralis*]). All opportunistic species will be handled as described below for target species, except that no pathogen-related blood sampling will be conducted on these individuals. All non-target species (e.g., ermine [*Mustela ermine*], northern pocket gopher [*Thomomys talpoides*]) will be released immediately at the point of capture, without handling. If possible, the species identification of these individuals will be recorded. A maximum of five individuals of non-target species are expected to be captured each year.

Upon capture, individuals of target and opportunistic species would be identified to species, sex and reproductive condition assessed, size measurements taken, checked for attached ticks, and marked for identification if recaptured subsequently. Individuals would be marked with either one numbered ear tag (0.25 inches long) or a subcutaneous, RFID PIT tag (pre-sterilized 8 millimeters or 12 millimeters). Mode of tagging will be based on the length of the external ear lobe, as some species, such as voles (e.g., *Microtus* spp*., Myodes* spp.) do not have sufficiently large ear lobes for securing ear tags. Due to their sensitivity to handling, shrews will not be tagged, but instead marked on the belly with a colored permanent marker and released immediately. Individuals are marked to allow the study of population sizes and dynamics, longevity and movement, and a variety of other aspects of life history that require permanent individual marking.

Blood samples will be collected from target species for either offsite pathogen screening or archiving at an accredited institution to enable a diversity of future analyses. Blood samples will not be collected from opportunistic or non-target species, any individual weighing less than 10 grams, any individual with a pronounced or physically debilitating injury, any individual that has already been captured and bled during a current sampling period, and/or any species excluded from bleeding based on permitting regulations.

Additional tissue samples to be collected from target and opportunistic species (except shrews) will include one ear tissue sample from the untagged ear for archiving at an accredited institution to enable genetic analyses and clipped whiskers and/or hair for archiving at an accredited institution to enable genetic and isotopic analyses. Fecal samples will also be collected from captured individuals for archiving at an accredited institution to enable pathogen, genetic, and a variety of potential analyses. Samples will not be collected from shrews.

Accidental vertebrate mortality could result from small mammal trapping. NEON attempts to limit such mortality. In the unlikely event that greater than five small mammals die during one night of trapping on a particular trapping grid, trapping would be immediately discontinued on that grid for that sampling period (roughly equivalent to a month). If an accidental death occurs during research activities, a voucher specimen would be collected and curated according to NPS guidelines for future research and educational needs. In 2012, NEON small mammal trapping at Rocky Mountain National Park, which has a similar small mammal community to Yellowstone, resulted in a 2% mortality rate for captured individuals. In 2015, NEON small mammal trapping at 25 sites throughout the U.S. experienced site-specific mortality rates of 0 to 7%, with an

average rate of 1.9%. The above-average mortality rates occurred at sites with higher shrew populations, which are not expected at the sampling location in the Park. Annually, NEON would conduct a maximum of 4,800 trap nights (one trap night equals one trap set for one night) in the Park. With an average capture rate of 10% (based on hundreds of previous small mammal trapping studies), NEON would capture approximately 480 small mammals. With a 2% mortality rate, approximately 10 small mammals would be expected to be lost from the Park each year.

NEON would comply with all applicable provisions of the Animal Welfare Act (Title 7 U.S.C. § 2131 et seq.) and the regulations promulgated there under by the Secretary of Agriculture (9 CFR 1.1-4.11) pertaining to the humane care, handling, and treatment of live, vertebrate animals, as well as any other applicable federal statutes or regulations relating to the animals. NEON has prepared an Animal Welfare Assurance Plan that adheres to the "U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research and Training" and pledges to carry out its activities in accordance with several applicable guides. These include the most recent edition of the Guide for the Care and Use of Laboratory Animals published by the Institute of Laboratory Animals Research of the National Research Council, Guidelines of the American Society of Mammologists for the Use of Wild Long-term Mammals in Research, and Guidelines for the Use of Fishes in Research. NEON would acknowledge and accept responsibility for the care and use of animals involved in research activities and would make a reasonable effort to ensure that all individuals involved in the care and use of animals understand their individual and collective responsibilities for compliance with its Animal Welfare Assurance Plan and applicable laws, regulations and guidelines noted above. NEON's IACUC policies and procedures were heavily adapted from the NPS IACUC, and the development of such included consultation with Dr. John A. Bryan II, the Chair and Attending Veterinarian of the NPS IACUC from 2009-2015. NEON's IACUC would be reviewed and approved annually to ensure the highest level of animal handling standards.

NEON protocols are reviewed and approved by the Battelle Memorial IACUC. Once approved by the Battelle Memorial IACUC, the protocols are submitted to the NPS IACUC for review and approval. The NPS IACUC approved the NEON fish protocol on March 9, 2016, and the Small mammal and beetle pitfall trap protocols on April 15, 2016. The NPS IACUC approvals are valid for three years. Any IACUC updates or changes to NEON protocols would be submitted to the NPS IACUC for review.

A one-time survey of soil physical and chemical properties would be investigated by conducting an initial soil characterization whereby 16 or fewer (average of four) soil samples would be extracted from 10 to 20 plots within the TOS (Figure 3). Soil cores would be back-filled with weed-free sand or according to Park recommendations. Soil cores for the initial characterization effort are approximately 0.28 cubic feet each, whereas the soil cores planned for the life of the project are approximately 0.03 cubic feet of soil each. The initial characterization effort would therefore involve collecting up to a maximum of 89 cubic feet of soil from the Park, if the maximum number of 16 cores is collected from each of the maximum number of plots (20). The ongoing effort involves collecting approximately 2.7 cubic feet of soil per year from the Park. Hand augers of approximately 4 inches in diameter would be used to extract the samples and examine the soils to a depth of approximately 3 feet or to bedrock, whichever is shallower. Soil sampling tubes would be used to collect the sample. Ten plots within the TOS (between base and tower plots as illustrated on Figure 3) would continue to be monitored three times a year for the 30-year life of the project. Three cores per plot would be collected to a depth of up to 12 inches using a small hand auger. Soil sampling also involves infrequent (every five years) in situ incubation of soil cores at each of these 10 plots to measure the rates of nitrogen production during spring, summer, and fall. This involves collection of one extra soil core per sampling location per sampling event that is placed in a PVC tube (3 inches wide and 13 inches long) and

put back into the ground for two to four weeks for incubation. The PVC tube of soil is then removed and sent off to a laboratory for nitrogen analysis.

During any given sample period (April to October) it is expected that four to ten technicians grouped into crews of two to six individuals would be deployed daily from the Bozeman, Montana (i.e., no overnight. stays within the Park would occur) to collect observations and/or samples from one to ten plots per day within the TOS. Appendix 5 provides a proposed

Reclamation Activities

Upon completion of NEON activities at the site, all infrastructure features would be removed, including the tower, tower pad, instrument hut, instrument hut foundation, groundwater wells, and utility conduit. All areas would be returned to as natural a condition as possible. Any materials removed during these processes would be reused, recycled, or properly disposed of. Disturbed ground would be stabilized with biodegradable materials and revegetated with species native to the area, appropriate for site-specific conditions, and in coordination with the Park. Compacted soils would be loosened and scarified, then seeded and/or planted with native seed, shrubs, and trees. If needed, topsoil appropriate for the area would be brought in and spread over the loosened soil prior to revegetation activities. NEON would conform to all NPS construction BMPs (provided in the following section), requirements outlined in a research permit, and requirements outlined in the MOU (agreement between the Park and NEON).

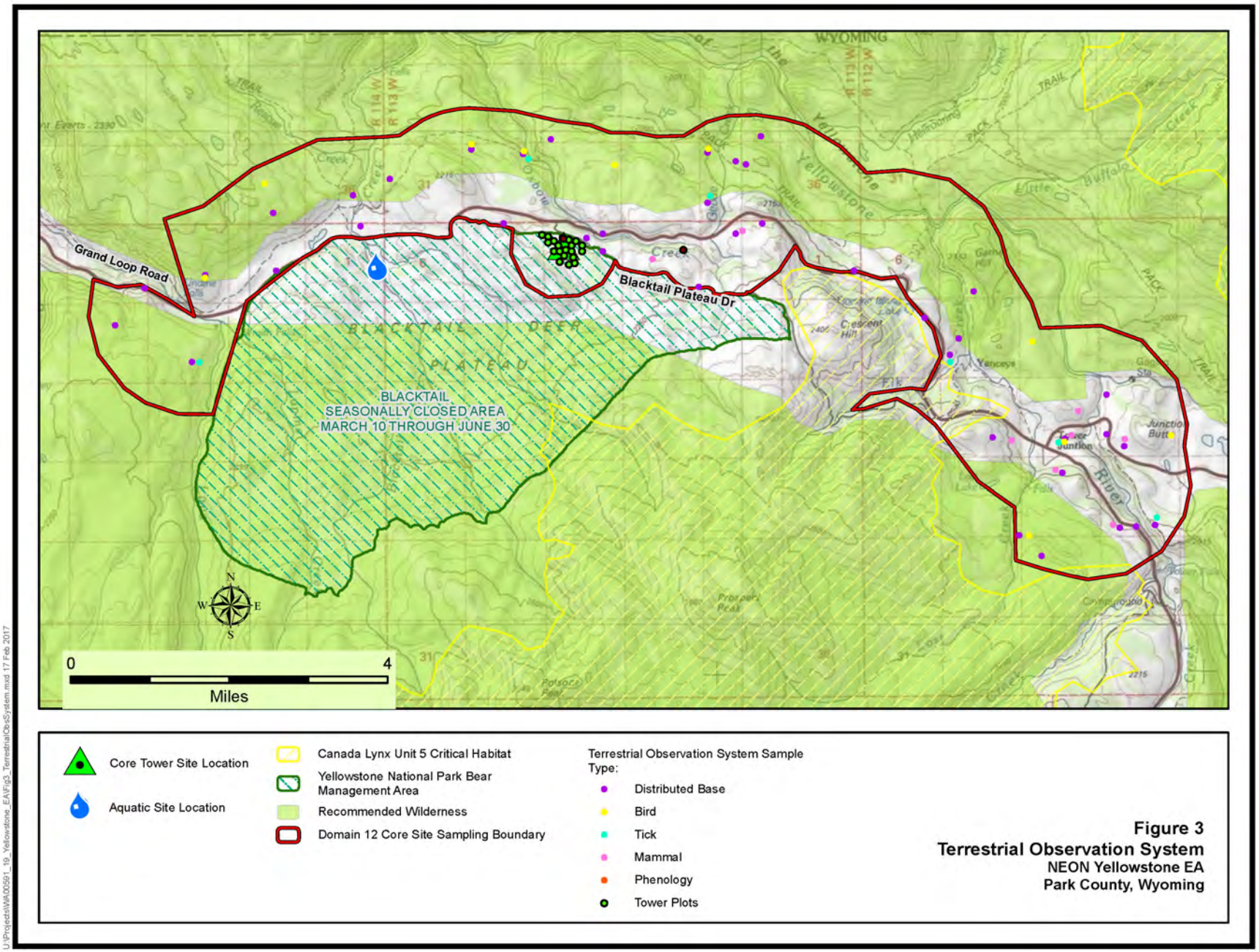
Action Alternative Option 2 – Tower Height 59 Feet (Preferred)

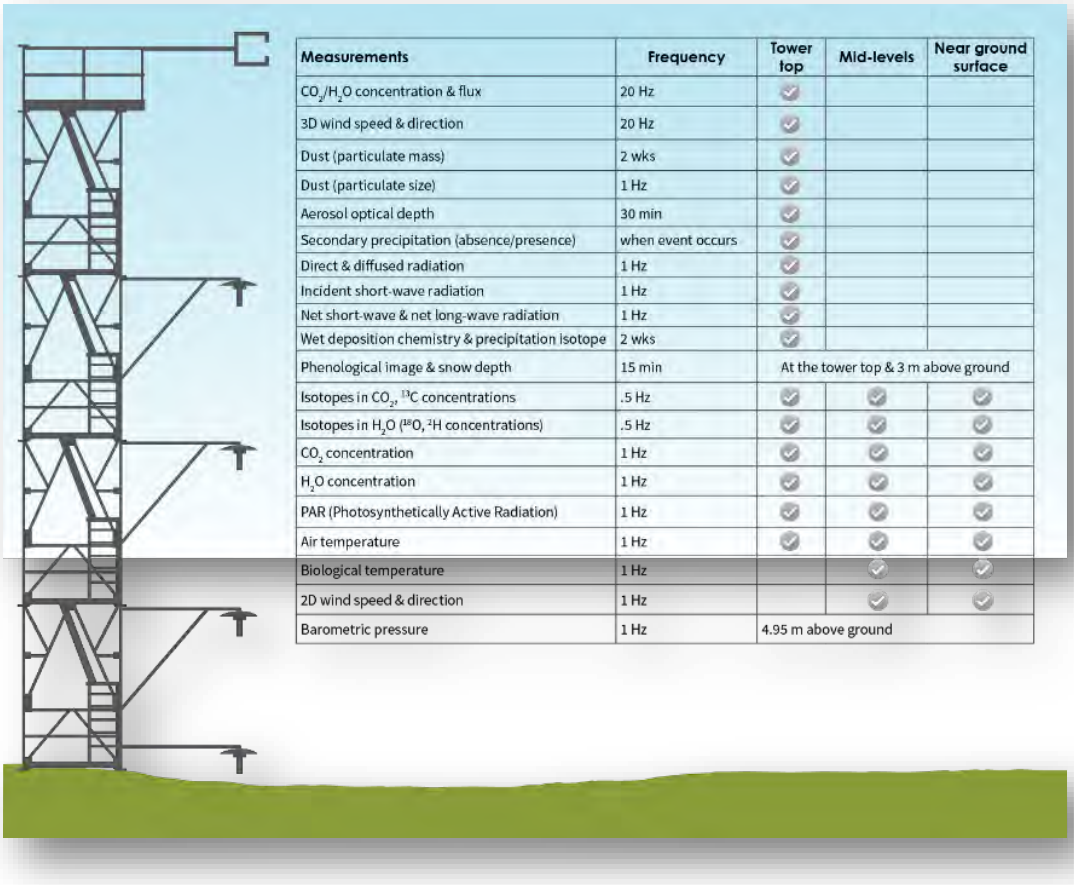
Action Alternative Option 2 is the preferred alternative in this EA. Under Option 2, site components (including the tower site, aquatic site, and TOS) would maintain the same locations, design layout, infrastructure, mitigation actions, operation protocols, and closures as under Option 1. The sole difference is that Option 2 would have a tower height of 59 feet; the lightning rod would extend 10 feet above the tower structure.

The lower tower height would reduce the quality and accuracy of the environmental data collected from the sensors on the Tower top (Schematic 6), and under certain environmental conditions could render the collected data parameters (particularly the carbon dioxide and water fluxes) unusable by the scientific community. This is due to the lack of a “well-mixed atmosphere” close to the canopy top. A “well-mixed atmosphere” is required for accurate calculations of carbon dioxide and water fluxes. The lower tower height would also reduce the number of environmental data parameters (mainly those just discussed) and parameters discussed in detail under Option 1 with regard to atmospheric and soil measurements. However, the tower height under Option 2 would conform to the preferable height threshold for towers identified in the Park’s Wireless Communications Services Plan (NPS 2009) of towers not exceeding 20 feet above the average tree canopy height in the immediate surrounding area schedule for terrestrial observations described above.

Best Management Practices and Mitigation Measures for Action Alternatives Options 1 and 2

A number of BMPs, mitigation measures, and SOPs would be integrated into design, construction, operations, and decommissioning of the site to minimize the degree and/or severity of adverse effects. These mitigation measures apply to all aspects of the project unless otherwise noted. They are as follows listed by impact topic category:


WYOMING
Grand Loop Road
Blacktail Plateau Dr
BLACKTAIL
SEASONALLY CLOSED AREA
MARCH 10 THROUGH JUNE 30
BLACKTAIL DEER PLATEAU
Crescent Hill
Yancey's
Lower Junction
Junction Butte
Yellowstone River
Prospect Peak
Potosi Peak
N
S
E
W
0
4
Miles
Core Tower Site Location
Aquatic Site Location
Canada Lynx Unit 5 Critical Habitat
Yellowstone National Park Bear Management Area
Recommended Wilderness
Domain 12 Core Site Sampling Boundary
Terrestrial Observation System Sample Type:
Distributed Base
Bird
Tick
Mammal
Phenology
Tower Plots
Figure 3
Terrestrial Observation System
NEON Yellowstone EA
Park County, Wyoming
U:\Projects\WA00591_19_Yellowstone_EA\Fig3_TerrestrialObsSystem.mxd 17 Feb 2017



Measurements	Frequency	Tower top	Mid-levels	Near ground surface
CO_2/H_2O concentration & flux	20 Hz	✓		
3D wind speed & direction	20 Hz	✓		
Dust (particulate mass)	2 wks	✓		
Dust (particulate size)	1 Hz	✓		
Aerosol optical depth	30 min	✓		
Secondary precipitation (absence/presence)	when event occurs	✓		
Direct & diffused radiation	1 Hz	✓		
Incident short-wave radiation	1 Hz	✓		
Net short-wave & net long-wave radiation	1 Hz	✓		
Wet deposition chemistry & precipitation isotope	2 wks	✓		
Phenological image & snow depth	15 min	At the tower top & 3 m above ground		
Isotopes in CO_2, ^{13}C concentrations	.5 Hz	✓	✓	✓
Isotopes in H_2O (^{18}O, ^{2}H concentrations)	.5 Hz	✓	✓	✓
CO_2 concentration	1 Hz	✓	✓	✓
H_2O concentration	1 Hz	✓	✓	✓
PAR (Photosynthetically Active Radiation)	1 Hz	✓	✓	✓
Air temperature	1 Hz	✓	✓	✓
Biological temperature	1 Hz		✓	✓
2D wind speed & direction	1 Hz		✓	✓
Barometric pressure	1 Hz	4.95 m above ground		

Schematic 6: Environmental Data Measurements Collected from the Sensors on the Tower

General BMPs

1. Construction and operation protocols would adhere to NEON's Operations Field Safety and Security Plan (Appendix 6) and include language stating that all personnel would avoid contact with wildlife to ensure a safe, clear distance. In consultation with Park staff, appropriate interpretive signage would also be installed in and around the site to increase awareness of research activities taking place and restrictions, as applicable.
2. The Park would require NEON to follow protocol outlined in a Field Safety and Security Plan, to identify hazards and potential hazards that exceed the safety standard requirements of the Occupational Safety and Health Administration and the Neon's Site Specific Environment/Health/Safety Policy and Program Manual.
3. The MOU (agreement between the Park and NEON) would describe all communication protocols for the project.
4. Car- and/or van-pooling would be implemented to minimize the number of vehicles travelling within and to and from the Park.

5. The Park would require all NEON employees and contractors be housed outside of the Park.
6. Long-term use of plot markers would be based on site conditions and Park preferences and recommendations. Potential markers could include aluminum stakes, PVC stakes, wooden stakes, or buried magnetic markers.
7. The Park would require NEON to avoid entry into the BMA (Figure 1) when restrictions are in place; however, in situations where a work-around is not feasible, exceptions to the restriction would be considered. As this area is close to the road, entry may be granted for a short-duration, upon coordination with the Park.
8. NPS fire response or defense of infrastructure or instrumentation in the event of a wildland fire would not be required as NEON's objective is to monitor natural occurrences at wildland sites. This would alleviate potential increased workloads on wildland fire crews, unless NPS determined human life or other health and safety concerns superseded this protocol.
9. The Park would require NEON to obtain a research permit and MOU (agreement between the Park and NEON) prior to the commencement of construction.

Vegetation, Water Resources, Geology, and Soils

1. Standard BMPs would be applied during construction of the tower and associated infrastructure to prevent soil erosion and sedimentation of creeks and streams, including implementation of an erosion, sedimentation, and pollution control plan, silt fencing, retention areas, energy dissipaters, slope breaks, conservation of top soil, and use of geotextile blankets or jute mesh on slopes.
2. The Park would require that Park geologists be contacted and drilling stopped if water temperatures of 50 degrees Fahrenheit (°F) or greater are encountered at depths greater than 5 feet with regard to the ground water monitoring wells at the proposed aquatic site.
3. The proposed parking area would occur and co-located within already disturbed areas of the Frog Rock Pit (proposed construction staging area); therefore, no new ground disturbance for parking would occur.
4. No off-road travel during construction or decommissioning phases would be allowed by vehicles without prior approval by Park personnel.
5. An unimproved footpath would be utilized to access the tower, instrument hut, and soil sampling (array) plots. The unimproved footpath widened during construction would be restored to a width of 18 inches (1.5 feet) during operations.
6. The Park would require areas of temporary surface disturbance, created during construction, be revegetated with local, native, weed-free seed mix upon completion of construction related activities.
7. In an effort to combat the introduction of weeds during construction, crews monitored by NEON and the Park, would "peel back" existing topsoil and vegetation and stockpile to one side of the trench or pathway. This material would be saved and replaced as part of rehabilitation efforts. NPS crews may be employed to re-seed or supervise re-seeding efforts by NEON staff or contractors, prior to winter months with native seed gathered onsite or from adjacent sites; mulch may also be required. Native seed would be collected as early as June, for grasses, and as appropriate for other species. NEON would monitor revegetation activities during operations and coordinate any further efforts

necessary with Park staff. NEON would employ a local landscaping crew to assist in revegetation and reclamation activities.

8. Some social trails would likely develop from accessing TOS plots and aquatic monitoring equipment. To minimize the potential creation of such trails, NEON personnel would instruct personnel to tread lightly and avoid repeated travel by the same routes when implementing protocols where established footpaths do not exist.
9. Approximately three trees would need to be removed in order to create the required cleared space for the DFIR near the tower site. Tree cutting selection would be conducted in coordination with the Park.
10. All equipment for ground-disturbing activities required for construction would be required to be clean (i.e., free of mud, dirt, and other debris that could contain or hold seeds) prior to entering the Park.
11. Where soil is removed as part of the TOS collection, soil in and around the resulting 1- to 4-inch hole would be lightly compressed at the surface allowing the holes to refill with native material. Due to the freeze/thaw cycle in the Park, it is anticipated that only a small depression would remain after one to two seasons.
12. Certified seed-free mulch as well as certified weed free gravel, rock, and soil backfill material would be used to minimize the potential spread of exotic or invasive plant species following construction.
13. The Park would require NEON provide prompt control of invasive exotic species that become established on areas disturbed during construction. NEON would be required to work with the Park vegetation specialist and adhere to the Invasive Vegetation Management Plan (2013). NEON would incur the costs associated with these activities.
14. If noxious weeds are found in the proposed project areas, the Park vegetation specialist, in consultation with NEON personnel, would determine whether weed treatment is needed prior to construction or during subsequent operation of the facility.
15. Aquatic sampling of benthic invertebrates, aquatic plant, and algae would not be conducted directly following stream flooding, when flow rate exceeds channel capacity.
16. NEON personnel would install groundwater wells using a small track mounted drilling rig, taking care to avoid the Blacktail Creek. Additionally, the meteorological station would be mounted on a tripod and would be set away from the stream.
17. The in-stream sensors at the aquatic site would be placed within the creek bed by hand to minimize stirring up sediment in the creek bed.
18. Upon decommissioning, the Park would require NEON to remove all infrastructure. Reclamation and revegetation of the site would be accomplished with native species. A bond may be required to ensure this work prior to construction.

Wildlife Resources

1. No trees with active bird nests would be removed during bird breeding season (season dates to be defined by Park personnel). If construction is scheduled to occur during bird nesting periods, in compliance with the Migratory Bird Treaty Act, any trees to be removed would be first checked to guarantee they do not contain active bird nests. Likewise, the ground surface would be checked for ground-nesting bird nests prior to initiation of ground-disturbing activities. Should an active nest be located in trees or on the ground, Park personnel would be consulted as to how to proceed.

2. Utility conduit would be installed in accordance with Park guidelines and recommendations to reduce ground disturbance and deter wildlife interactions. Conduit would be buried where trenching would result in minimal resource damage and revegetation would be successful. Conduit would be anchored to the ground when not buried (e.g., rocky areas with near-surface bedrock).
3. Structures to deter nesting and perching would be installed on the tower to discourage nesting raptors. The landscape within 0.5 miles of the proposed tower, would be inventoried for raptor nests in coordination with the Park. Construction would be timed and/or conducted to mitigate potential disturbance or destruction of any active raptor nests in coordination with the Park.
4. If construction activities are initiated during avian nesting times, sweeps for nesting birds would be conducted within 72 hours of construction. If any are located, those areas would be avoided or construction delayed until songbirds fledge. Monitoring of active nests and noise mitigation would be employed as necessary in coordination with the Park as to not disturb nesting eagles or raptors.
5. NEON would be required to work closely with the IACUC office to remain in compliance with collections, archives, and animal-handling standards for the duration of the project based on approved protocols. NEON has already coordinated with IACUC for all sites located in National Parks (i.e., Yellowstone, Rocky Mountain, and Great Smoky Mountains National Park), and would need to obtain approval from both the IACUC and NPS (Yellowstone National Park).
6. Since 1996 gray wolves have traditionally denned on Blacktail Deer Plateau adjacent to the proposed NEON construction site. Should an active den be located within a range of possible disturbance (as determined by Park staff), Park personnel would be consulted as to how to proceed. Plots within the BMA (Figure 1) in the vicinity of the tower would not be sampled when closures and/or restrictions are in place (March 10 through June 30 closure for Blacktail Management Area), providing protection for wolf packs that may have established dens during that period. However, as the aquatic site is close to the road, entry may be grated for a short-duration, upon coordination and approval with the Park.
7. The Park would require NEON to avoid entry into the BMA (Figure 1) when closures and/or restrictions are in place (March 10 through June 30 closure for the Blacktail Management Area); however, in situations where a work-around is not feasible, exceptions to the restriction would be considered by the Park. As this area is close to the road, entry may be grated for a short-duration, upon coordination and approval from the Park. If bears are encountered, NEON personnel would be required to move away from the site.
8. The Park would require NEON to contact the Park's RPO prior to each sampling season for designation and visiting of observation/sampling plots distributed outside of the BMAs to discuss any potential issues with sensitive species or wildlife in general.
9. The Park would require NEON to re-evaluate sampling methodology and protocols or employ adaptive management techniques in coordination with the Park if unanticipated interactions with wildlife occur. Adaptive management refers to a system of management practices based on clearly identified outcomes and monitoring to determine whether management actions are meeting desired outcomes; and if not, facilitating management changes that will best ensure that outcomes are met or re-evaluated. If management changes are recommended additional compliance might be necessary.

Visual Resources/Visitor Experience

1. The small parking lot just off of Grand Loop Road would be located in an administrative area not open to the public. No camping or recreational vehicles are allowed in this area. The area would be signed to state: “No Camping, No Recreational Vehicles Allowed, per NPS review and approval”.
2. The Park would require the tower and instrument hut surface be painted to blend into surrounds and minimize potential visual contrast. Specific colors will be chosen in the field.
3. The electrical conduits would be either installed above ground or buried depending upon site and subsurface conditions in order to minimize impacts at the direction of Park management and site conditions.
4. Sounds from operations equipment would not be allowed to exceed 60 decibels (dBa) at a distance of 50 feet. If equipment will exceed the dBa limit, NEON will be required to mitigate noise.

Wilderness

1. Aquatic sensors and groundwater wells would be located outside of the Recommended Wilderness, which would eliminate impacts to recommended wilderness and preserve wilderness character.
2. Sampling would be scheduled in order to minimize the number of trips to the site, which would reduce anthropogenic activity in the area preserving recommended wilderness and wilderness character.
3. No material would be left behind aside from the plot markers (previously described), beetle cups, mosquito traps, mammal traps on nights they are out, tree tags, and litter traps. This would reduce evidence of anthropogenic activity in the area preserving recommended wilderness and wilderness character.
4. The Park would require NEON to develop a protocol and site-specific plan that specifies actions to minimize trailing and trampling at sites prior to construction and operations. This would reduce evidence of creation of trails in the area preserving recommended wilderness and wilderness character.

Alternatives Considered and Dismissed

The following site locations within the Park were investigated for project implementation, but were ultimately dismissed from further consideration because they did not meet one or more of the requirements of the site selection criteria as follows:

1. The site would provide representative ecosystems, landscapes, and aquatic processes to best address the key research themes for the domain.
2. The site would meet local topographical constraints and climatic conditions to allow for the state-of the art measurement techniques to best address the key research themes for the domain (i.e., site would be relatively flat to accommodate the core metrological tower).
3. All towers and observation systems and aquatic sites would be within a three-hour drive from each other.
4. All sites would meet education and outreach requirements (see *Purpose and Need*).

5. All locations and associated science questions would be based on coordination with the scientific community within the domain.
6. The site would be easily accessed for construction and operational activities with minimum impact to existing soils, vegetation, water resources, and wildlife, etc.
7. The site would avoid sensitive viewshed areas or areas where the tower and infrastructure could be easily seen by the public/visitors to the area.

Elk Plaza

Elk Plaza was considered and evaluated in 2008 and ultimately dismissed due to limited access for construction crews and equipment, and due to cold air drainage concerns with the operation of the tower because the site would have been located on a steep slope; thereby not meeting #2 above in the site location criteria.

Panther Creek

Panther Creek was considered in 2008, but ultimately dismissed due to viewshed concerns and high visibility of the tower; thereby not meeting item #7 as stated above in the site location criteria. Additionally, this site was dismissed because the extant lodgepole pine does not meet the basic ecological system requirements that the site sample low-elevation woodland sage system.

Stephen's Creek

Stephen's Creek was considered in 2008, but dismissed because it did not meet the science criteria required by the program; it is not a sage-low elevation woodland system rather it is dominated by grasses, rabbitbrush, and juniper. Therefore, it did not meet item #2 and #3 as stated above in the site location criteria.

Tower Junction

Tower Junction was considered in 2008, but ultimately dismissed due viewshed concerns and high visibility of the proposed tower; thereby not meeting item #7 as stated above in the site location criteria.

Buffalo Ranch

Buffalo Ranch was dismissed due to viewshed concerns, high visibility by the visitors and proximity to the Yellowstone Association Institute; thereby not meeting item #7 as stated above in the site location criteria.

Alternative Summaries

Option 1 meets all of the objectives identified for this project, but does not adhere to the suggested tower height threshold outlines in the Park's Wireless Communication Services Plan (NPS 2009). Option 2 would meet most of the project objectives and adhere to the Park's Wireless Communications Services Plan. However, the lower tower height would reduce the quality and accuracy of the environmental data parameters collected from the sensors on the tower and under certain environmental conditions could render the collected data parameters (particularly the carbon dioxide and water fluxes) unusable to the scientific community.

CHAPTER 3: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the affected environment (existing setting or baseline conditions) and analyzes the potential environmental consequences (impacts or effects) that would occur as a result of implementing the proposed project. The affected environment takes into account recent NPS and other federal agency best available information and data. In accordance with NPS NEPA guidance (NPS 2015a), the impact analysis must take a “hard look” at impacts of alternatives. NPS is required to consider “all foreseeable direct, indirect, and cumulative impacts, used sound science and best available information, and made a logical, rational connection between the facts presented and the conclusions drawn.” (NPS 2015a).

The direct, indirect, and cumulative effects are analyzed for each resource topic carried forward.

- **Type** describes the classification of the impact as either beneficial or adverse, direct or indirect:
  - *Beneficial*: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
  - *Adverse*: A change that moves the resource away from a desired condition or detracts from its appearance or condition.
  - *Direct*: An effect that is caused by an action and occurs in the same time and place.
  - *Indirect*: An effect that is caused by an action but is later in time or farther removed in distance, but is still reasonably foreseeable.
- **Context** describes the area or location in which the impact would occur. Effects may be site-specific, local, regional, or even broader.
  - *Localized* effects would be realized at specific sites or locations.
  - *Regional* effects would be realized at several sites and/or locations and would be applicable to one or more management zones.
- **Intensity** refers to the severity or magnitude of an impact, which may be direct, indirect, or cumulative.
  - Linked to the context in which the resource is found.
  - If the resource is rare or unique the intensity of the impact would be greater.
- **Duration** describes the length of time an effect would occur, either short-term or long-term:
  - *Short-term* impacts generally last only during construction, and the resources resume their pre-construction conditions following construction.
  - *Long-term* impacts last beyond the construction period, and the resources may not resume their pre-construction conditions for a longer period of time following construction.
- **Timing** describes use patterns ranging from one-time occurrence, seasonal, year-round, etc.

Cumulative Impact Scenario

The CEQ regulations which implement NEPA require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "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" (40 CFR 1508.7). Cumulative impacts are considered for both the No Action and action alternatives.

To evaluate cumulative impacts, it is necessary to identify other past, ongoing or reasonably foreseeable future projects at Blacktail Deer Plateau and, if applicable, the surrounding region. The geographic scope for this analysis includes actions within the vicinity of the proposed core site project area (tower site, aquatic site, TOS, and immediate surrounding area) within Park boundaries, while the temporal scope includes projects within a range of approximately 10 years. The Park has predicted reasonably foreseeable project plans for their ten-year planning horizon. Foreseeable project plans beyond 10 years cannot be reasonably predicted.

Given this, the following projects were identified for the purpose of conducting the cumulative effects analysis, listed from past to future:

- Parking lot expansion of existing stock and fisherman parking lot on the south side of Grand Loop Road at Blacktail Deer Creek, approximately 0.08-acre expansion, completed 2015;
- Periodic grading of Blacktail Plateau Drive and maintenance of Blacktail Cabin or associated structures;
- Widening of Grand Loop Road to 30-foot paved width, expansion of approximately 8 feet (this project has not been scheduled, but anticipated to be completed between 2020 and 2022); and
- Periodic chipseal of Grand Loop Road.

The following resources or issues have been carried through analysis in the EA.

Geology

Affected Environment

The Park lies in a geologically dynamic region of the northern Rocky Mountains. The Park is noted for its geologic features that are the result of volcanism, glaciation, and continued geological processes fueled by a continental hotspot. The region 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, including the Beartooth, Snowy, Gallatin, Madison, and Teton Ranges. The project area is situated on the Blacktail Deer Plateau between the Gallatin and Washburn mountain ranges. The underlying geology in the vicinity of the tower site includes mostly basalt flows and intrusive igneous rocks, with some Absaroka Volcanic Supergroup, Sunlight Group (Love and Christiansen 1985). The underlying geology in the vicinity of the aquatic site includes mostly undivided alluvium, colluvium, and glacial and landslide deposits, with some rhyolite flows, tuff, and intrusive igneous rocks (Love and Christiansen 1985).

Bedrock (basalt) is exposed over about 70% of the site and the remainder is covered with organic material generally located in surface depressions (Kleinfelder 2011). There are no unique geologic features at the project site. Considering the highly fractured nature of the visible rock on the surface of the site, the abrupt changes in the local topography, and the results from the geophysical exploration, it is possible that the rock below the site is highly fractured and may contain sediment or air-filled void spaces (Kleinfelder 2011).

Impacts of No Action Alternative

Under the No Action Alternative, the core site infrastructure would not be installed; therefore, geology would remain unchanged.

Cumulative Effects – Under the No Action Alternative, the core site infrastructure would not be installed and so there would be no cumulative impacts to geology.

Impacts of Action Alternative Option 1 – Tower Height 70.5 Feet

Construction – Construction activities under Option 1 associated with the installation of the tower would adversely affect geology as foundation blocks would likely extend down to the bedrock. The foundation tower anchors (four) would be installed to a depth of 2 feet and measure 16 square feet, total. The 16 square feet of surface rock that would be impacted is very small in comparison to the geologic resource on the Blacktail Deer Plateau, which is approximately 12,336 acres, because most of the site as well as much of the Park contains basalt and intrusive rocks. There are no unique geologic features associated with the site geology and there would be few short- and long-term, localized, and direct impacts to geologic resources as a result of construction activities.

Operations and Maintenance – There would be no impacts to geology from operations and maintenance.

Cumulative Effects – The direct and indirect impacts of the proposed project to geology from construction would result from some disturbance during the installation of the tower foundation blocks. There would be no impacts from operations and maintenance. Geology within the vicinity of the tower site was previously impacted by road building that included the Blacktail Plateau Road, and the two-track road that connects the Blacktail Plateau Road with the Frog Rock Pit. Both of these roads have been constructed for decades and the gravel Blacktail Plateau Road receives annual surface grading. Short-term research projects and visitor use occur in the area and are the typical activities associated with this area in addition to routine road maintenance. Other short-term research projects could result in additional impacts to geology, but because the geology of the site is not unique, especially in the context of the exceptional Park geology. Collecting rocks, fossils, and other geological materials is prohibited in the Park (36 C.F.R. § 2.1(a) and § 2.5(a)). Visitor foot traffic on geologic formations would not result in erosion because the rocks are not prone to erosion from casual use. There would be no impacts from visitor use. Routine road maintenance would not result in additional impacts because no new construction that would disturb geologic formations is planned. Future road widening of the Grand Loop Road could occur, as it is included in the Yellowstone Parkwide Road Improvement Plan. The road would be widened to a 30-foot width, though future compliance would need to be completed. If a decision is made in the future to widen, it would require removal of rock along the edges of the widened road. However, the geology is not unique in this area within the larger context of the Park. While there would be marginal incremental impacts from the project to geologic resources, they would contribute only slightly to the impacts of the present and reasonably foreseeable future actions.

Impacts of Action Alternative Option 2 – Tower Height 59 Feet (Preferred)

Potential impacts to geology from implementation of Option 2 would be the same as those noted for Option 1.

Cumulative Effects – Potential cumulative impacts to geology from implementation of Option 2 would be the same as those noted for Option 1.

Soils

Affected Environment

Soils in the vicinity of the tower site are Hobacker Family-Greyback Family-Shadow Family Complex (Rodman et al. 1996) (MU 2213). This complex forms on concave and rolling glaciated

uplands and the main surficial deposit is glacial till derived from a mixture of rock types, with small areas of colluvium in the Northern Range area of the Park. This soil type is present in forested and non-forested areas. Soils are glacial tills with some colluvium, and slopes are commonly between five and 25%. Rock outcrops may be present within this soil type. Soils are important to the analysis because soils form the substrate for vegetation. However, soils at the tower site are not unique in the project site and make up 100% of soils in the area.

Bedrock (basalt) is exposed over about 70% of the tower site and the remainder is covered with organic material generally located in surface depressions (Kleinfelder 2011). Considering the highly fractured nature of the visible rock on the surface of the site, the abrupt changes in the local topography, and the results from the geophysical exploration, it is possible that the rock below the site is highly fractured and may contain sediment or air-filled void spaces (Kleinfelder 2011).

Soils in the vicinity of the aquatic site consist of Cryaquolls and Histosols Undifferentiated Group (MU 2662), which are medium to fine textured sandy loam, loam and loamy sands formed in aquatic environments and Shook Family-Badwater Family-Passcreek Family Complex (sand loams, sandy clayey loams, loams formed in glacial till and alluvium) and Gallatin Family loams formed in till and alluvium derived from volcanic rocks (Rodman 1996) (MU 2996). These deep soil types are not unique at the Park or in the project area. These soil types make up 100% of soil in the area.

Impacts of No Action Alternative

Under the No Action Alternative, the core site infrastructure would not be installed; therefore, soils would remain undisturbed.

Cumulative Effects – Under the No Action Alternative, the core site infrastructure would not be installed and soils would remain undisturbed; therefore, cumulative impacts are not anticipated.

Impacts of Action Alternative Option 1 – Tower Height 70.5 Feet

Construction – Construction activities under Option 1 would adversely affect soils in the project area as a result of grading, compacting, and soil disturbance associated with the tower installation and the aquatic site construction.

At the tower site, short-term and long-term impacts from disturbance of approximately 0.14 acres (Table 2). These would be mostly as physical disturbance or compaction of soils. Unique soil types are not present at the project site. Effects to soil chemistry and composition are not expected. Implementation of BMPs and mitigation measures described in *Chapter 2: Alternatives* would protect soils from impacts. Construction would result in short- and long-term, adverse, localized, and direct impacts to soils as a result of activities.

There would be 2,276 square feet of soil disturbance associated with construction of the aquatic site. The power and communication conduit trench disturbance (2,119 square feet) would be immediately reclaimed, resulting in long-term disturbance of 157 square feet (0.004 acres). This disturbance is a very small percentage of 12,336 acres of soils in the project area on Blacktail Deer Plateau.

At the aquatic sites, long-term impacts would be negligible because there would be approximately 30 square feet of disturbance from monitoring equipment. This disturbance would result mostly in the physical disturbance of aquatic soils, while effects to soil chemistry and composition are not expected. There may be soil erosion and/or compaction associated with groundwater well installation, but the impacts would be short-term (approximately two weeks). Upon implementation of BMPs and mitigation measures described in *Chapter 2: Alternatives*,

construction would result in short- and long-term, adverse, localized, and direct impacts to soils as a result of construction activities.

Operations and Maintenance – The initial soil characterization at the tower site would disturb up to 89 cubic feet, while monitoring activities within the TOS would disturb 16 cubic feet of soil over the lifetime of the project. There would also be 4 square feet of soil disturbance at ten plots associated with beetle pit fall traps.

Some soils might be disturbed during other operational activities within the TOS over the life of the project because of project personnel visiting the site for maintenance, sampling, and monitoring. While the creation of social trials is to be avoided, long-term impacts of annual foot traffic could have adverse effects to soils in the form of erosion and compaction. The proposed TOS encompasses approximately 17,834 acres (0.8% of the Park); however this area in its entirety would not be impacted. To help quantify these impacts, a near analysis using geographic information system (GIS), which calculates distance and additional proximity information between the input features and the closest feature in another layer or feature class, was used to estimate the length of trails that could result during operational activities within the TOS. The near analysis evaluated TOS plots near highways or Park trails, then TOS plots were grouped where they could be accessed from identical access points, and for each such group, the maximum distance, plus a "spread" factor equal to the maximum perpendicular distance between TOS points and the access near feature (road or trail) was assigned. Given a focus on minimizing the creation of social trails, it was assumed that trails might be created on 30 to 50% of this distance. Approximately 4 to 6.5 miles of social trails could result within the TOS. For comparison, the Blacktail Deer Plateau includes approximately 32 miles of established trails and 17 miles of paved roads. The entire Yellowstone area includes approximately 1,083 miles of established trails and 332 miles of paved roads. The potential social trails would be less than 1% of the total trails in the Park and a 20% increase over the established trails within the proposed NEON Domain 12 site.

This alternative would result mostly in the physical disturbance or compaction of soils; however, the area affected would be very small especially in relation to Park soil resources. Effects to soil chemistry and composition are not expected. Upon implementation of BMPs and mitigation measures described in *Chapter 2: Alternatives*, this operations and maintenance activities would result in short- and long-term, adverse, localized, and direct impacts to soils as a result of operations and maintenance activities.

Cumulative Effects – The impacts of Alternative Option 1 to soils from construction of the tower and installation of the ground-water monitoring wells would be short term and only minor amounts of soil would be removed or compacted as a result of the proposed project. BMPs would be used to reduce erosion, and areas would be reclaimed as soon as possible after disturbance. Operations and maintenance activities would disturb very small amounts of soil. Disturbed areas would be reclaimed as soon as possible, and protocols to reduce creation of social trails would be put in place. Other past, present, present, and reasonably foreseeable activities within the vicinity of tower site, aquatic site, and TOS, including short-term research projects, visitor use, and routine road maintenance and potential road expansion would result in additional impacts through the displacement of small amounts of soil. While there would be soil erosion and compaction from visitor use, it would likely be dispersed. Potential impacts from short-term research projects would have minimal impacts because projects would be required to use BMPs and other mitigation techniques to reduce impacts. During Park road maintenance activities soils along the margins of the road would be disturbed, displaced, or eroded. However, these soils are already likely to have been disturbed by road building and no longer have native soil characteristics. Park road expansion would remove or compact soils, but the Park would employ BMPs and mitigations to protect soils during road projects. There would be cumulative

effects to soils but soils in this area of the Park are not unique and BMPs, mitigation, and reclamation techniques would be used to protect soils. Impacts of past actions include approximately 8 acres of soils disturbance for the Frog Rock Pit, approximately 8 miles of one-lane road for the Blacktail Plateau Road, 0.7 miles of one-lane road, and approximately ¼ mile of two-track road from the Frog Rock Pit to the Blacktail Plateau Road. When the effects of this alternative (0.14 acres) are combined with these past, present, and reasonably foreseeable future impacts to soils, the total cumulative impact would continue to be adverse. The incremental impacts of alternative would contribute only slightly to the impacts that are already occurring.

Impacts of Action Alternative Option 2 – Tower Height 59 Feet (Preferred)

Potential impacts to soils from implementation of Option 2 would be the same as those noted for Option 1.

Cumulative Effects – Potential cumulative impacts to soils from implementation of Option 2 would be the same as those noted for Option 1.

Water Resources

Affected Environment

The region 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, including the Beartooth, Snowy, Gallatin, Madison, and Teton Ranges. This large area of mountains and valleys, including the 8,000-foot-high Yellowstone Plateau, intercepts winter storms from the west and becomes progressively drier to the east.

Climate data collected from Yellowstone Park station near Mammoth (Western Regional Climate Center 2014) at an elevation of 6,240 feet above mean sea level (amsl), shows average temperatures ranging from 10.5°F in January to 79.9°F in July, with average annual precipitation of 15.41 inches and snowfall of 64.4 inches. The highest amount of snowfall occurs between November and March (Current Results 2015).

The tower site is located in the western portion of Oxbow Creek watershed (tributary to Yellowstone River) at an elevation of approximately 6,980 feet amsl (Figure 1). The aquatic site lies within the Blacktail Deer Creek watershed at an elevation of approximately 6,680 feet amsl (Figure 1). Blacktail Deer Creek is a small perennial stream that originates above Blacktail Deer Plateau and flows northward into the Yellowstone River. Flow records from the inactive United States Geological Survey (USGS) gage located on Blacktail Deer Creek (USGS 06189000 [2016]), in the vicinity of the aquatic site, show mean annual flow ranging from 4 cubic feet per second (cfs) to 13 cfs and peak stream flow ranging from 37 cfs to 198 cfs (over the period of record, 1938–1993).

Impacts of No Action Alternative

Under the No Action Alternative, the core site infrastructure would not be installed; therefore, water resources would remain undisturbed.

Cumulative Effects – Under the No Action Alternative, the core site infrastructure would not be installed and soils would remain undisturbed; therefore, cumulative impacts are not anticipated.

Impacts of Action Alternative Option 1 –Tower Height 70.5 Feet

Construction – Construction activities under Option 1 from tower and aquatic site installation are not anticipated to adversely affect water resources because the proposed site is about 650 feet from Oxbow Creek (Figure 1) on relatively flat ground and is separated from the Creek by

two roads (Figure 2). Standard BMPs, including erosion control barriers, would prevent sediment and other materials from reaching Oxbow Creek. There would be no construction impacts from TOS activities.

Installation of the in-stream sensors at the aquatic site would be placed within the creek bed by hand over a five-day period to minimize stirring up sediment in the creek bed. Installation of in-stream infrastructure and sensors would require two personnel wading in the stream for 0.5 to 1 day per station. Sediment disturbance would be limited to driving a single steel anchor into the streambed at each of the two sensor stations and personnel wading in the stream. This anchoring approach utilizes a single point of contact to minimize disturbance. Further, the minimum number of work hours and personnel will be used to install infrastructure and sensors in the stream. This activity would result in short-term disturbance (approximately two weeks) of instream sediment and could temporarily increase turbidity. Increases in turbidity could reduce light availability for primary productivity, which can lead to lower dissolved oxygen impacting aquatic life. Elevated turbidity could also increases sedimentation and siltation however; this is not anticipated to result in long-term impacts to water resources at the proposed aquatic site.

Upon implementation of BMPs and mitigation measures provided in *Chapter 2: Alternatives*, impacts from construction of the meteorological station and installation of groundwater wells at the proposed aquatic site are anticipated to be minimal as erosion control barriers would protect water resources from sediment and other materials. Overall, construction actives are anticipated to have temporary impacts (approximately two months) to Blacktail Deer Creek.

Operations and Maintenance – Impacts from project operations at the tower and aquatic sites in addition to TOS activities could increase erosion into Blacktail Deer Creek and loss of vegetation near the creek from ongoing maintenance and sampling activities. Both of these could increase sedimentation reducing productivity. BMPs would be used to reduce potential erosion impacts. Additionally, some water would be lost due to the collection of sample water from the groundwater wells over the life of the project; total extraction of water from each well will be around 4 to 8 gallons; for a total groundwater extraction of around 30 to 60 gallons per year; however, this is anticipated to result in minimal impacts to water resources.

With regard to tracers, it is anticipated that salt (NaCl) would be used. This would be dependent on background conductivity and discharge. Background conductivity is anticipated to be 300 micromhos (µS/cm); therefore salt would be appropriate. Salt would be added to increase the conductivity 5-10 µS/cm; therefore, there would be no influence on aquatic organisms. If the discharge levels are so high that salt is no longer feasible due to large quantities that would be required, bromide may be used (in low levels), in which case, NEON would add sodium bromide (NaBr) tracer in concentrations < 0.5 milligrams Br per liter for < 2 hours. Adverse impacts are not anticipated as a result of the use of the conservative tracer (either the NaCl or the NaBr) on the creek or organisms in the creek. This is a common practice by stream ecologists and is meant to be a short term addition (average 30–45 minutes and maximum of 3 hours) so that water travel times and groundwater dilution within our sensor reach could be measured. There would be no impacts to water quality from the tracer study.

Upon implementation of BMPs and mitigation measures provided in *Chapter 2: Alternatives*, impacts from operations and maintenance at the aquatic site are anticipated to be temporary and minimal to Blacktail Deer Creek.

Cumulative Effects – The impact of Action Alternative Option 1 to water resources from construction and operations and maintenance would be minimal because BMPs would be used to protect streams from erosion and sedimentation and salt used for conductivity studies would not last for more than 3 hours in the stream environment. The area considered for cumulative impacts to water resources is the watershed of Blacktail Deer Creek. Other short-term research projects, if approved by the Park, could result in some impacts to water quality largely through erosion and resuspension of sediments, they would be required to implement BMPs and mitigation measures to protect streams. Visitors could use the streams for fishing, resulting in some erosion along the stream bank and resuspension of sediment. During routine road maintenance and potential road expansion impacts to water quality could be the result of runoff and erosion from the worksite, however, the Park would use BMPs and mitigations to protect water resources and reduce impacts during road projects. The incremental adverse impact to water resources from the project is expected to be relatively minor as described above, and when considered along with the other past, present, and reasonably foreseeable actions would not contribute substantially to adverse impacts that are already occurring.

Photo 6: Topography and Vegetation at Proposed Tower Location

Impacts of Action Alternative Option 2 – Tower Height 59 Feet (Preferred)

Potential impacts to water resources from implementation of Option 2 would be the same as those noted for Option 1.

Cumulative Effects – Potential cumulative impacts to water resources from implementation of Option 2 would be the same as those noted for Option 1.

Vegetation

Affected Environment

The proposed tower site lies at an elevation of 7,060 feet in a transitional zone between Douglas fir (*Pseudotsuga menziesii*) forest and middle successional lodgepole pine (*Pinus contorta*) forest, while the aquatic site lies within sage- grassland ecotone between 6,620 and 6,700 feet in elevation (Photo 6). The site area is a mosaic of forest and woodlands, dominated by Douglas fir with scattered lodgepole and limber pine (*Pinus flexilis*) (Photo 6) with a large sagebrush (*Artemisia tridentata*) and willow (*Salix* spp.) component near the aquatic site (Photo 7). These vegetative communities are also common throughout the TOS and are not unique

within the Blacktail Deer Plateau. No special status plant species (or habitat) are known to exist within the proposed project area.

Impacts of No Action Alternative

Under the No Action Alternative, the core site infrastructure within the proposed project area would not be installed and vegetation would remain undisturbed.

Cumulative Effects – Under the No Action Alternative, the core site infrastructure would not be installed and so there would be no cumulative impacts to vegetation.

Photo 7: Topography and Vegetation at Proposed Blacktail Deer Creek Aquatic Site

Impacts of Action Alternative Option 1 – Tower Height of 70.5 Feet

Construction – Construction activities under Option 1 would adversely affect vegetation in the project area as a result of trampling, permanent vegetation loss, and the increased potential for non-native weed species to occupy areas where vegetation would be removed. Vegetation in this area is not unique to the proposed project area and there are no known special status plants. Vegetation removal could increase runoff and erosion which is discussed in the impact analysis for soils and for water resources. Construction of the tower and aquatic instrumentation would require the removal and/or disturbance of vegetation for the tower foundation, device posts, soil-sampling array, and instrument hut totaling 0.14 acres (Table 2) and 0.004 acres at the aquatic site (Table 3). A UTV would be used for soil instrumentation (array) plots. The UTV has is a six-wheeled, lightweight, all-terrain vehicle that has its weight dispersed across six wheels thereby "riding" above the vegetation to minimize impacts. Other measures to minimize UTV disturbance would be implemented to avoid vegetation (e.g., ramps for uneven terrain, and careful planning of access routes). The individual boreholes for sensors would be placed to avoid sensitive areas, as necessary. Impacts to vegetation are anticipated to be small because of avoidance, BMPs, and timely reclamation.

Three lodgepole pine trees near the DFIR (Figure 2A) would be cut down. The fallen trees would be left on the ground near their original locations. Ground disturbance at the aquatic site would total 0.07 acres over a two- to seven-day installation period for meteorological station, upland sensors, instream sensors, and groundwater wells; however, a very little non-unique vegetation is anticipated to be removed.

Operations and Maintenance – Operational activities, including surveys, sampling, and maintenance may result in the creation of social trails over the 30-year life of the project. While the creation of social trials would be discouraged, long-term impacts of foot traffic as a result of ongoing surveys within the TOS sampling area and along Blacktail Deer Creek within the

aquatic site could occur, i.e., traversing the area could have adverse effects to vegetation through trampling, erosion, and soil compaction. However, impacts would generally be close to and between the established plots (Figure 3), and would not be dispersed over the entire area. A near analysis using GIS, which calculates distance and additional proximity information between the input features and the closest feature in another layer or feature class, was used to estimate the length of trails that could result during operational activities within the TOS. The near analysis evaluated TOS plots near highways or established Park trails, then TOS plots were grouped where they could be accessed from identical access points, and for each such group, the maximum distance, plus a "spread" factor equal to the maximum perpendicular distance between TOS points and the access near feature (road or trail) was assigned. As an estimate, given a focus on minimizing the creation of social trails, it was assumed that trails might be created on 30 - 50% of this distance. Approximately four to 6.5 miles of social trails could result within the TOS. For comparison, the Blacktail Deer Plateau includes approximately 32 miles of established trails and 17 miles of paved roads. The entire Yellowstone area includes approximately 1,083 miles of established trails and 332 miles of paved roads. The Park has an area of 2,196,405 acres, while the proposed TOS has an area of 17,834 acres (0.8% of the Park). The potential social trails would account for less than 1% of the total trails in the Park and a 20% increase over the established trails within the proposed NEON Domain 12 site.

Some vegetation would be lost but would be reclaimed at the end of the 30-year long project. Additionally, despite the implementation of BMPs described in *Chapter 2: Alternatives*, potential for the spread of non-native weed species exists, which adversely affects native vegetation. However, the loss of native vegetation is not expected to affect the viability of local plant populations over the long-term, and with the application of BMPs including minimizing the construction zone to the extent possible and revegetation efforts following construction, impacts to vegetation would be reduced. This alternative would result in short- and long-term, adverse, direct, and localized impacts to common vegetation within the project area.

Cumulative Effects – During project implementation – construction, operations, and maintenance, short and long term impacts to vegetation would be mitigated by reclamation as soon as possible. Impacts to vegetative communities within the project area from other activities include limited hiking by visitors along the Blacktail Plateau and Upper Blacktail Roads, mostly to view wildflowers and to fish, which, would result in vegetation trampling but the impact would be intermittent and dispersed, allowing vegetation to recover. Other short-term research projects within the project area would also result in some vegetation trampling or removal but would be required to implement mitigation techniques and BMPs to reduce impacts to vegetation. The Park would employ BMPs and mitigations to protect vegetation during road projects. During road expansion, some vegetation would be removed, but vegetation along roads is not unique, the amount of vegetation removed would be small, and the road margins would be reclaimed with native species. When the effects of Action Alternative Option 1 are combined with other past, present, and reasonably foreseeable future impacts, such as the approximately 8 acres of disturbed vegetation at the Frog Rock Pit (a NPS maintenance and staging area, the total cumulative impact on vegetation would continue to be adverse. The incremental impacts of the alternative would contribute only slightly to, but would not substantially change the impacts that are already occurring.

Impacts of Action Alternative Option 2 –Tower Height of 59 Feet (Preferred)

Potential impacts to vegetation from implementation of Option 2 would be the same as those noted for Option 1.

Cumulative Effects – Potential cumulative impacts to vegetation from implementation of Option 2 would be the same as those noted for Option 1.

Wildlife Resources

Affected Environment

Wildlife in the Park is extremely diverse and abundant. Seven species of ungulates, or hoofed mammals, occupy the Park, four of which are likely to occur in the proposed area: American elk, mule deer, white-tailed deer, and bison. The Park's large herds of elk winter in the northern range, which includes the core site. Mule deer are widely dispersed, and white-tailed deer are only occasional (NRC 2002). Bison herds are migratory, and come through at variable intervals. Virtually all North American large carnivores occur in the Park: grizzly bear, black bear, coyote, mountain lion, and reintroduced wolf. Wolves may use the site at various times of the year in association with searching for prey, dispersal of young and general movements within a home range. The core site is in a designated BMA, whose purpose is to reduce human impacts on bears in high-density grizzly bear habitat (Figure 1). BMA (Figure 1) enforce the following closures: March 10 through June 30 closure for the Blacktail Management Area. Coyotes are likely resident on the site. They feed on rodents and other smaller prey that are resident on the Blacktail Deer Plateau. Other mammal species present in the area include red foxes, long-tailed weasels, Uinta and golden-mantled ground squirrels, least chipmunk, yellow-pine chipmunk, deer mice, sagebrush voles, and long-tailed voles. Nuttall's cottontails inhabit the sagebrush and pine and fir forests. Bushy-tailed woodrats and yellow-bellied marmots are restricted to available rock outcrops. Porcupines may occur both in the forests and sagebrush. Little brown bats, big brown bats, and long-eared Myotis are likely common, feeding on insects during summer and migrating to winter hibernation sites in the fall.

Black-billed magpies, common ravens, Stellar's jays, white- and red-breasted nuthatches, mountain chickadees, and dark-eyed juncos are year-round residents and forage and nest in the forested areas. During summer, sage thrashers, sage sparrows, lark sparrows, and Brewer's sparrows nest in the sagebrush areas. Yellow-rumped warblers and black-throated gray warblers forage on insects and nest in the forest. Chipping sparrows also nest in the forest. Red-tailed hawks, American kestrels, and loggerhead shrikes occur in the area. Common nighthawks make their breeding-call dives at dusk, and nest on the ground, as do common poorwills.

Columbia spotted frogs and boreal chorus frogs are widely distributed with many breeding sites in the Park. Tiger salamanders are common and abundant in some portions of the Park, including the northern range. Reptiles common to the area, and potentially present on the core site, include prairie rattlesnake, bull snake, and sagebrush lizard.

The Park is home to 13 native fish and six non-native fish species. Two species of native fish, the Yellowstone cutthroat trout (YCT) and arctic grayling, had historic ranges in the core site (YCR 2013). Current efforts are underway to restore populations of the YCT to streams where they occurred. The common non-native species that may be present include brook trout, brown trout, and rainbow trout.

Impacts of No Action Alternative

Under the No Action Alternative, the site infrastructure would not be installed; therefore, impacts to wildlife resources would not occur. However, if the site is not installed, the Park would not obtain the long-term data, including wildlife observations, that the NEON project would provide and that could facilitate effective management of the Park's wildlife populations.

Cumulative Effects – Under the No Action Alternative, the site infrastructure would not be installed and so there would be no cumulative impacts to wildlife resources.

Impacts of Action Alternative Option 1 –Tower Height of 70.5 Feet

Construction –The proposed infrastructure installation at the tower and aquatic sites would include actions such as temporary surface disturbance, operating small equipment, and localized increase of human activity and noise that could affect wildlife and their habitat use within and/or adjacent to the site. Construction of the tower and aquatic instrumentation would require the removal and/or disturbance of vegetation for the tower foundation, device posts, soil-sampling array, and instrument hut totaling 0.14 acres (Table 2) and 0.004 acres at the aquatic site (Table 3). Project design includes mitigation actions to minimize removal of the vegetation and many other impacts to wildlife; these are outlined in *Chapter 2: Alternatives.*

Construction impacts include temporary visual and acoustic disturbance impacts that would cause sensory disturbance to wildlife, especially medium and large animals that have larger home ranges, and would result in some reduced use of the site during construction. Small mammals such as mice, voles, songbirds, reptiles, and amphibians that have home ranges adjacent to the disturbance may be less affected due to being nocturnal and/or for some, their home ranges may not overlap the disturbance area.

Modular equipment components would reduce the amount of time needed for construction, construction traffic, and noise. This would allow wildlife to reuse the site more quickly and likely cut down on long-term avoidance of the area. Additionally, using hand carried sampling equipment further reduces wildlife avoidance because there would be less noise and disturbance of the sites.

Destruction of mouse, vole, reptile, and other small animal dens, nests, or runways could result during construction activities due to the short-term and long-term loss of vegetation. These wildlife species may also be inadvertently harmed by construction equipment and vehicles. Because the proposed project area is a small component of a much more extensive and common sagebrush habitat and lodgepole pine forest, it is expected that any wildlife temporarily disturbed by construction activities would easily return to the site or relocate in adjacent areas. Larger animals, such as bison, elk, mule deer, pronghorn, wolves, black and grizzly bears and mountain lions, would easily skirt the site during their movements through the area, with plentiful habitat available in the adjacent areas. The exception could be the disturbance to any dens or nesting areas within the immediate vicinity.

Indirect impacts to wildlife could include disturbance and degradation of habitat through introduction of noxious weeds, surface compaction, or trampling. Most indirect impacts are assumed to result from direct impacts in proportion to the relative amount of surface disturbance.

Animals in adjacent areas would be expected to receive impacts from noise and disturbance from construction activities. Short term impacts to wildlife would occur from tower installation and human disturbance during construction causing animals to leave or avoid the area. Some animals may relocate permanently in surrounding habitat but most individuals would not be expected to move far and would occupy similar habitat nearby. Some wildlife would move back to the area once construction is complete. All disturbed ground would be reclaimed and restored to pre-construction conditions. Some long term habitat loss would occur because of vegetation loss immediately around the tower.

Operations and Maintenance – Over the 30-year period of operations, activities and the tower and aquatic sites along with ongoing terrestrial observations (TOS activities) would have long-term general disturbance effects due to increased human activity at the tower, aquatic, and sampling locations, especially for animals whose home ranges overlap the footprint of the area.

Impacts at the tower and aquatic sites would be localized and result from periodic human activity and noise that could affect wildlife and their habitat use within and/or adjacent to the sites.

Accidental vertebrate mortality could occur resulting from small mammal trapping, pitfall trapping, and other research activities. In 2012, NEON small mammal trapping at Rocky Mountain National Park, which has a similar small mammal community to Yellowstone, resulted in a 2% mortality rate for captured individuals. In 2015, NEON small mammal trapping at 25 sites throughout the U.S. experienced site-specific mortality rates of 0 to 7%, with an average rate of 1.9%. The above-average mortality rates occurred at sites with higher shrew populations, which are not expected at the sampling location in the Park. Annually, NEON would conduct a maximum of 7,200 trap nights (one trap night equals one trap set for one night) in the Park. With an average capture rate of 10% (based on hundreds of previous small mammal trapping studies), NEON would capture approximately 720 small mammals. With a 2% mortality rate, approximately 14 small mammals would be expected to be lost from the Park each year.

Small mammal and beetle sampling locations are typically found more than 300 feet (approximately) from a riparian area and populations of these animals are expected to be lower than most NEON sites, accidental capture and mortality of amphibians and reptiles is expected to be between 0 and 5 individuals per year. In 2015, NEON beetle pitfall trapping at 27 sites, over half of which were in the northeast and southeast U.S., resulted in an average of 16 vertebrates accidentally dying in a pitfall trap. However, NEON conducted pitfall trapping in nearby Paradise Valley, Montana, in August 2014, and had no instances of vertebrate bycatch.

NEON IACUC protocols for both small mammal trapping and beetle pitfall trapping and the scientific research permit between the Park and NEON would require mortality to be closely monitored and protocols modified if an agreed-upon threshold is exceeded. For example, in the unlikely event that >5 small mammals die during one night of trapping, the NEON IACUC protocol requires that trapping be immediately discontinued for that month. If an accidental death occurs during research activities, a voucher specimen would be collected and curated according to NPS guidelines for future research and educational needs. Tick, beetle, and mosquito sampling techniques intentionally result in the mortality of the captured individuals, as described in *Chapter 2: Alternatives*; however, estimated numbers are not yet known.

Long-term general disturbance effects due to increased human activity during ground surveys and sampling over the life of the project would include: trampling or destruction of vegetation resulting in limited loss of cover or foliage, sound disturbance from human voices, and the general disturbance due to the presence of humans. Sampling effort, and therefore the magnitude of disturbance, varies with the procedures used to study the diversity of plants and animals (see Appendix 5 for details). These activities may result in minor changes in species composition, as species that are more tolerant of disturbance (such as deer mice, red foxes, and coyotes) would likely maintain their presence, and species that are less tolerant of disturbance (such as northern red-backed voles, pine martens, ferruginous hawks) are potentially displaced. Similar displacement may occur in the aquatic sampling locations as well.

For small mammal trapping in which bait is placed in traps, there may be some attraction of small mammals to the traps during the week of trapping. However, this is very short-term and the small mammals that are captured (mice, voles, chipmunks) would quickly return to their regular foraging routes once the traps are removed. Most individuals of these species live less than a year and thus would not be impacted over multiple years.

Bears and other mammals may also be attracted to the bait, although NEON typically baits with dry, sterilized seeds rather than the more aromatic option of peanut butter (commonly used in small mammal trapping studies). In addition, the NEON small mammal protocol dictates that, in

the event of predator destruction of more than 15 traps on one grid of 100 traps in a night, the traps would be removed immediately and not replaced until the next monthly sampling event. NEON would work with the Park to modify the protocol if particular sampling locations are disturbed by bears multiple times. Finally, NEON sampling of terrestrial plants and animals, including small mammals, would occur outside of BMA. The purpose of BMAs is to reduce human impacts on bears in high-density grizzly bear habitat. Eliminating human disturbance in specific areas would prevent human/bear conflicts and provides areas where bears can pursue natural behavioral patterns and other social activities free from human disturbance.

Overall, these impacts would involve individual animals in highly localized areas, and would not affect Park or regional wildlife species populations. Disturbance of animals would be largely temporary, but these temporary disturbances could accumulate to result in long-term movement of some animals away from the site. While animals could move away, they would reestablish in similar areas resulting in no net loss. Impacts to habitats would also occur because maintenance and sampling activities would result in changes to vegetation from erosion and trampling on social trails. This analysis integrates the assumptions regarding relevant mitigation actions and BMPs discussed in *Chapter 2: Alternatives* into the implementation of the alternative.

Cumulative Effects – The proposed project would temporarily displace wildlife, although would not affect Park or regional wildlife species populations. The geographic area considered for cumulative impacts to wildlife is the project area and immediate surrounding area. Past road building in the area resulted in a movement barrier and destruction of some habitat and already impacted wildlife. Other activities that could occur include short-term research projects, visitor use, routine road maintenance, and potential road expansion. These activities would have the same impacts as the proposed project, resulting in temporary displacement of wildlife because of human disturbance. Wildlife would return to the area when disturbance ceased and there would not be any long term impacts. Additionally, the Park would employ BMPs and mitigations to protect wildlife resources during road maintenance. When the effects to wildlife from Action Alternative Option 1 are considered along with other past, present, and reasonably foreseeable future impacts, the total cumulative impact on wildlife would continue to be adverse. The incremental impacts of the alternative would contribute slightly to but not substantially change the impacts that are already occurring.

Impacts of Action Alternative Option 2 – Tower Height of 59 Feet (Preferred)

Potential impacts to wildlife resources from implementation of Option 2 would be the same as those noted for Option 1.

Cumulative Effects – Potential cumulative impacts to wildlife resources from implementation of Option 2 would be the same as those noted for Option 1.

Special Status Species

Affected Environment

For the purpose of the EA, Special Status Species are defined as those listed under the USFWS as endangered, threatened, or candidate; or considered to be of concern by the Park or the State of Wyoming (Wyoming Game and Fish Department). These are listed in Table 4.

Park biologists familiar with each of the special status species present in Yellowstone were consulted for their knowledge and opinion on potential project impacts. The evaluation of effects included direct, indirect, interrelated, interdependent, and cumulative impacts as defined by the Endangered Species Act (ESA). Species that are not listed under the ESA are also discussed

below.

Consultation with USFWS would occur for this proposed project. During consultation (referred to as Section 7 Consultation), any mitigation proposed by the Park for impacts to threatened or endangered species would include avoidance, minimization, and conservation measures as defined by the ESA. For all species currently listed as threatened or endangered under the ESA, a separate Biological Assessment (BA) is provided as Appendix 7. These species (bolded in Table 4 below) are not discussed further in this EA. All remaining Special Status Species listed in Table 4 are discussed below.

Table 4: Special Status Species Potentially Present at Proposed NEON Site

Common Name	Scientific Name	Status	Agency	Comments
Mammals				
Gray Wolf	*Canis lupus*	Experimental Population, Nonessential	USFWS	There have been dens on Blacktail Deer Plateau adjacent to the proposed NEON construction site since 1996
Grizzly Bear	*Ursus horribilis*	Threatened	USFWS	Known to be present in core site area, which overlaps with Bear Management Area (Figure 1)
Canada Lynx	*Lynx canadensis*	Threatened	USFWS	Generally rare in the Park; the core site is almost entirely outside Canada lynx Critical Habitat (Figure1)
Pronghorn	*Antilocapra americana*	Stable	NPS	Sagebrush habitat, likely present
Wolverine	*Gulo gulo*	April 4, 2016, the court ruled to vacate the 2014 decision not to list the species. This returns the status to Proposed Threatened.	USFWS	High-elevation areas with good snow cover; not present in proposed core site

Table 4: Special Status Species Potentially Present at Proposed NEON Site

Common Name	Scientific Name	Status	Agency	Comments
Sagebrush vole	*Lemmiscus curtatus*	Native Species Status (NSS)4	Wyoming Game and Fish Department (WGFD)	Uncommon in sagebrush habitat, near southeastern distributional edge
Little brown myotis	*Myotis lucifugus*	NSS3	WGFD	Common
Long-eared myotis	*Myotis evotis*	NSS4	WGFD	Ponderosa pine and spruce-fir forests
Long-legged myotis	*Myotis volans*	NSS4	WGFD	Ponderosa pine forests
Yellow-pine chipmunk	*Tamias amoenus*	NSS4	WGFD	Aspen and lodgepole pine forests where open areas are adjacent
Preble's shrew	*Sorex preblei*	NSSU	WGFD	Very rare
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	De-listed August 8, 2007	USFWS	Likely present in general area of the proposed core site.
American Peregrine Falcon	*Falco peregrinus anatum*	De-listed August 25, 1999	USFWS	Requires rock outcrops for nesting
Golden eagle	*Aquila chrysaetos*	NSS4	WGFD	Nests in cliff faces and coniferous forests
Brewer's sparrow	*Spizella breweri*	NSS4	WGFD	Sagebrush habitat, but uncommon
Black-throated gray warbler	*Setophaga nigrescens*	NSS4	WGFD	Nests in forests, could be present

Table 4: Special Status Species Potentially Present at Proposed NEON Site

Common Name	Scientific Name	Status	Agency	Comments
Loggerhead shrike	*Lanius ludovicianus*	NSS4	WGFD	Occur in general area
Red crossbill	*Loxia curvirostra*	NSS4	WGFD	Uncommon
Common nighthawk	*Chordeiles minor*	NSS4	WGFD	Nests and feeds in open areas
Amphibians				
Columbia spotted frog	*Rana luteiventris*	NSS3	WGFD	Requires open water for breeding
Western tiger salamander	*Ambystoma mavortium*	NSS4	WGFD	Requires open water for breeding
Fish				
Yellowstone Cutthroat Trout	*Oncorhynchus clarkia bouvieri*	Stable	NPS	Occurs in tributaries of Yellowstone Lake
Trees				
Whitebark Pine	*Pinus albicaulis*	Candidate	USFWS	Upper margins of subalpine, up to treeline; not in proposed site

Pronghorn

Yellowstone's pronghorn population was one of only a few not exterminated or decimated by the early 20th century and, as a result, was the source for re-establishing or supplementing populations throughout much of its range (Lee et al. 1994). These pronghorn contain much of the genetic variation that was formerly widespread in the species, but is no longer present elsewhere (Reat et al. 1999). This population also sustains one of only two long-distance pronghorn migrations that persist in the greater Yellowstone region (White et al. 2007). There are serious concerns about its viability because low abundance (~200) and apparent isolation have increased its susceptibility to random, naturally occurring catastrophes (NPS 2015b).

Wolverine

On August 13, 2014, the USFWS withdrew a proposal to list the distinct population segment of the North American wolverine (in the contiguous U.S.) as a threatened species under the ESA. On April 4th, 2016, a U.S. District Court vacated the USFWS withdrawal of its proposed rule to list the distinct population segment of the North American wolverine as threatened and

remanded that the status be returned to "proposed" and conferenced on as necessary until a final proposed rule is filed (U.S. District Court 2016). Wolverines have been detected in the GYE, including the eastern, northern, and southern portions of the Park (Beauvais and Johnson 2004; Copeland et al. 2007). Wolverines are rare and sparsely distributed in the Park and adjacent National Forest areas (Beauvais and Johnson 2004; Inman et al. 2007; Murphy et al. 2011). Wolverines are not known to be present on Blacktail Deer Plateau, which is at 7,000 feet elevation and does not present suitable habitat for the species. They are unlikely to spend much time in the proposed NEON site, though they may travel through the area.

Bald Eagle

The USFWS removed the bald eagle from the list of endangered and threatened wildlife on August 8, 2007. Current data indicate populations of bald eagles have recovered in the lower 48 states, with an estimated minimum of 9,789 breeding pairs now compared to 417 active nests in 1963. Nesting and fledgling bald eagles in the Park increased incrementally from 1987 to 2005 (McEneaney 2006). Resident and migrating bald eagles are now found throughout the Park, with nesting sites located primarily along the margins of lakes and shorelines of larger rivers. The bald eagle management plan for the GYE achieved the goals set for establishing a stable bald eagle population in the Park, with a total of 26 eaglets fledged from 34 active nests during 2007. This is the most fledged eaglets ever recorded in the Park, and the increasing population trend indicates habitat is not presently limiting population growth.

Peregrine Falcon

The peregrine falcon was removed from the list of endangered and threatened wildlife on August 25, 1999 due to its recovery following restrictions on organochlorine pesticides in the U.S. and Canada, and implementation of various management actions, including the release of approximately 6,000 captive-reared falcons (64 Federal Register [FR] 46541). The USFWS has implemented a post-delisting monitoring plan pursuant to the ESA that requires monitoring peregrine falcons at three-year intervals; it began in 2003 and scheduled to end in 2015. Monitoring estimates from 2003 indicate territory occupancy, nest success, and productivity were above target values set in the monitoring plan and that the peregrine falcon population is secure and viable (71 FR 60563). Peregrine falcons reside in Yellowstone from April through October, nesting on large cliffs. The number of nesting pairs and fledglings in the Park has steadily increased from zero in 1983 to 32 pairs and 47 fledglings in 2007 (Baril et al. 2009).

Yellowstone Cutthroat Trout

A range-wide status review estimated that the conservation population (defined as greater than 90% genetic purity) of YCT occupy roughly 1,243 miles of streams in the Park; additional streams in the Park have YCT that have hybridized with introduced rainbow trout. Yellowstone Lake, at over 83,998 surface acres, is home to the largest population of YCT in existence (Varley and Schullery 1998) and is an important food source for around 40 species, including bears, osprey, and bald eagles.

The YCT population has declined substantially since the mid-1980s in the Yellowstone Lake ecosystem. This is due to predation by non-native lake trout, drought, and whirling disease. A Native Fish Conservation Plan (YNP 2010) includes maintaining access for spawning YCT in at least 45 of Yellowstone Lake's historical spawning tributaries, maintaining genetic purity in those streams, and recovery of YCT abundance in the lake. Monitoring indicates that the population continues to include smaller fish that are surviving to adulthood, a good sign (YCR 2013).

Whitebark Pine

Whitebark pine is a candidate species for listing under the ESA. Whitebark pine is a major component of the forest community in areas above 8,400 feet and a major understory component of lodgepole-dominated forests from 7,035 to 8,400 feet. Seeds of the whitebark pine are important food for grizzly bears and a variety of other wildlife species. Whitebark pine populations in Yellowstone have been declining due to native mountain pine beetles (*Dendroctonus ponderosae*) and non-native blister rust, which is caused by the fungus *Cronartium ribicola* (Schwandt 2006). It is estimated that 20 to 30% of whitebark pines in the Greater Yellowstone Area are infected with blister rust (YCR 2013). Mountain pine beetle activity and whitebark pine mortality have been more evident in large trees, which the beetles appear to prefer for egg laying, as the larvae fee on the inner phloem of the bark. The rate of new attacks in the Park began increasing in about 2000, peaked from 2007 to 2009, and has declined since then.

In July 2011, the USFWS determined that whitebark pine warrants protection under the ESA, but that adding the species to the list is precluded by the need to address other listing actions of a higher priority. This species is now added to the list of candidate species eligible for ESA protection and its status would be reviewed annually. Whitebark pines exist both as an overstory and understory component within the forest communities in many regions of the Park, typically at the upper end of the subalpine to treeline. They are not present in proposed core site.

Impacts of No Action Alternative

Under the No Action Alternative, the core site infrastructure would not be installed; however the Park would not obtain the long-term data, including observations, that the NEON project would provide and that could facilitate management of the Park's resources in this regard.

Cumulative Effects – Under the No Action Alternative, the core site infrastructure would not be installed and so there would be no cumulative impacts to threatened and endangered species.

Impacts of Action Alternative Option 1 –Tower Height of 70.5 Feet

Construction –The proposed infrastructure installation at the tower and aquatic sites would include actions such as temporary surface disturbance, operating small equipment, and localized increase of human activity and noise that could affect wildlife and their habitat use within and/or adjacent to the site. Construction of the tower and aquatic instrumentation would require the removal and/or disturbance of vegetation for the tower foundation, device posts, soil-sampling array, and instrument hut totaling 0.14 acres (Table 2) and 0.004 acres at the aquatic site (Table 3). Project design includes mitigation actions to minimize removal of the vegetation and many other impacts to wildlife; these are outlined in *Chapter 2: Alternatives.*

Special status wildlife are expected to avoid the area, at least temporarily during construction, operations, and maintenance. Some species would return to the area after disturbance and others would occupy new locations. Special status plants are not present in the project area and would not experience any impacts. Special status species are evaluated in the sections below.

Pronghorn

Pronghorn inhabit grasslands and sagebrush shrublands in western North America and Canada, and are likely to occur in core site. Social animals (Armstrong et al. 2011), they occur in herds. They are likely move through the area at dusk, after human activity has ceased, and may also circumnavigate the areas and times of greatest activity during construction. These impacts are both short-term during construction and long-term during site visitation and data collection. With a large landscape of available habitat on Blacktail Deer Plateau, they are not anticipated to experience any substantive impacts.

Bald Eagle

Bald eagles are doing well in the Park, and are typically associated with water bodies such as lakes and streams. They are not known to nest on the Plateau. A large bird with a large home range, they are not anticipated to experience substantive short-term or long-term impacts.

Peregrine Falcon

Cliff-nesting areas for peregrine falcons are especially important because they require high cliffs for nesting. For the peregrine falcon, proximity to a large body of water is also important because it supports the falcon's favorite prey—waterfowl. No cliff-nesting areas or water bodies with waterfowl occur on the Plateau. Peregrine falcons are not anticipated to experience short-term or long-term impacts from the project.

Yellowstone Cutthroat Trout

Construction would involve installation of two sensor units embedded in the stream bottom, and installation of 8 groundwater wells (Figure 2B). The ground disturbance at the aquatic site would be 16 square feet for the in-stream sensor suite, 28 square feet for the meteorological station, and 13 square feet for the wells (Table 3 and Figure 2B). These are short-term impacts during construction. Design criteria and BMPs would include complete avoidance of sediment introduction into the waters of Blacktail Deer Creek. Further actions in regard to potential for sedimentation include strict construction limits, temporary erosion barriers, and removal of any excess earth after installation. Access and construction of wells would be by foot and conducted manually. This could cause short-term noise impacts, but would only be detectable within the close proximity to activities. The wells are set back from the creek and during construction erosion controls would be used to keep sediment from impacting the Creek (Figure 2B). During operations over the long-term, wells and sensors would be visited every two weeks during peak flow times, and reduced thereafter. Technicians would access the creek on foot to conduct the non-invasive sampling along the existing trail used by fishermen. This would cause a small and intermittent long-term increase in foot traffic. Only minor temporary sedimentation from these activities is anticipated as described in the soils and water resources impact analysis. Given the minor nature of impacts to habitat from the project, no substantive impacts to Yellowstone Cutthroat Trout are anticipated.

Whitebark Pine

Whitebark pines are not known to occur on Blacktail Deer Plateau. Therefore, there are no anticipated impacts to this species from the proposed project.

WGFD Special Status Species

Forest Species

Forest mammals and birds, including black-throated gray warbler, red crossbill, long-eared myotis, long-legged myotis, little brown myotis, and yellow-pine chipmunk, may be present in the project area. Three trees near the DFIR (Figure 2A) would be cut down, which would result in removal of some forest species habitat in the long-term. Some individuals could avoid the area, short-term, during project construction, but could return when construction is finished. With a large landscape of available habitat on Blacktail Deer Plateau, they are not anticipated to experience any substantive impacts.

Sagebrush Species

Sagebrush obligate species, including Brewer's sparrow and sagebrush vole, are uncommon in the project area. There would be a vegetation loss of approximately 0.14 acres (6,086 square feet) during construction, which would impact sagebrush habitats and could decrease nesting

and foraging areas for these species. They may avoid human disturbance and project construction activities. These impacts are both short-term during construction and long-term during site visitation and data collection. With a large landscape of available habitat on Blacktail Deer Plateau, they are not anticipated to experience any substantive impacts.

Species of Multiple Habitats

The loggerhead shrike and common nighthawk occur in the general Yellowstone area. The Preble's shew could also be present, associated with sagebrush and grassland habitats. Golden eagles could nest in the general area on cliff faces and in coniferous trees. There are no cliffs Blacktail Deer Plateau. These species could be displaced by loss of some habitat due to project construction and individuals could avoid the area because of human presence and noise during construction activities. These activities would result in intermittent short-term impacts over the operational life of the project. With a large landscape of available habitat on Blacktail Deer Plateau, they are not anticipated to experience any substantive impacts.

Wetland/Open Water Species

Western tiger salamanders require a body of water for breeding, and do not occur far from open water. Adults may occur in coniferous forests, meadows, grasslands, and are occasionally found in streams. The Columbia spotted frog is aquatic and adults require habitats near lakes, ponds, slow-moving streams, and marshes. These two amphibians, if present, could be displaced by loss of some habitat due to project construction and individuals could avoid the area because of human presence and noise during construction activities. These activities would result in intermittent short-term impacts over the operational life of the project. With a large landscape of available habitat on Blacktail Deer Plateau, they are not anticipated to experience any substantive impacts.

Operations and Maintenance

Pronghorn

Pronghorn are likely to move through the TOS area at dusk, after human activity has ceased, and may also circumnavigate the areas and times of greatest activity during construction. These impacts are would be long-term during site visitation and data collection. With a large landscape of available habitat on Blacktail Deer Plateau, they are not anticipated to experience any substantive impacts.

Bald Eagle

Bald eagles are doing well in the Park, and are typically associated with water bodies such as lakes and streams. They are not known to nest on the Plateau. A large bird with a large home range, they are not anticipated to experience substantive short-term or long-term impacts.

Peregrine Falcon

Cliff-nesting areas for peregrine falcons are especially important because they require high cliffs for nesting. For the peregrine falcon, proximity to a large body of water is also important because it supports the falcon's favorite prey—waterfowl. No cliff-nesting areas or water bodies with waterfowl occur on the Plateau. Peregrine falcons are not anticipated to experience short-term or long-term impacts from the project.

Yellowstone Cutthroat Trout

During operations over the long-term, wells and sensors would be visited every two weeks during peak flow times, and reduced thereafter. Technicians would access the creek on foot to conduct the non-invasive sampling along the existing trail used by fishermen. This would cause an intermittent long-term increase in foot traffic. Only minor temporary sedimentation from these

activities is anticipated as described in the soils and water resources impact analysis. Given the minor nature of impacts to habitat from the project, no substantive impacts to Yellowstone Cutthroat Trout are anticipated.

Whitebark Pine

Whitebark pines are not known to occur on Blacktail Deer Plateau. Therefore, there are no anticipated impacts to this species from the proposed project.

WGFD Special Status Species

Forest Species

Forest mammals and birds, including black-throated gray warbler, red crossbill, long-eared myotis, long-legged myotis, and yellow-pine chipmunk may be present in the project area. Individuals could avoid the area because of human presence when conducting monitoring activities. These activities would result in intermittent short-term impacts over the operational life of the project. With a large landscape of available habitat on Blacktail Deer Plateau, they are not anticipated to experience any substantive impacts.

Sagebrush Species

Sagebrush obligate species, including Brewer's sparrow and sagebrush vole are uncommon in the project area. Individuals could avoid the area because of human presence when conducting monitoring activities. These activities would result in intermittent short-term impacts over the operational life of the project. With a large landscape of available habitat on Blacktail Deer Plateau, they are not anticipated to experience any substantive impacts.

Species of Multiple Habitats

The loggerhead shrike and common nighthawk occur in the general Yellowstone area. Preble's shew could also be present, associated with sagebrush and grassland habitats. Golden eagles could nest in the general area on cliff faces and in coniferous trees. There are no cliffs Blacktail Deer Plateau. These species could be displaced by loss of some habitat and individuals could avoid the area because of human presence when conducting monitoring activities. These activities would result in intermittent short-term impacts over the operational life of the project. With a large landscape of available habitat on Blacktail Deer Plateau, they are not anticipated to experience any substantive impacts.

Wetland/Open Water Species

Western tiger salamanders require a body of water for breeding, and do not occur far from open water. Adults may occur in coniferous forests, meadows, grasslands, and are occasionally found in streams. The Columbia spotted frog is aquatic and adults require habitats near lakes, ponds, slow-moving streams, and marshes. These two amphibians, if present, could be displaced by loss of some habitat and individuals could avoid the area because of human presence when conducting monitoring activities. These activities would result in intermittent short-term impacts over the operational life of the project. With a large landscape of available habitat on Blacktail Deer Plateau, they are not anticipated to experience any substantive impacts.

Cumulative Effects – The geographic area considered for cumulative impacts to special status species is the project area and surrounding area. Special status wildlife would be able to avoid disruptive activities and reestablish in other nearby habitat or return after disturbance. Project actions would displace wildlife, although would not affect Park or regional special status species populations as described above. Past road building in the area resulted in a movement barrier and destruction of some habitat and already impacted special status wildlife. Other activities that

could occur include short-term research projects, visitor use, routine road maintenance, and potential road expansion. These activities would have the same impacts as the proposed project, resulting in temporary displacement of special status wildlife because of human disturbance. Wildlife would return to the area when disturbance ceased and there would not be any long term impacts. Additionally, the Park would employ BMPs and mitigations to protect special status species during road maintenance. With a large landscape of available habitat on Blacktail Deer Plateau and in the Park impacts from all projects would be intermittent and short term. There would be no impacts to special status plants. When the effects to special status species from Action Alternative Option 1 are considered along with other past, present, and reasonably foreseeable future impacts, the total cumulative impact on special status species would continue to be adverse. The incremental impacts of the alternative would contribute slightly to but not substantially change the impacts that are already occurring.

Impacts of Action Alternative Option 2 – Tower Height of 59 Feet (Preferred)

Potential impacts to threatened and endangered species from implementation of Option 2 would be the same as those noted for Option 1.

Cumulative Effects – Potential cumulative impacts to threatened and endangered species from implementation of Option 2 would be the same as those noted for Option 1.

Visual Resources/Visitor Experience

Affected Environment

Visual simulations provide a sense of what a developed tower would look like from various key locations. For this project, both a viewshed analysis without canopy model, and a balloon test wherein a helium balloon was stationed the specified height of the proposed tower were initiated to scope suitable locations from which to obtain photographs to be used as the basis of visual simulations. Four locations were identified as potentially visible by the viewshed analysis. The Park had identified four additional locations on the basis of the balloon trial. In the field, photographs were taken from seven of these eight locations. Visual simulations were produced for four of the seven locations. The two most distant locations from which the tower was deemed visible were not simulated, and the final position of the last location was determined to be positioned where the tower would be completely obstructed from view.

Photographs were taken on September 23, 2014, from these specified locations with information regarding view location (GPS point), date, weather, camera type, focal length, camera elevation, direction of view, and horizontal angle of view noted.

A generalized 3D digital model of the proposed structure using Google Sketchup Pro 8 was developed, and then placed the model at its designated location in Google Earth Pro with terrain modeling activated. This served as the structural model to assess the proportions and relative surroundings of the digital model with the view setting. A digital image of this view was exported for use in the next step. The Park also conducted balloon trials that were used to verify interpretations of the structural models.

Using Photoshop CS6 – Extended, the exported digital image of the perspective view was precisely overlaid and registered/scaled to each photograph. Matching the generalized terrain with the photographic setting often proved difficult especially where extensive canopy cover masks most or all of the terrain setting. To compensate for this difficulty, a digital base map was also created of the project and view areas and individual GIS line of sight analyses were conducted for each view location to identify the extent to which the proposed tower would rise above any obstructing horizon. Area canopy obstructions were estimated to be approximately an additional 45 feet in all areas. These steps in combination, to the extent practicable, served

as the basis for placement and rotation of the 3D model within the photographic image. The 3D masking feature in Photoshop CS6 – Extended was employed at high resolution to remove all below horizon and canopy obstructed portions of the 3D structural model. Finally, various options of lighting, linear definition, shadowing, and other options available in Photoshop CS6 – Extended were tested to produce an agreeably realistic representation of the visual environment given the time of day and lighting conditions. Figures were constructed to illustrate the results of this analysis for each of the photo points (Figures 5 and 6). Visitors currently observe the mosaic of forest and woodlands, dominated by Douglas fir with scattered lodgepole and limber pine with large open areas of sagebrush as they travel between Mammoth Hot Springs east on Grand Loop Road within the vicinity of the proposed core site. Very little infrastructure exists along the corridor; however, there is a small cabin near Blacktail Deer Creek near the proposed aquatic site and several pull outs along Grand Loop Road.

Impacts of No Action Alternative

Under the No Action Alternative, the core site infrastructure would not be installed; therefore, visual resources/visitor experience in this area would be maintained.

Cumulative Effects – Under the No Action Alternative, the core site infrastructure would not be installed and so there would be no cumulative impacts to visual resources/visitor experience.

Impacts of Action Alternative Option 1 –Tower Height of 70.5 Feet

Construction – Visitors driving on or using pull-outs along the Grand Loop Road, or the Blacktail Plateau Drive, would experience impacts from construction, which would be an increase in human and equipment activity. These impacts would be temporary (lasting four to six months). Impacts would be minimized by application of mitigation actions and BMPs that are components of Option 1. With mitigation integrated into the analysis as discussed in *Chapter 2: Alternatives*, Park visitors driving along these roads would be expected to experience impacts to their visual experience from specific road sections where the tower construction would be theoretically visible. Impacts to vistas would be potentially unpleasant to some visitors; others would be less affected. Visitors driving on the roads would move away from the impacts very quickly. Visitors would experience intermittent, very short term impacts to visual resources because of the relatively small size of the structure, the topography and vegetation of the immediate area, and the distance that the structure would be viewed from, which would largely obscure the structure from view.

Operations and Maintenance – The results of the viewshed analysis for the Option 1 with a proposed tower height of 70.5 feet are illustrated in Figure 4. The tower would be painted a color to blend in with vegetative backdrop. Based on the viewshed analysis, the tower would be theoretically visible to Park visitors within 10,000 feet of the tower but would be approximately 1,178 acres when the forest canopy is included in the model. This viewshed area includes 474 acres of recommended wilderness from which the proposed tower would be visible when forest canopy is included in the model. An extended viewshed analysis of Blacktail Deer Creek (not included within the 10,000-foot radius) reveals that the tower would not be visible from anywhere along the creek nor at least 1,000 feet from either side of it.

The viewshed analysis was conducted without the 3-inch-diameter, 10-foot-long antenna. Compared to the scale of the tower, the antenna would be approximately 0.1% the size of the tower. The closest viewshed would be Blacktail Plateau Drive (Figure 6) and the antenna would not generally be perceived at this distance. It is possible that at certain times of the day, the sun could glint off of the antenna but this would be a very short-term impact.

Impact to visitors driving on or using pull-outs along the Grand Loop Road, Blacktail Plateau Drive, or the Gravel Mine Road (an administrative road) would be minimized by application of

mitigation actions and BMPs that are components of Option 1. With mitigation integrated into the analysis as discussed in *Chapter 2: Alternatives*, Park visitors driving along these roads would be expected to experience impacts to their visual experience from specific road sections where the tower would be theoretically visible.

The image points used to create visual simulations of the proposed tower from select observation points along the Grand Loop Road and Blacktail Plateau Drive are illustrated in Figures 5 and 6 illustrate visual simulations from these select points. Photo simulations were constructed for only those points where the tower would be visible based on the model. The simulated tower is largely occluded by forest canopy or intermediary topographic horizons to some degree from most vantage points, but would be visible above the canopy from the four observation points. Impacts to visual resources/visitor experience from these viewpoints are direct, and local and very short term. Some visitors would not notice the tower and would experience no impacts. No permanent impairment of Park resources or values is expected.

Cumulative Effects – Impacts from construction would result in short term impacts to visual resources because visitors would be able to see construction activities. Ongoing impacts of operations and maintenance would occur because the tower would visible from specific areas of the road, but impacts would be mitigated by BMPs. Other tower structures are already present in other areas of the Park and contribute impacts to Park visual resources. However, these other towers are not visible from the project area and the Action Alternative Option I proposed tower would not be visible from the other existing tower locations. The Park is planning to move communication antennas from being mounted directly to the existing fire lookout to a structure that is directly next to the structure. As the structure would be slightly higher than the existing lookout building, the visual impacts of these antennas could be more visible to visitors hiking to this vista location. Changes of views of Mt. Washburn from distant trails and roads would not result substantially different visual impacts than those that already exist. The impact of the Action Alternative Option 1 tower would not contribute meaningful impacts to Park visual resources. The proposed core site would be located near an existing gravel quarry. The parking lot expansion of existing stock and fisherman parking lot on the south side of Grand Loop Road at Blacktail Deer Creek and potential road expansion might increase visitor stops in the area, but the tower would not be visible from this area. When the effects to visitor experience and visual resources from Action Alternative Option 1 are considered along with other past, present, and reasonably foreseeable future impacts, the total cumulative impact on visual resources would continue to be adverse. The incremental impacts of the alternative would contribute slightly to but not substantially change the impacts that are already occurring.

Impacts of Action Alternative Option 2 –Tower Height of 59 Feet (Preferred)

The results of the viewshed analysis for the Action Alternative Option 2 proposed tower height of 59 feet are illustrated in Figure 4. The viewshed where the tower would be theoretically visible to Park visitors would be slightly less than under Option 1 (approximately 960 acres as opposed to 1,178 acres under Option 1). This viewshed area includes 378 acres (taking into account tree canopy) of recommended wilderness from which the proposed tower would be visible. An extended viewshed analysis of Blacktail Deer Creek (not included within the 10,000-foot radius) reveals that the tower would not be visible from anywhere along the creek nor at least 1,000 feet from either side of it.

The viewshed analysis was conducted without the 3-inch-diameter, 10-foot-long antenna. Compared to the scale of the tower, the antenna would be approximately 0.1% the size of the tower. The closest viewshed would be Blacktail Plateau Drive (Figure 6) and the antenna would not generally be perceived at this distance. It is possible that at certain times of the day, the sun could glint off of the antenna but this would be a very short-term impact.

As under Option 1, impact to visitors driving on or using pull-outs along the Grand Loop Road, Blacktail Plateau Drive or the Gravel Mine Road (an administrative road) would be minimized by application of mitigation actions and BMPs that are also components of Action Alternative Option 2. With mitigation integrated into the analysis as described in *Chapter 2: Alternatives*, Park visitors driving along these roads would be expected to experience direct, local impacts; however, no permanent impairment of Park resources or values is expected.

Visual simulations were not performed for Action Alternative Option 2.

Cumulative Effects – Cumulative impacts to visual resources from implementation of Option 2 would not be meaningfully different as those noted for Option 1.

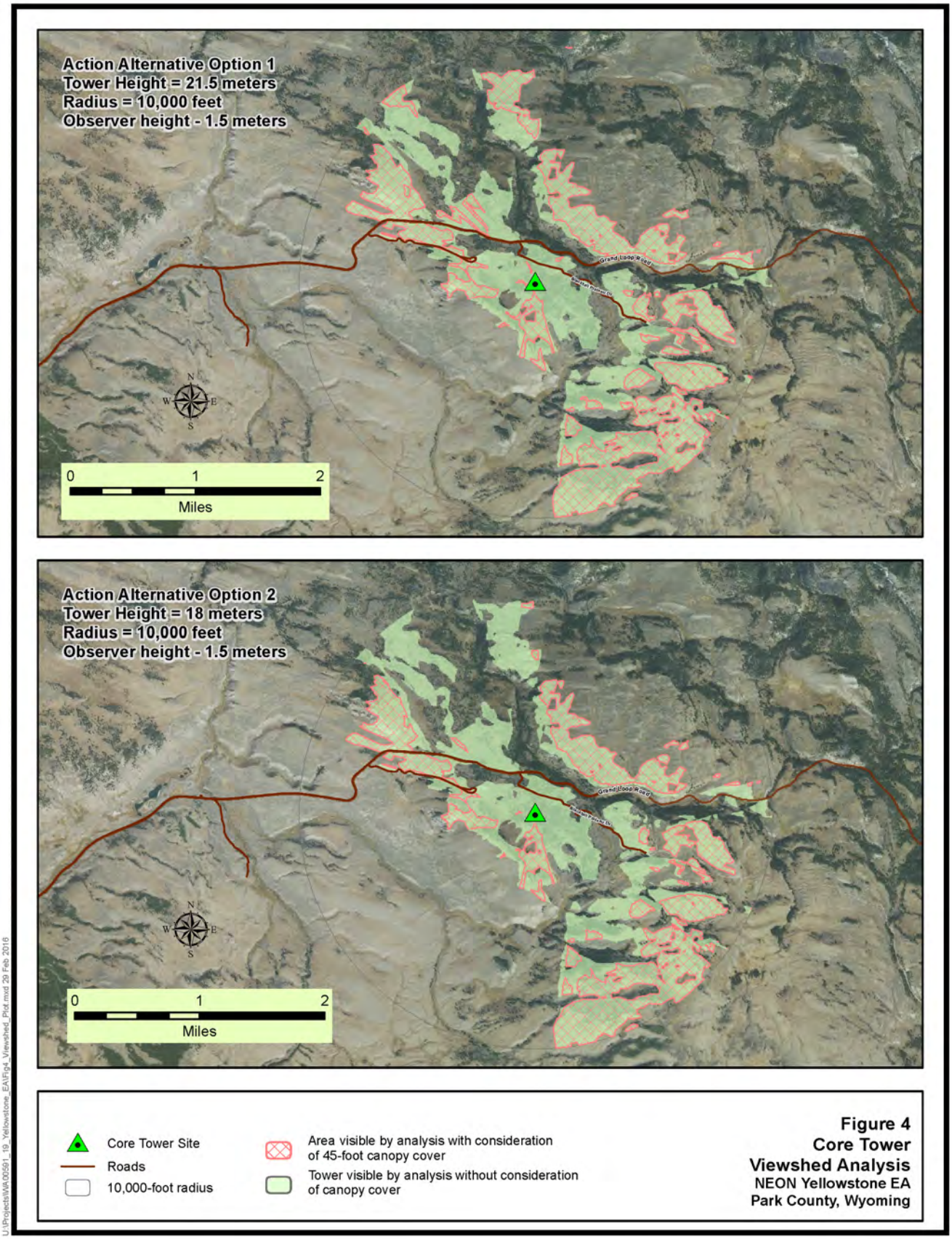
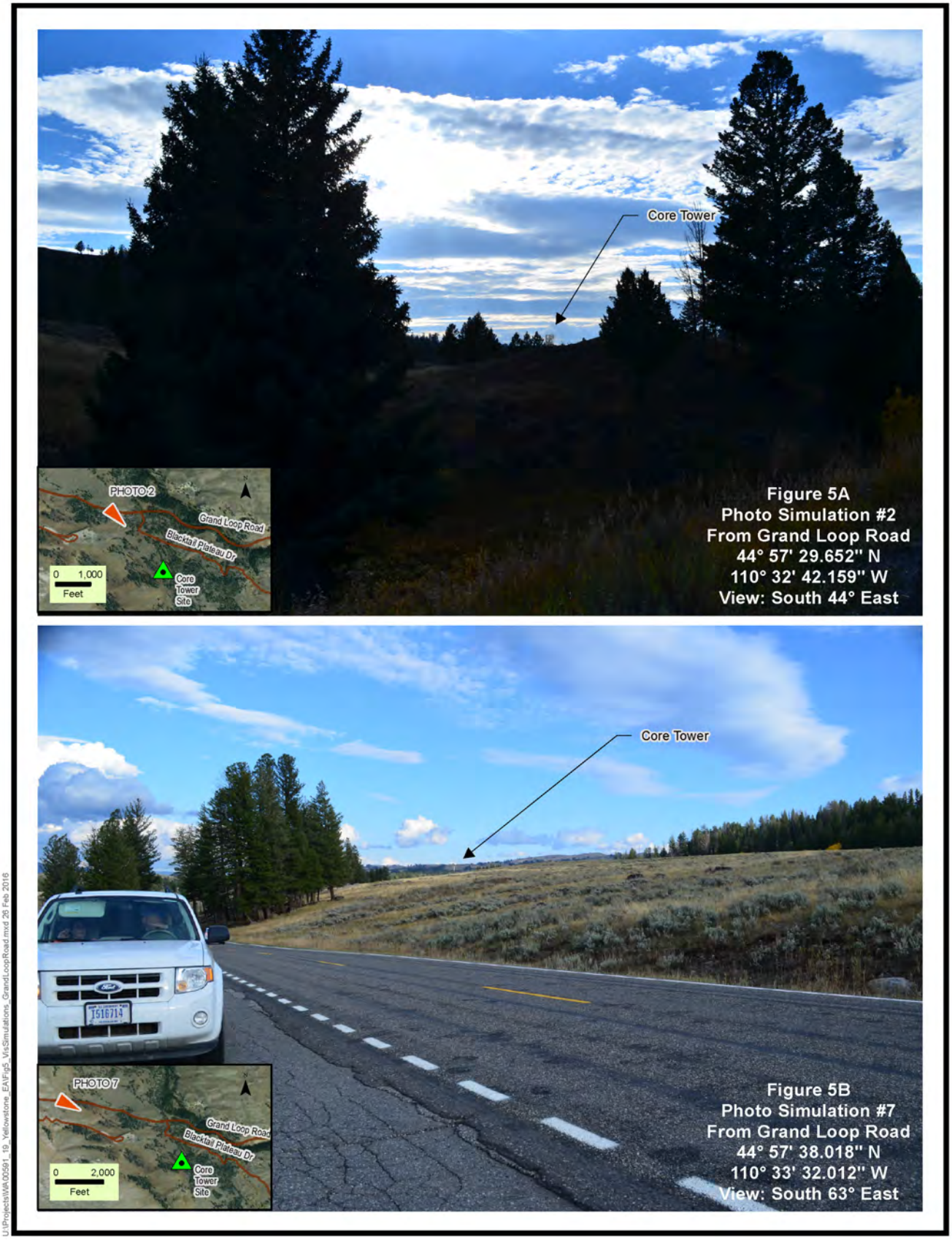


Figure 4
Core Tower Viewshed Analysis
NEON Yellowstone EA
Park County, Wyoming


Core Tower
PHOTO 2
Grand Loop Road
Blacktail Plateau Dr
0 1,000
Feet
Core Tower Site
Figure 5A
Photo Simulation #2
From Grand Loop Road
44° 57' 29.652" N
110° 32' 42.159" W
View: South 44° East
Core Tower
PHOTO 7
Grand Loop Road
Blacktail Plateau Dr
0 2,000
Feet
Core Tower Site
Figure 5B
Photo Simulation #7
From Grand Loop Road
44° 57' 38.018" N
110° 33' 32.012" W
View: South 63° East
U:\Projects\WA00591_19_Yellowstone_EA\Fig5_VisSimulations_GrandLoopRoad.mxd 26 Feb 2016


Core Tower
PHOTO 5
Grand Loop Road
Blacktail Plateau Dr
0 1,000
Feet
Core Tower Site
Figure 6A
Photo Simulation #5
From Blacktail Plateau Drive
44° 57' 21.671" N
110° 32' 33.242" W
View: South 60° East
Core Tower
Grand Loop Road
Blacktail Plateau Dr
PHOTO 6
0 1,000
Feet
Core Tower Site
Figure 6B
Photo Simulation #6
From Blacktail Plateau Drive
44° 57' 18.597" N
110° 32' 11.972" W
View: South 41° West
U:\Projects\WA\00591_19_Yellowstone_EA\Fig6_VisSimulations_BlacktailPlateauDr.mxd 26 Feb 2016

Wilderness

Affected Environment

The Park has not been formally designated as wilderness; however, it is managed as recommended wilderness. The tower may be visible from Wilderness Area #4 to the north (Appendix 8). This wilderness boundary edge is approximately 3,000 feet from the tower site. The tower may also be visible from Wilderness Area #3 to the south based on the Park's 1972 Wilderness Recommendations (Appendix 8).

The Park manages recommended wilderness and wilderness character in accordance with NPS Management Policies (NPS 2006) and Director's Order 41 (NPS 2013). These policies and orders include a requirement for a minimum requirements analysis. The Park conducts a minimum requirements analysis (MRA) in accordance with the Minimum Requirements Decision Guide (MRDG), which is designed to assist wilderness managers in making stewardship decisions (BLM, USFWS, USFS, and NPS 2016). An MRA (Appendix 9) was completed for this proposed project and the aquatic site was moved to the north to ensure that all installed equipment would be outside recommended wilderness (Appendix 9).

Director's Order 41 states that "Scientific activities will be encouraged in wilderness, provided that the benefits of what may be learned outweigh the negative impacts to wilderness character. Managers need to be aware of, and guard against, cumulative effects from simultaneously occurring projects. It is important for scientists to understand that the conduct of their research should be in accord with wilderness preservation principles. Applications for research and other scientific work in wilderness should demonstrate a positive benefit to wilderness or wilderness purposes, and must include an MRA of the project's methods. Monitoring systems must be implemented to ensure wilderness character is preserved." (NPS 2013).

Potential impacts described below consider NPS Management Policies, Director's Order 41, MRDG incorporating wilderness legislation, other legislation, wilderness character, and that scientific activities are encouraged in wilderness.

Impacts of No Action Alternative

Under the No Action Alternative, the core site infrastructure would not be installed; recommended wilderness character would remain unchanged.

Cumulative Effects – Under the No Action Alternative, the core site infrastructure would not be installed and so there would be no cumulative impacts to wilderness.

Impacts of Action Alternative Option 1 –Tower Height of 70.5 Feet

Construction – Impacts to visitors to recommended wilderness could include seeing or hearing temporary construction activities in the vicinity. No construction activities would be conducted in recommended wilderness and there would be no direct impacts.

Operations and Maintenance – Under Option 1, the tower would be visible from approximately 474 acres of recommended wilderness. Specific BMPs and mitigation actions would further reduce potential impacts to recommended wilderness.

Park visitors to recommended wilderness area in the vicinity of the proposed project may observe operational activities being conducted; however, this would be intermittent and operations would be scheduled to reduce the number of trips. A subset of the proposed TOS plots would be located within the recommended wilderness and may include observation or collection of vegetation, soil, beetles, breeding birds, mosquitoes, and small mammals;

therefore, these areas would be accessed by NEON crews on foot according to sampling protocols discussed in *Chapter 2: Alternatives*.

Aquatic sensors and ground water wells would be placed outside of the recommended wilderness; however, some aspects of AOS sampling activities would occur within the recommended wilderness boundary as described in *Chapter 2: Alternatives*. NEON would use hand saws to collect coarse downed wood samples and sling-shots or trained tree climbers to collect leaves from the upper canopy of trees. No material would be left at the plot aside from the plot markers described above; however, beetle sampling does require short term installation of some sampling equipment at the beginning of the sampling season (as described in *Chapter 2: Alternatives*); equipment requirements at plots where vegetation, soil, and bird observations occur would include tape measures, range finders, soil cores, and equipment required for harvesting canopy leaves, and coarse downed wood (a complete list of all equipment required for all protocols can be made available). Operational activities are not expected to create noise or glare.

Under this action alternative the *untrammeled, natural, and undeveloped* wilderness qualities would be degraded because the tower would be visible from 474 acres of recommended wilderness. This would be a long-term impact to the resource but over a very small area. There would be temporary impacts to wilderness character when NEON personnel are scheduled to conduct on-the-ground observations and sampling within the TOS area (Figure 3). A subset of the proposed TOS plots within recommended wilderness would be visited as scheduled in Appendix 5. Sampling would be scheduled in order to minimize the number of trips to the site, which would reduce anthropogenic activity in the area preserving recommended wilderness and wilderness character. Additionally, NEON personnel would be instructed to tread lightly and avoid repeated travel by the same routes when implementing protocols where established footpaths do not exist. Social trail creation would be minimized by reducing the amount of recurring traffic that occurs in recommended wilderness; this would be accomplished by approaching TOS plots from different locations and tracking each route with GPS technology to guide subsequent trips to new areas. NEON personnel would also take care to avoid trampling vegetation (please see other applicable BMPs related to recommended wilderness at the end of Chapter 2). Visitors to the area may notice temporary sampling equipment, but these activities would be intermittent for durations of 1 to 20 days resulting in very short term impacts.

The opportunities for *solitude and primitive and unconfined recreation* quality could be temporarily degraded because NEON personnel could be encountered by visitors to recommended wilderness. NEON personnel would access recommended wilderness intermittently when on-the-ground observations within the TOS area (Figure 3) are scheduled to occur (Appendix 5). All TOS protocols involve physical sample collection in addition to observations, except for the breeding landbird sampling, where the protocol is restricted to point counts. These point counts might not impact the visitor experience, but other activities such as mammal trapping, could be detected over two to four day periods, six times per year because traps would be left out. Impacts to this wilderness quality would be intermittent and very short term.

The *other features of value (wildlife*) could be adversely impacted because wildlife could temporarily avoid the TOS area during sampling periods when NEON personnel are present within recommended wilderness.

Most impacts to wilderness qualities would be very temporary and are not anticipated to impact all visitors. For the majority of the year, no impacts from sampling activities are anticipated. However, the tower and potentially other infrastructure would be visible from recommended wilderness, but this impact would be localized and short term.

Upon implementation of protocols and other BMPs and mitigation measures to reduce disturbance, discussed in *Chapter 2: Alternatives*, this alternative is anticipated to result in direct, indirect, localized, short-term and long-term impacts to recommended wilderness.

Cumulative Effects – Impacts from the proposed project to the wilderness qualities of *untrammeled, natural, and undeveloped* wilderness qualities; s*olitude and primitive and unconfined recreation qualities;* and *other features of value (wildlife)* would be temporary because visitors could encounter NEON personnel during sampling events during operations and maintenance or could see the tower from limited areas. There would be no impacts from construction because all construction would take place outside of recommended wilderness. Similar impacts would occur from other short-term research projects and from other visitors. Past road building in the area resulted in changing wilderness qualities. There would be no impacts from road maintenance or expansion because the road is not in wilderness. When the incremental impact of Action Alternative Option 1 is considered with impacts of other past, present, and reasonably foreseeable projects there would be adverse cumulative impacts. The incremental impacts of the alternative would contribute slightly to but not substantially change the impacts that are already occurring.

Impacts of Action Alternative Option 2 –Tower Height of 59 Feet (Preferred)

Under Action Alternative Option 2, the tower would be visible from approximately 378 acres of recommended wilderness. Other impacts discussed in Option 1 would apply to Option 2.

Cumulative Effects – Potential cumulative impacts to wilderness from implementation of Option 2 would be the same as those noted for Option 1.

CHAPTER 4: CONSULTATION AND COORDINATION

Internal Scoping

Scoping is a process to identify the resources that may be affected by a project proposal, and to explore possible alternative ways of achieving the proposal while minimizing adverse impacts. Internal scoping was conducted by the ID Team made up of Park personnel. ID Team members met in September 2014 to discuss the purpose and need for the project; various alternatives; potential environmental impacts; past, present, and reasonably foreseeable projects that may have cumulative effects; and BMPs. The team also gathered background information and discussed public outreach for the project. Over the course of the project, various team members have conducted individual site visits to view and evaluate the proposed construction site.

External Scoping

External scoping was initiated with the distribution of a scoping letter to inform the public of the proposal to install a NEON core site at the Park, and to generate input on the preparation of this EA. The scoping letter dated November 21, 2014, was mailed to interested parties on the Park's mailing list. A press release was also sent to local news organizations. In addition, the scoping letter was posted on the NPS Planning, Environment and Public Comment (PEPC) website.

During the 30-day scoping period, the Park received 34 pieces of correspondence from the general public. A Scoping Report was prepared and responses to comments posted on the NPS PEPC website following the close of the public scoping period.

Agency Consultation

Endangered Species Act

In accordance with the ESA, the Park contacted the USFWS with regard to federally listed special status species. USFWS directed the Park to a current species list, July 2016 which was used in preparation of this EA (USFWS 2016). A BA was prepared and sent to USFWS in February 2017 (Appendix 7). A letter of Concurrence was received on May 27, 2017 that concurred with the Park's determination that the proposed project "may affect, but is not likely to adversely affect" federally listed species and designated critical habitat (Appendix 7).

Section 106 of the National Historic Preservation Act

In accordance with Section 106 of the National Historic Preservation Act, a cultural resource records and literature review, including archival records and prehistoric and historic records, historic maps, geomorphologic history, settlement history, and aerial photographs, was conducted in November of 2008. The literature review was conducted through the Wyoming Cultural Resource Information System within a 1,987-acre study area around the proposed tower location. The literature search revealed one previously known historic property near the proposed tower location; however, no historic properties were identified within the areas of disturbance associated with the installation of the tower and related infrastructure (Wyoming SHPO 2015). Blacktail Plateau Road and Grand Loop Road are eligible for the National Register of Historic Places (NRHP); however, neither one are anticipated to be adversely affected by the proposed core site (Wyoming SHPO 2015). A similar literature review was conducted within the vicinity of the proposed aquatic site in November 2008 in addition to a Class III pedestrian cultural resources inventory in July 2011. No NRHP listed or eligible sites

were identified within the vicinity of the proposed aquatic site during the literature review or field reconnaissance. In 2013, NPS determined that activities at the proposed aquatic site would have no effect on historic properties and requested concurrence from the Wyoming State Historic Preservation Officer on February 4, 2013. The Wyoming State Historic Preservation Officer provided a letter of concurrence to NPS on February 25, 2013, stating that no historic properties are anticipated to be affected as a result of the proposed project (Wyoming SHPO 2013). No historic structures are present within the project area and no physical impacts are expected to cultural resources.

Clean Water Act

In accordance with the Clean Water Act of 1972, which establishes the basic structure for regulating discharges of pollutants into the waters of the U.S. and regulating quality standards for surface waters, NEON would be required to coordinate with the U.S. Army Corps of Engineers, Omaha District, Wyoming Regulatory Office to determine what permitting actions are necessary.

Native American Consultation

Tribal Consultation for the NEON project was conducted with 26 associated tribes during scoping and is on-going. The Park did engage with one tribe on project specifics, but the tribes did not provide any concerns over the project. Some associated tribes were briefed on the project at a tribal consultation meeting in 2013 and did not raise any concerns at that time. Consultation with the 26 associated tribes will continue with the release of this EA and additional engagement. If consultation with tribes during the release of the EA raises any concerns, additional consultation may be undertaken prior to a decision document depending on the nature of those concerns.

Environmental Assessment Review and List of Recipients

The EA is subject to a 30-day public comment period. To inform the public of the availability of the EA, NPS will publish and distribute a letter to various agencies, tribes, and the Park's mailing list, as well as place an ad in the local newspaper. The document will be available for review on the PEPC website at http://parkplanning.nps.gov/YNPNeon and at the Park's visitor center. Copies of the EA will be provided to interested individuals, upon request.

During the 30-day public review period, the public is encouraged to submit their written comments to NPS, as described in the instructions at the beginning of this document. Following the close of the comment period, all public comments will be reviewed and analyzed, prior to the release of a decision document. NPS will issue responses to substantive comments received during the public comment period, and will make appropriate changes to the EA, as needed.

List of Preparers

The following persons assisted with the preparation of the EA.

Table 5: List of Preparers

Name/Title	Title/Contribution
Yellowstone National Park Interdisciplinary Team	
Doug Madsen	Environmental Compliance
Roy Renkin	Vegetation
PJ White	Wildlife and Aquatics
Bret De Young	Telecommunications
Ann Rodman	GIS/Geothermal/Air Quality
Dan Stahler	Threatened and Endangered Species
Erik Oberg	Permits and Process
Tobin Roop	Cultural Resources
Wade Vagias	Management Assistant (former)
Katy Duffy	Interpretation/Education (former)
Tom Schwartz	Law Enforcement/Resource Protection
Mike Finken	Maintenance
National Park Service – Intermountain Region	
Richard Neubauer	Environmental Compliance
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Susan Serreze	Senior NEPA Manager
Jennifer Jackson	Project Manager

Table 5: List of Preparers

Name/Title	Title/Contribution
Carron Meaney, Ph.D.	Senior Wildlife Ecologist
Chris Jessen	GIS Specialist

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Appendix 1
SHPO Letters of Concurrance

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National Science Foundation
4201 Wilson Boulevard, Arlington, VA 22230

January 15, 2010

Ms. Mary Hopkins
State Historic Preservation Officer (Interim)
Wyoming State Historic Preservation Office
2301 Central Ave., Barlett Building, 3rd Floor
Cheyenne, WY 82002

Reference: Request for Comment Related to the National Science Foundation's Proposed Funding for Construction and Operation of the National Ecological Observatory Network (NEON)

Dear Ms. Hopkins:

The National Science Foundation (NSF) has initiated its Section 106 process pursuant to the National Historic Preservation Act, 16 U.S.C. § 470 (NHPA), concerning the proposed construction and operation of the National Ecological Observatory Network (NEON). NEON is a continental-scale observatory of long-term ecological infrastructure deployments and field measurements for the purpose of understanding the effects of climate change, landuse change, and invasive species on the biological systems of the US.

This letter is being sent to request your review of the NEON facilities in Wyoming, and to respectfully ask for your thoughts and confirmation of our approach to Section 106 compliance. We have conducted a comprehensive archival cultural resources study, including a search of the Wyoming Cultural Resource Information System (WYCRIS), held two public meetings, and contacted over 2000 groups and individuals to inform them of the NEON Environmental Assessment. We are asking your help in identifying any other potential parties with specific concerns or sensitivities to the archeological, cultural, or historic aspects at these locations.

Two sites located in Wyoming were selected for inclusion in NEON: 1 the proposed Core Site infrastructure (C-34, C-35, and C-36) which is proposed along a portion of the Yellowstone Northern Range (YNR) in YNP and 2. an Aquatic Array (A-28) which is also proposed within the Core Site and in YNP (see Attachment A).

For each Core, Relocatable, and Aquatic site, the area of direct impact of the infrastructure (0.01 hectare) and a surrounding 804 hectare study area were assessed to determine potential effects of the infrastructure on historic properties and provide infrastructure "micrositing" options.

As part of the NEON Environmental Assessment prepared in compliance with the National Environmental Policy Act (NEPA), cultural resources information was collected and

analyzed for each location including those in Wyoming (synopsis and analysis provided below; see also Final Environmental Assessment November 2009 pages 3-367 through 3-396 and Figures 3.D12-1 through 3.D12-5, pages 3-397 and 3-401). The NEON Final EA is available at http://www.nsf.gov/bio/outreach/final_neon_ea_addendum_a_combined.pdf and the Finding of No Significant Impact is available at http://www.nsf.gov/bio/outreach/neon_finding_nsi_2009.pdf.

As part of our information collection efforts to-date, WYCRIS was searched to obtain the existing information in the State's archival database. The information obtained from WYCRIS, along with historic maps, geomorphologic history, settlement history, and aerial photographs, were reviewed and factored into our analysis of NEON's potential effects on historic properties.

As explained in more detail below, no previously recorded resources or sites were documented within the 0.01 hectare (ha) area of direct infrastructure impact (NEON Final Environmental Assessment 2009 Table 3.5.12.3-3 on page 3-385).

To further reduce the likelihood of any impact, NSF is proposing that if the construction project is approved, "micro-siting" will occur in each location. At that point, NSF intends to take another look at whether micro-siting requires us to revisit our findings.

NSF's assessment of the proposed project's potential to impact historic properties to-date are presented below, in addition to a general description of the NEON project, and a more detailed description of facilities location in Wyoming, or ecological Domain 12 of NEON.

NEON Project Description

NEON will be a tool for the ecological research community that will allow scientists to analyze, understand, and forecast the nature and pace of biological change at scales ranging from local to continental. 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 instrument towers, a panelized modular enclosure called an instrument hut, and in some cases an Aquatic sensor array. A variety of field sampling plots and transects would be established for data and sample collection. 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 instrument Tower, sensor arrays and would have fewer sampling plots and 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 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. MDPs would be deployed from a few days to several months at any given location. The Mobile platforms would include a mobile tower, sensor arrays, and temporary fields sample plots and transects.
- 26 Aquatic Arrays - An Aquatic Array would be placed in and adjacent to a stream or lake. The Aquatic Array is a sensor system deployed to automatically monitor stream physical, chemical, and biological properties. Each Aquatic Array would collect data from a 500-meter (m) stream reach.
- Three Aerial Observation Platforms (AOPs) – AOPs would include three 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 Stream Observatory Network (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.

Best Management Practices

The purpose of the NEON infrastructure and sampling is to assess, measure, and understand the effects of climate change, landuse change, and invasive species on the living systems of the US. The NEON Core, Relocatable, and Aquatic sites have been designed explicitly to minimize the impacts associated with the project's infrastructure deployment, footprint, and maintenance and operations. The amount of ground disturbance for placement of infrastructure would generally be less than 0.01 ha (100 square meters). The installation of utilities may require more than .01 ha of ground disturbance in some cases. A detailed description of the Core, Relocatable, and Aquatic site deployments can be found on pages 2-5 to 2-13 of the Final Environmental Assessment November 2009. 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 and continue through surface conduits or shallowly buried conduits from the road to an Instrument Hut (IH), towers, and Aquatic Array (where a Core Site includes an Aquatic Array). 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.

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. The terrestrial field sampling and transects 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. The construction project design features to minimize affects on the sites are described on pages 2-14 to 2-17 of the Final Environmental Assessment November 2009.

NEON Domain 12 Wyoming Facilities

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. Attachment A contains location maps for all of the Domain 12 NEON facilities.

The proposed Core Site infrastructure (C-34, C-35, and C-36, Figure 3.D12-1) would be placed 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) is also proposed 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.

Maps depicting the specific locations of NEON facilities in Domain 12 are provided as Attachment A to this letter.

Cultural Resources Assessment Conducted To-Date

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 12, including an 804 ha study area around the proposed location. A literature search of the WYCRIS database was performed in November 2008. The files of WYCRIS contain information on surveyed cultural resources in the State of Wyoming. The search included the NRHP.

None of the proposed NEON locations in Domain 12 for which information is currently available have been previously surveyed for cultural resources, although several surveys have been conducted in proximity to several of the proposed NEON locations. 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 historic residences, irrigation systems, lithic scatters, buffalo jumps, and a buffalo pound. The literature review documented multiple previously recorded sites within the 804 ha study area of several of the project components.

The literature search revealed that one previously known historic property occurs near the proposed area of disturbance 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. Other than the site at A-28, none of these resources would be within the area of disturbance.

The literature review of the proposed NEON locations in Domain 12 did not identify 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.

Summary

In order to fulfill responsibilities to determine potential impacts to historic properties under Section 106 of NHPA, NSF has conducted an archival cultural resources assessment for all NEON facilities within each of the 20 NEON domains. The project's cultural resources Area of Potential Effects has been determined as the area of direct impact to native soils, such as the foundations of the observation towers and associated equipment. The archival assessment included an 804 ha 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.

Based on the analysis in the NEON Final Environmental Assessment, 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. Therefore, NSF is seeking your thoughts and confirmation of this approach as it relates to compliance with Section 106.

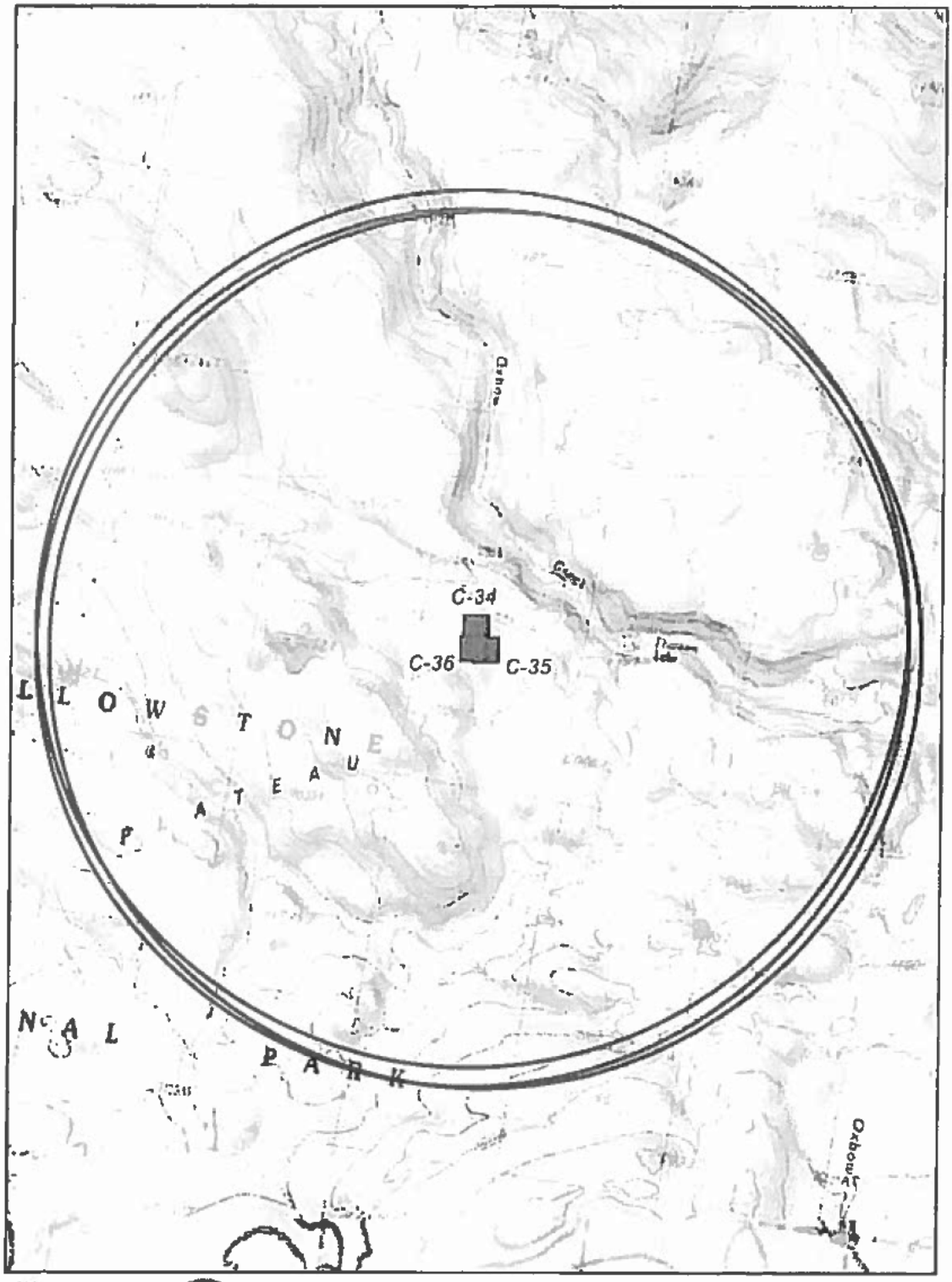
I look forward to your reply and suggestions. Please don't hesitate to contact me at eblood@nsf.gov or 703-292-4349. Your assistance is greatly appreciated.

Sincerely,

Elizabeth Blood

Elizabeth Blood
NEON Program Officer
Office of the Assistant Director
Biological Sciences Directorate
National Science Foundation

Enclosure(s)
Attachment A (Figures 3.D12-1 through 3.D12-5)



Location Source: February 6, 2009, Version 5 NEON, Inc

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Figure 3.D12-1
Domain 12 Proposed Site Locations
National Ecological Observatory Network (NEON) EA

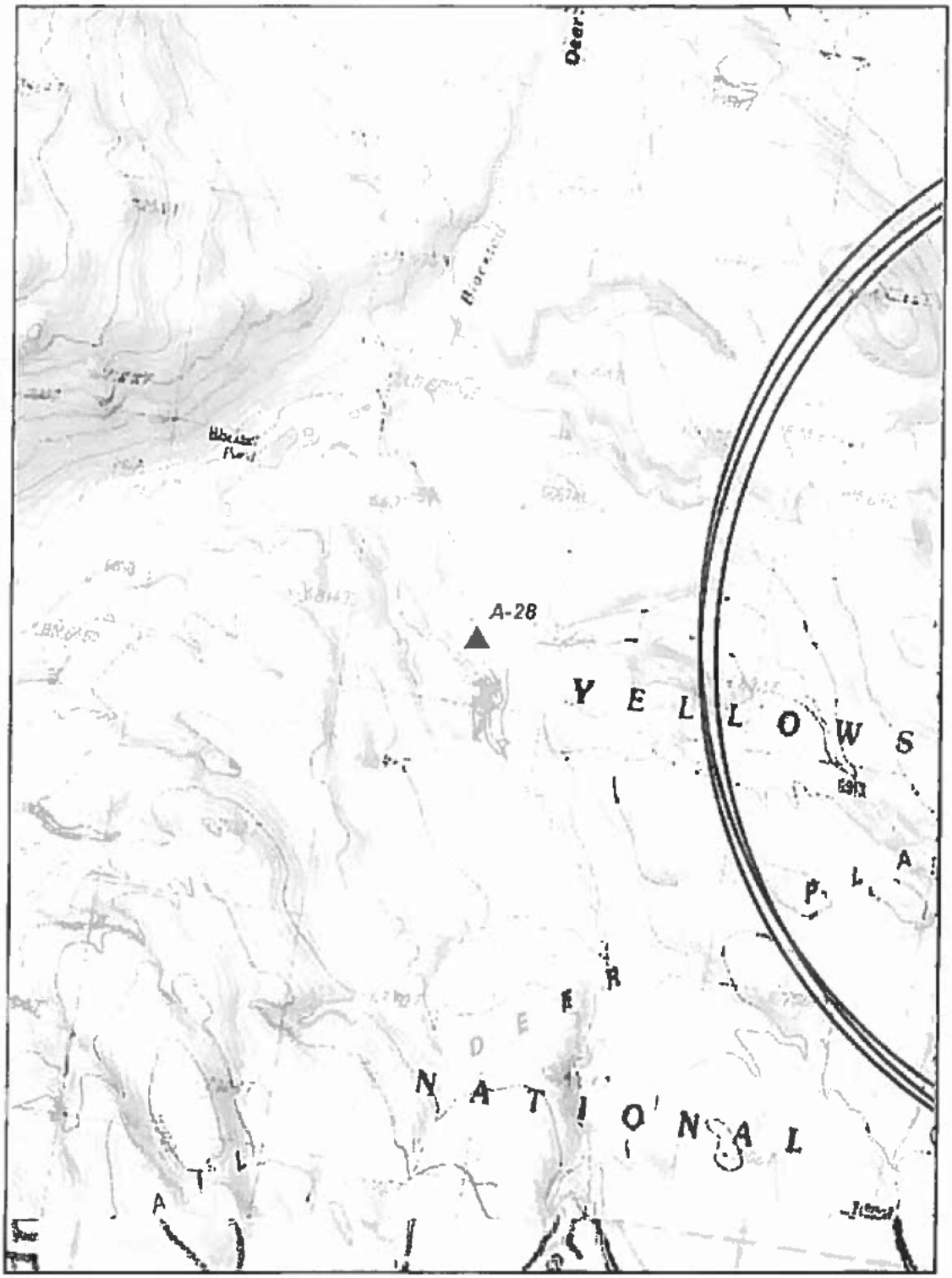

Figure 3.D12-4
Domain 12 Proposed Site Locations
National Ecological Observatory Network (NEON) EA

Location Source: February 6, 2009, Version 5 NEON, Inc

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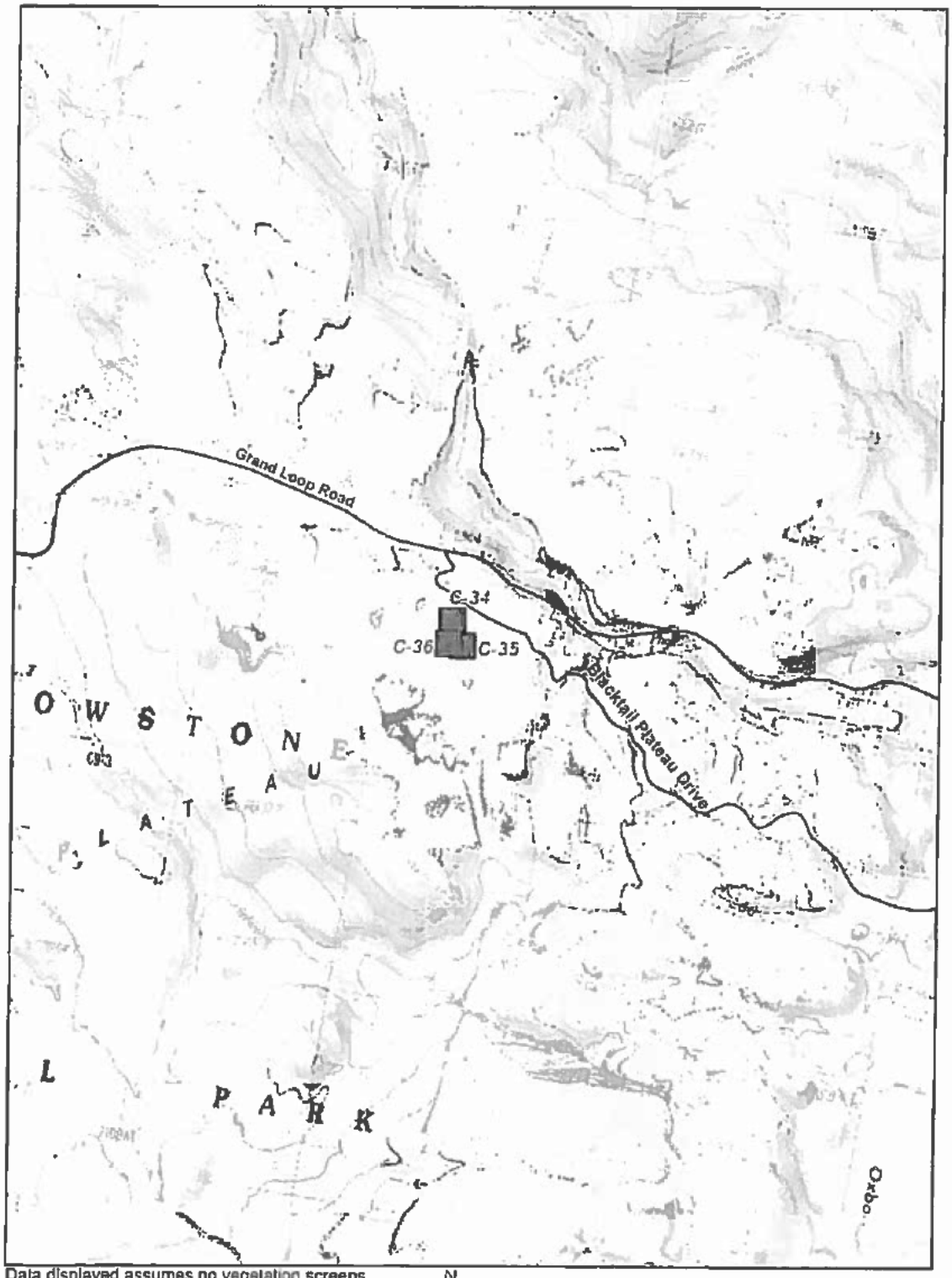

Figure 3.D12-5
Yellowstone NP Viewshed Analysis
National Ecological Observatory Network (NEON) EA

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ARTS. PARKS. HISTORY.
Wyoming State Parks & Cultural Resources

State Historic Preservation Office
Barrett Building, 3rd Floor
2301 Central Avenue
Cheyenne, WY 82002
Phone: (307) 777-7697
Fax: (307) 777-6421
http://wyoshpo.state.wy.us

February 1, 2010

COPY

Elizabeth Blood, NEON Program Officer
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

re: National Science Foundation, Proposed Funding for Construction and Operation of the National Ecological Observatory Network (NEON) (SHPO File # 0210RLC001)

Dear Ms. Blood:

Thank you for consulting with the Wyoming State Historic Preservation Office (SHPO) regarding the above referenced project.

As noted in your letter, none of the proposed locations within the State of Wyoming have been previously surveyed for cultural resources. Following 36 CFR Part 800, and prior to any ground disturbing activities, we recommend the National Science Foundation carry out an intensive field survey of all areas that may be disturbed during the implementation of this undertaking. This survey must be conducted by a consultant and/or federal staff meeting the Secretary of the Interior's Professional Qualification Standards (48 FR 22716, Sept. 1983). A report detailing the results of this survey, including determinations of eligibility and effect, as well as any proposed mitigation measures, must be provided to SHPO staff for our review and comment prior to implementing the undertaking.

Additionally, since this project is located within the boundaries of Yellowstone National Park (YNP) we recommend that you work closely with the cultural resources staff of YNP to meet any requirements of the National Park Service, and to identify any Native American Tribes which may have an interest in the project.

Please refer to SHPO project control number #0210RLC001 on any future correspondence dealing with this project. If you have any questions, please contact me at 307-777-5497.

Sincerely,

Richard L. Currit
Senior Archaeologist

H3015(YELL) CERTIFIED

FEB 0 5 2013

Ms. Mary Hopkins
State Historic Preservation Officer
Barrett Building, 3rd Floor
2301 Central Avenue
Cheyenne, Wyoming 82002

RE: Section 106 Review, National Ecological Observatory Network (NEON) Yellowstone Blacktail Deer Creek Aquatic Candidate Site Project, Park County, Wyoming. WYSHPO #0210RLC001

Dear Ms. Hopkins:

In accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and the Advisory Council on Historic Preservation regulations, 36 CFR Part 800.4(a) and (b), the National Park Service requests your concurrence with identification, eligibility, and effect for the proposed undertaking National Science Foundation-funded NEON Yellowstone Blacktail Deer Creek Aquatic Candidate Site Project, Park County, Wyoming, in Yellowstone National Park (YNP). Construction of the observatory will involve ground disturbance for installation of sensors and associated buried utilities. Previous consultation with your office resulted in concurrence with a no historic properties affected determination for the associated Frog Rock candidate site.

In July 2011, HDR Incorporated performed a Class III cultural resources inventory for the NEON Yellowstone Blacktail Deer Creek Aquatic Candidate Site Project, Park County, Wyoming. The area of potential effect (APE) included a portion of site 48YE313 within boundaries reported in 1958 by J.J. Hoffman and which was unevaluated as to eligibility for the National Register. In an email correspondence dated September 9, 2011, SHPO required that portions of 48YE313 outside of the APE also be investigated prior to concurrence with the park's determination of effect for the aquatic candidate site.

In 2012, the APE was enlarged to include new project areas. The revised APE and those portions of site 48YE313 outside of the original and revised APE were inventoried by HDR Incorporated. As a result of those efforts, two new archeological sites have been identified (48YE2196 and 48YE2197) and the boundary of site 48YE313 has been redrawn based on modern documentation methods. The attached report describes the inventory and evaluation efforts for this second phase of survey and recommended determinations of eligibility. Based on these efforts, Yellowstone National Park has determined that archeological sites 48YE2196, 48YE2197, and 48YE313 are not eligible for the National Register of Historic Places (NRHP). Because the APE contains no sites eligible for or listed on the NRHP, Yellowstone National Park has determined that the undertaking will have no effect on historic properties.

We hope you will concur with our determinations. You will also be receiving a similar request for concurrence from the National Science Foundation. Yellowstone National Park, the National Science Foundation, and NEON program managers have collaborated extensively on satisfying the requirements of Section 106 and are in agreement regarding eligibility and effect. If you have any questions, please contact Staffan Peterson at (307) 344-2290, or Tobin Roop at (307) 344-2224

Sincerely,

Daniel N. Wenk
Superintendent

Enclosures:
Class III Archeological Inventory of Site 48YE313 and the Archeological Testing of the Revised Area of Potential Effect for the National Ecological Observatory Network (NEON; Yellowstone Blacktail Deer Creek Aquatic Candidate Site, Park County Wyoming. (2 copies)

48YE520 Site Form (2 copies)

48YE2196 Site Form (2 copies)

48YE2197 Site Form (2 copies)

cc: (w/o enclosures)
Elizabeth Blood, National Science Foundation (electronic copy only)
Jody Bolyard, NEON (electronic copy only)
Liz Wright, NEON (electronic copy only)

bcc (w/o enclosures)
Central Files
Supt's Files
Dave Hallac
Tobin Roop
Jennifer Carpenter
Doug Madsen
Staffan Peterson
Elaine Hale
Bianca Klein
YCR Files
No Reading Files

FNP:SPeterson:bec:2/1/13:2203

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Wyoming State Parks & Cultural Resources

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Barrett Building, 3rd Floor
2301 Central Avenue
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Fax: (307) 777-6421
http://wyoshpo.state.wy.us

February 25, 2013

Daniel N. Wenk, Superintendent
U.S.D.I. National Park Service
P.O. Box 168
Yellowstone National Park, WY 82190

re: National Ecological Observatory Network, Yellowstone Blacktail Deer Creek Aquatic Candidate Site Project (SHPO File # 0210RLC001)

Dear Mr. Wenk:

Thank you for consulting with the Wyoming State Historic Preservation Office (SHPO) regarding the above referenced undertaking. We have reviewed the associated report and find the documentation meets the Secretary of the Interior's Standards for Archaeology and Historic Preservation (48 FR 44716-42). We concur with your finding that sites48YE313, 48YE2196 and 48YE2197 are not eligible for listing in the National Register of Historic Places (NRHP) and no further work or protective measures are necessary.

We further concur that site 489YE520, the Grand Loop Road, is currently listed in the NRHP and will not be affected by the undertaking as planned.

We recommend the U.S.D.I. National Park Service allow the undertaking to proceed in accordance with state and federal laws subject to the following stipulation:

> If any cultural materials are discovered during construction, work in the area shall halt immediately, the federal agency and SHPO staff be contacted, and the materials be evaluated by an archaeologist or historian meeting the Secretary of the Interior's Professional Qualification Standards (48 FR 22716, Sept. 1983).

This letter should be retained in your files as documentation of a SHPO concurrence with your finding of no historic properties affected. Please refer to SHPO project #0210RLC001 on any future correspondence regarding this undertaking. If you have any questions, please contact me at 307-777-5497.

Sincerely,

Richard L. Currit
Senior Archaeologist

Cc: Elizabeth Blood, NEON Program Officer, National Science Foundation, Arlington, VA

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Wyoming State Parks & Cultural Resources

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Cheyenne, WY 82002
Phone: (307) 777-7697
Fax: (307) 777-6421
http://wyoshpo.state.wy.us

May 27, 2015

Steven F. Iobst, Acting Superintendent
U.S.D.I. National Park Service
P.O. Box 168
Yellowstone National Park, WY 82190

re: National Ecological Observatory Network, Yellowstone Frog Rock Terrestrial Candidate Site Project, Park County, Wyoming (SHPO File # 0210RLC001)

Dear Mr. Iobst:

Thank you for consulting with the Wyoming State Historic Preservation Office (SHPO) regarding the above referenced undertaking. We have reviewed the associated report and find the documentation meets the Secretary of the Interior's Standards for Archaeology and Historic Preservation (48 FR 44716-42). We concur with your finding that site 48YE2187 is not eligible for listing in the National Register of Historic Places (NRHP) and no further work or protective measures are necessary.

We further concur that 48YE828 is currently listed in, and 48YEW520 is eligible for listing on the NRHP but will not be adversely affected by the undertaking as planned.

We recommend the U.S.D.I. National Park Service allow the undertaking to proceed in accordance with state and federal laws subject to the following stipulation:

> If any cultural materials are discovered during construction, work in the area shall halt immediately, the federal agency and SHPO staff be contacted, and the materials be evaluated by an archaeologist or historian meeting the Secretary of the Interior's Professional Qualification Standards (48 FR 22716, Sept. 1983).

This letter should be retained in your files as documentation of a SHPO concurrence with your finding of no historic properties adversely affected. Please refer to SHPO project #0210RLC001 on any future correspondence regarding this undertaking. If you have any questions, please contact me at 307-777-5497.

Sincerely,

Richard L. Currit
Senior Archaeologist

Appendix 2
Schematic of Tower Foundation

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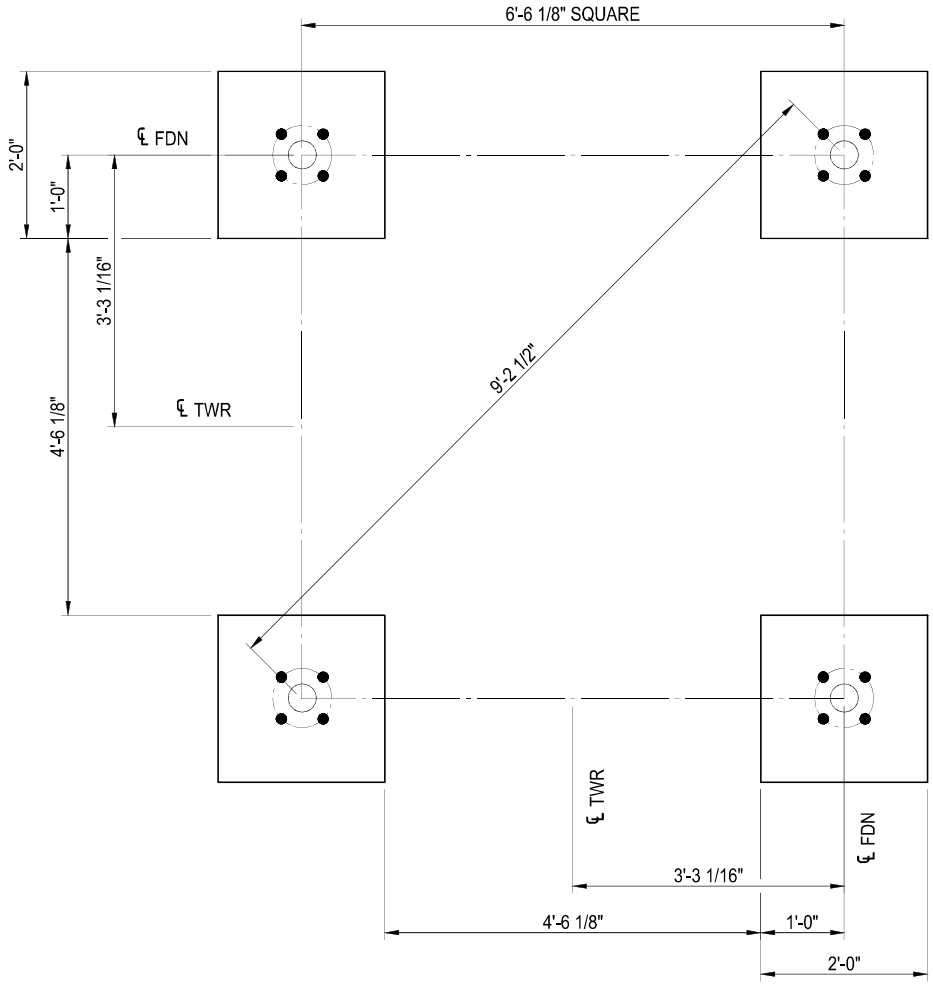
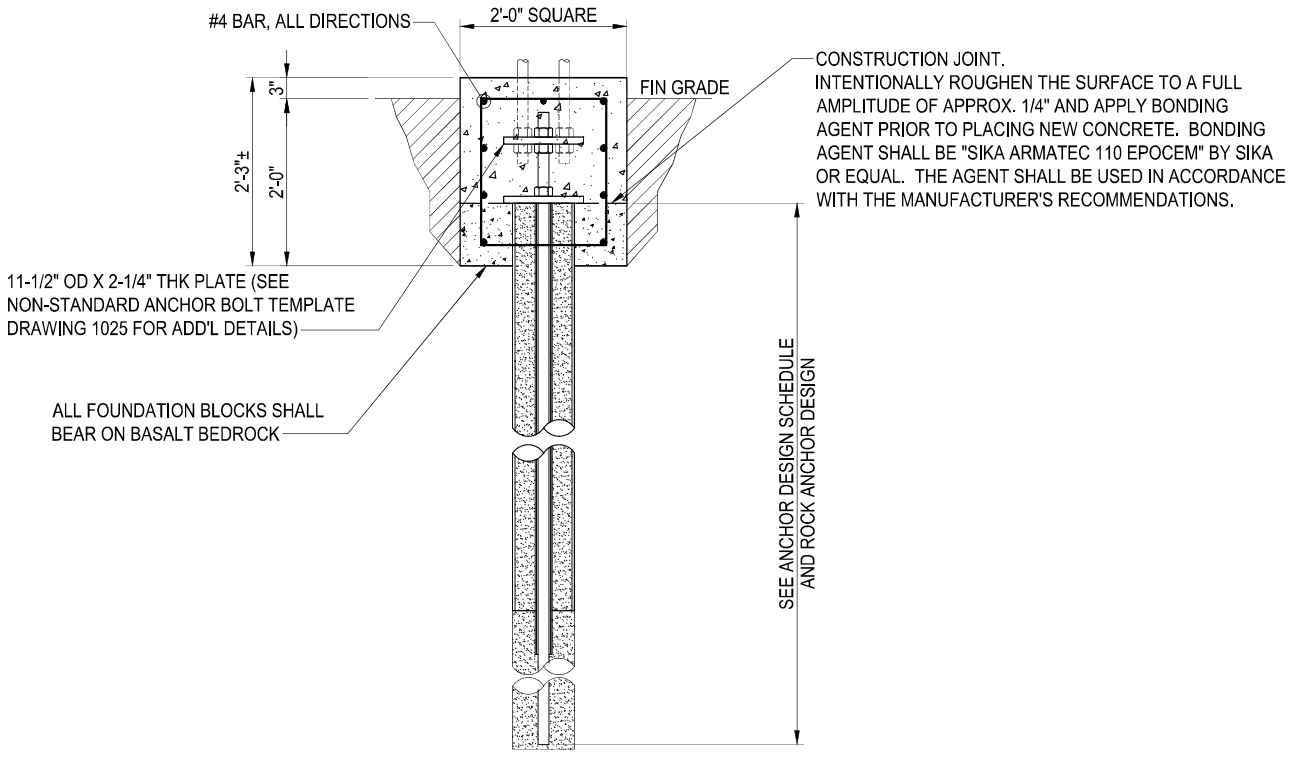


FOUNDATION PLAN

SCALE: 3/4" = 1'-0"



FOUNDATION SECTION

SCALE: 3/4" = 1'-0" (TYPICAL 4 LEGS)

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Appendix 3
Schematic of Detailed Well Design

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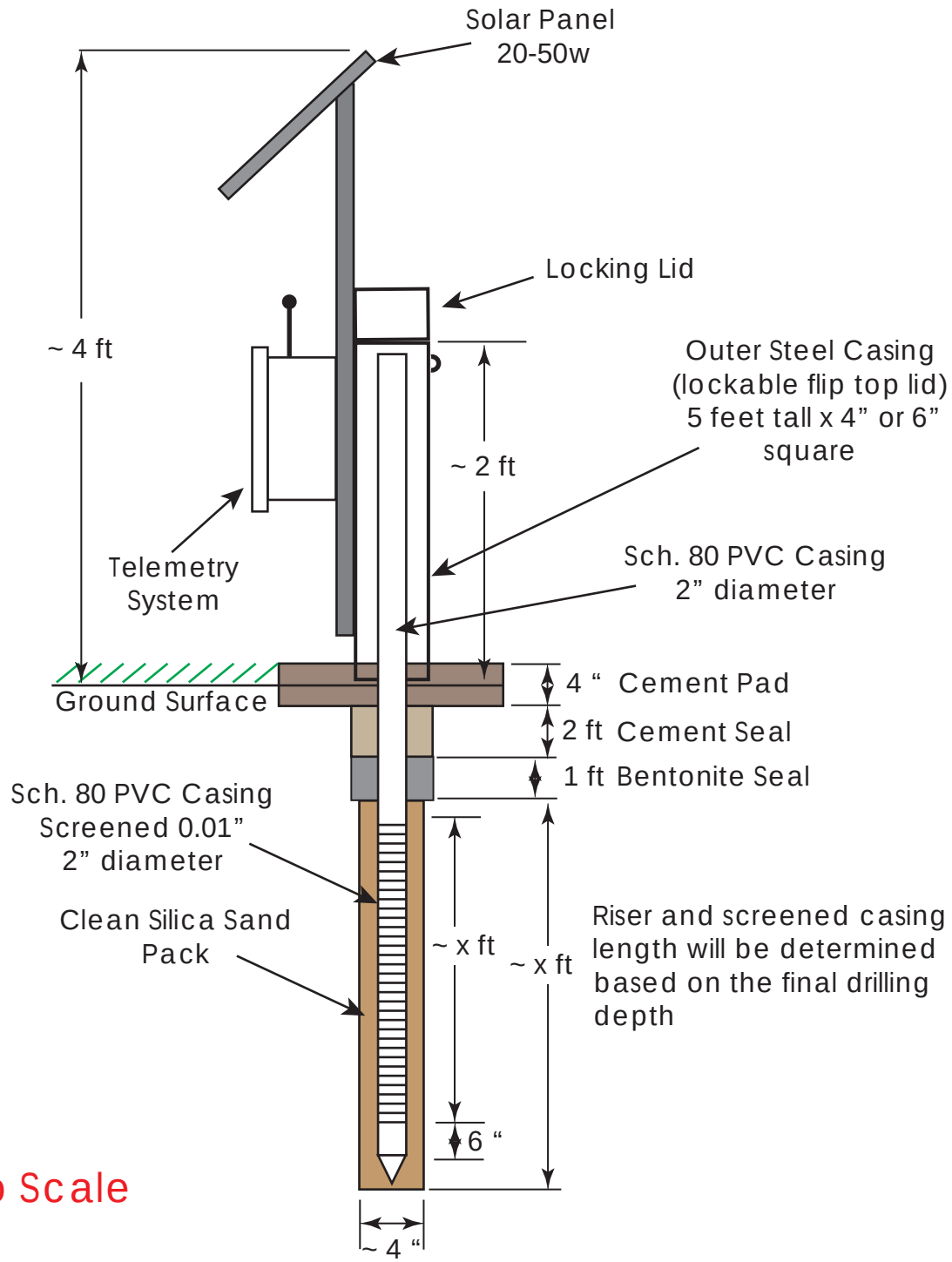
NEON Blacktail Deer Creek Well Design



Not to Scale

Notes:

1.) PVC casing shall couple using threaded joints with O-ring seals.

2.) Outer steel casing shall be made of stainless steel for wells near stream and may need to be cut down to ~4 feet in length to avoid covering screen and extending into the water table.

3.) Total drilling depth shall be targeted to be ~2-3 feet below the anticipated seasonal low water table. An onsite decision by NEON will be made to determine final depth.

4.) NEON will provide the PVC well cap, and the lock for the protective outer steel well casing.

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Appendix 4
Proposed Aquatic Observations Schedule

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APPENDIX 4: PROPOSED AQUATIC OBSERVATIONS SCHEDULE

Summary of Proposed Aquatic Sampling Protocols at D12 Blacktail Deer Creek

Type of Sampling	Description of Field Sampling Activity	Equipment Installed	Habitat Type	Sampling Season	Frequency	Duration of Each Event	Number of Technicians per Visit
Biological							
Surface Microbes	Additional aliquots will be removed from the water chemistry samples, flash frozen, and sent to a lab for microbial analysis.	None	Surface water	Year round	12x per year	1-2 hours per bout	2
Macroalgae, bryophytes, lichens, & aquatic plants	Macroalgae, bryophytes, lichens, and aquatic plants will be identified in-situ along 10 cross-stream transects between permitted boundaries. Occasional grab samples may be collected for taxonomic analysis.	Temporary placement of 10 x 0.01 m2 quadrats	Runs, riffles	May, July/August, September	3x per year	4-6 hours per bout	2
Benthic algae	The organisms will be collected by scrubbing samples from the substrate and/or captured from the water column using a 4 L container in order to assess the presence and abundance of multiple species. 8 composite cobble scrubs (8 x 0.0024 m2) or sediment grabs (8 x 0.0059 m^2) will be collected from 5 runs and 3 riffles between permitted boundaries.	Temporary use of a cobble scrub brush	Runs, riffles	May, July/August, September	3x per year	4 hours per sampling day (combined with benthic microbes)	2
Benthic microbes	Benthic microbe samples will be collected by scrubbing samples from the substrate at the same time as benthic algal collection. 8 cobble scrubs (8 x 0.0008 m^2) or sediment grabs (8 x 0.0059 m^2) from 5 runs and 3 riffles between permitted boundaries.	Temporary use of a cobble scrub brush	Runs, riffles	May, July/August, September	3x per year	4 hours per sampling day (combined with periphyton)	2
Macro-invertebrates	Benthic invertebrates will be sampled from riffles, runs, snags, pools, and lakes at or near baseflow conditions. Riffles will be sampled with a surber net, runs will be sampled with a surber net or kicknet, snags will be sampled with a snag net, and deep pools and lakes will be sampled with a corer and/or hess sampler. 5 modified kicknet samples (5 x 0.25 m^2); 3 surber samples (3 x 0.093 m^2) from 5 runs, 3 riffles between permitted boundaries	Temporary use of a kicknet or surber sampler	Mixed	May, July/August, September	3x per year	4 hours per sampling day	2
Fish	Fish will be sampled biannually with a backpack electrofisher using multiple pass depletion and/or minnow traps to provide information on the biodiversity and health of the fish populations. 6-100 m subreaches will be blocked with nets and sampled with an electrofisher. The 6 subreaches will represent a mix of habitat distributed throughout the permitted boundaries.	Temporary placement of block nets at the top and bottom of each sampling reach.	Mixed	May, August/September	2x per year	8-10 hours per sampling day (up to 5 days)	3-4
Riparian Assessment	Once per year during base flow and at peak greenness, riparian vegetation composition and canopy cover estimates will be recorded at ten permanent transects throughout the stream reach. Additionally, bank angle, bank texture, and water height will be recorded.	Permanent placement of field transect benchmarks	Riparian	June/July	1x per year	4-6 hours per bout	2
Physical							
Discharge	Stream flow, or discharge, will be measured over a range of stream-levels and flow rates using a permanently installed in-stream pressure transducer and manual measurements with a hand-held velocity meter during wading surveys.	Permanent in-stream pressure transducers. Temporary use of a stream flow meter	Surface water	March - November	26x per year	1 hour per bout	2
Reaeration	Reaeration will be measured by injecting an inert tracer gas (SF6) and a conservative tracer (NaCl) into an area of slow-moving water in the stream and monitoring for the presence of the tracer at a downstream sampling site, after which water and gas samples are collected at four locations downstream of the tracer addition which the injection is stopped.	Temporary placement of 2 HOBO conductivity loggers.	Surface water	March - November	10x per year	4-8 hours per bout	2

Type of Sampling	Description of Field Sampling Activity		Equipment Installed	Habitat Type	Sampling Season	Frequency	Duration of Each Event	Number of Technicians per Visit
Stream morphology and Rapid habitat assessment	Annual stream morphology assessments will be conducted to monitor changes of the stream channel and floodplain, identify bankfull widths, and monitor erosion. A rapid assessment of habitat conditions will also occur annualy.		Permanent placement of benchmarks; temporary placement of pin flags and the use of a total station and prism pole.	In-stream and riparian	October (morphology) June/July (habitat assessment)	1x per year	Up to 40 hours per bout (morphology) Up to 8 hours per bout (morphology)	2
Chemical								
Surface water chemistry	These protocols are conducted on the same sampling trip.	Water samples will be collected from the stream using a dip/grab sampling technique. Samples will be analyzed for general chemistry, anion and cations, dissolved and total carbon and nutrients, stable isotopes of water, particulate carbon and nitrogen, and dissolved gases (Carbon Dioxide, Methane, and Nitrous Oxide).	None	Surface water	Year round	26x per year	2-3 hours per bout	2
Dissolved gas			None	Surface water	Year round	26x per year	1 hours per bout	2
Stable isotopes			None	Surface water	Year round	26x per year	1 hours per bout	2
Sediment chemistry	Sediment samples will be collected composited across multiple depositional zones within 500 m of the permitted reach. Approximately 5% of the sediment sampling reach consists of suitable substrate. Up to 9 liters of sediment will be collected throughout the reach per bout for an annual total of up to 27 liters of collected sediment.		None	Sediment depositional zones	May, July/August, September	3x per year	4-8 hours per bout	2
Groundwater Chemistry	Groundwater samples will be collected twice per year from a subset of 4 wells per site. Water samples will be extracted from the groundwater wells using a portable water pump and/or bailer tube sampler and will be sent to a lab for analysis.		Up to 8 groundwater wells	Groundwater	May - August	2x per year	6-20 hours per bout	2

Summary of Proposed Aquatic Instrument Maintenance Activities

Type of Activity	Description of Field Activity	Equipment Installed	Habitat Type	Sampling Season	Frequency	Duration of Each Event	Number of Technicians per Visit
Aquatic Sensors	Technicians will inspect, clean and perform field calibrations for a variety of aquatic and meteorological sensors located on fixed infrastructure in the stream and riparian area during biweekly maintenance visits.	Two in-stream aquatic sensor stations that contain multi-parameter water quality sondes a nitrate analyzer, platinum resistance thermometer, and pressure transducer mounted to stainless steel unistrut anchored in the streambed.	Surface water	Year round	26 visits per year	2 hours per visit	2
Meteorological Station		A permanent micro-meteorological station will be located near the stream and includes a suite of sensors mounted on a tripod metal frame (10 feet tall). Ground anchors consist of 5 guy wires with 30-inch galvanized anchors.	Riparian	Year round	26 visits per year	2 hours per visit	2
Groundwater Sensors		Up to eight groundwater wells instrumented with a multi-parameter sensor, wireless telemetry and solar panel.	Groundwater	Year round	26 visits per year	4 hours per visit	2

Appendix 5
Proposed Terrestrial Observations Schedule

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Type of Sampling	Description of Field Sampling Activity		Equipment Installed	Plot/Grid Location	Sampling Season	Frequency	Duration of Each Event	Number of Visits to Each Plot per Event	Number of Technicians per Visit
Soil sampling	Three soil samples will be collected at each plot (to a depth of 11.8 in or refusal and until 10.6 oz. is collected, and diameter ranging between 1.4 and 4.3 in); holes will be backfilled with weed-free sand per the Park's request.	Soil microbes and soil biogeochemistry[1]	Tower Plots (4); Distributed Plots (6)	Tower plots (4); Distributed plots (6)	March - November	3 events per year	4-5 days (2-3 plots a day)	1	2
		Soil biogeochemistry: N transformations	Tower Plots (4); Distributed Plots (6)	Tower plots (4); Distributed plots (6)	March - November	3 events every 3 years	3-4 weeks (1 additional day of sampling 3-4 weeks after the combined microbe and biogeochemistry sample)	2	2
Plant diversity	Observations of species presence and cover (at 10.8 ft^2) will be made in 4,306-ft^2, multi-scale plots. Vouchers of a subset of representative plant species (approximately 20 per year) will be collected.		None	Tower Plots (3)	May-August	1 event per year	2-3 days (1-2 plots per day)	1	2
				Distributed Plots (30)	May-August	1 event per year	10-20 days (1-2 plots per day)	1	2
Litterfall and fine woody debris	Litter (non-living plant material) will be collected from basket-like traps, and from paired 'ground traps' for woody material < 1 in diameter, arrayed in 65.6-ft x 65.6-ft plots.		One 5.38-ft^2 PVC 'elevated' trap per plot (2.6 feet off the ground), and one 16.15-ft^2 'ground trap' per plot	Tower Plots (20)	May-November	4-12 events per year	1-2 days (10-20 plots per day)	1	2
Belowground fine root biomass	Four soil cores (3 in diameter, 11.8 in depth) will be extracted from each plot to measure fine root live and dead biomass. Holes will be backfilled with weed-free sand, or Park specified material, per Park's request.		None	Tower Plots (20)	May–September	1 event every 5 years	5-10 days (2-4 plots per day)	1	2
Vegetation structure	Measurements such as height and diameter at breast height of woody individuals will be measured. No collection will be made (unless diagnostic plant part is needed to facilitate species identification).		Tree tags	Tower Plots (20)	September–December	1 event per year	10-20 days (0.5-1 day per plot)	1	2
				Distributed Plots (20)	September–December	1 event every 3 years	20 days (1 plot per plot)	1	2
Coarse downed wood (tally)	Nondestructive tally measurements will be made along three 656-ft transects originating from within each plot.		Log tags	Tower Plots (20)	May-September	1 event every 3 years	20 days (1 plot per day)	1	2
				Distributed Plots (20)	May-September	1 event every 3 years	20 days (1 plot per day)	1	2
Coarse downed wood (density)	Disks (2-4 in width) will be cut from downed logs using a chainsaw or hand-powered bucksaw. A total of 100-200 disks will be cut; the final number will depend on the number of taxa and the number of decay classes encountered.		Log tags	Area surrounding tower	May-September	2 events total: once in first 3 years and again 5-6 years later	20 days (1 plot per day)	1	2
				Distributed Plots (20)	May-September	2 events total: once in first 3 years and again 5-6 years later	20 days (1 plot per day)	1	2
Canopy foliar chemistry	Sunlit leaves of dominant species will be harvested.		None	Tower Plots (4)	June-August	1 event every 5 years	4 days (1 plot per day)	1	2
				Distributed Plots (up to 16)	June-August	1 event every 5 years	6 days (1 plot per day)	1	2
Leaf area index	Digital hemispherical photographs of understory and overstory vegetation will be taken at multiple points within each plot.		None	Tower Plots (3)	April-October	1 event every 2 weeks	1 day (3 plots per day)	1	2
				Distributed Plots (20)	April-October	1 event every 3 years	10 days (2 plots per day)	1	2
Herbaceous biomass	Herbaceous material will be clip harvested from two 2.2-ft^2 (4-in x 6.6-ft) areas per Tower Plot and one 2.2-ft^2 area per Distributed Plot.		None	Tower Plots (20)	May-September	1 event per year	5-10 days (2-4 plots per day)	1	2
				Distributed Plots (20)	May-September	1 event every 3 years	5-10 days (2-4 plots per day)	1	2
Plant phenology	Phenological status and transitions of plant species will be monitored and recorded. Initially, up to 30 individuals of 3 species will be monitored. Over subsequent years, fewer individuals of 20 species will be monitored.		Tree tags and markers inserted in ground for herbaceous vegetation	Tower Plots (phenology, 2)	April-December	1–3 events per week	1 day (2 plots per day)	1	2
Ground beetles	Four pitfall traps at each plot will be deployed and checked at 2-week intervals to capture and describe the diversity and abundance of ground beetles.		Four pitfall traps per plot; each trap consists of a cup buried flush with the ground, filled with a preservative, and shaded by a flat cover	Distributed Plots (10)	April-September	1 event every two weeks	1 day every 2 weeks	1	2

APPENDIX 5: PROPOSED TERRESTRIAL OBSERVATIONS SCHEDULE

Type of Sampling	Description of Field Sampling Activity	Equipment Installed	Plot/Grid Location	Sampling Season	Frequency	Duration of Each Event	Number of Visits to Each Plot per Event	Number of Technicians per Visit
Mosquitoes	CO_2 traps will be deployed for 2 nights (approximately 40 consecutive hours) per sampling event; captured mosquitoes will be retrieved from the trap on three occasions (first morning, second evening, and second morning).	Trap consisting of small insulated cooler (loaded with CO_2 pellets), rain cover, a fan (with 6-volt battery), and catch cup; trap will be hung from a tree or post	Mosquito Plots (10), each within 115 ft of road	March-November	1 event every two weeks	2 days every 2 weeks	4	2
Breeding land birds	Bird abundance and diversity data will be collected using binoculars and laser rangefinder; point counts will be conducted for a total of 10 minutes per location	None	Bird Grids (10)	June-July	1 event per year	5-10 days (1-2 grids per day)	1	2
Small mammals	Mammal diversity and abundance data will be measured on grids containing 100 traps spaced at 32.8-ft.	100 Sherman traps will be left at each grid for the duration of the event	Mammal Grids (6)	April-October	6 events per year	2 days (1 evening and following morning)	2	2-4
	Mammal pathogen data will also be collected at three of the six grids where the sample event will be extended to adequately characterize population densities.	100 Sherman traps will be left at each grid for the duration of the event	Mammal Grids (3 of the 6 grids)	April-October	6 events per year	4 days (3 evenings and following mornings)	6	2-4
Ticks	Ticks will be sampled with cloth-dragging and flagging methods on the 525-ft plot perimeter.	None	Distributed Plots (6)	April-September	1 event every 3-6 weeks depending on tick detection	3-6 days (1-2 plots per day)	1	2

Notes:
[1] Soil biogeochemistry analyses will be conducted on a subset of soil collection every 3 years.

in = inches
oz = ounce
ft = feet
ft^2 = square feet

Appendix 6
NEON Operations Field Safety and Security Plan

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Title: Site-Specific EHS Plan: D12C YELL	*Date*: 2/9/2017
Author: Sarah Eastin/Tyler Shannon/Amy Jacobs/Sean Hauser	

SITE-SPECIFIC EHS PLAN

D12C YELL

PREPARED BY:	ORGANIZATION:	DATE:
Sarah Eastin	Permitting	3/01/2015
Tyler Shannon	Safety	2/9/2017
Amy Jacobs	D12 Domain Manager	3/29/2016
Sean Hauser	D12 Assistant Domain Manager	

The National Ecological Observatory Network is a project solely funded by the National Science Foundation and managed under cooperative agreement by Battelle. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Title: Site-Specific EHS Plan: D12 YELL	*Date*: 02/9/2017
Author: Sarah Eastin/Tyler Shannon/Amy Jacobs	

Domain/Project: D12 – Yellowstone National Park Candidate Core
D12 – Blacktail Deer Creek Aquatic Core

Site Location/Description: Yellowstone National Park Candidate Core Tower
Degree/Decimal Lat. 44.953480, Long. -110.539140
Degree/Min/Sec Lat. 33 22 42.92040N, Long. 097 46 56.12880W

Blacktail Deer Creek Aquatic
Degree/Decimal Lat. 44.950110, Long. -110.587150
Degree/Min/Sec Lat. 44 57 00.39600N, Long. 110 35 13.74000W

Project is approximately 70 miles south of Livingston, Montana. The site is located inside Yellowstone National Park.

Property Owner/Manager: **Yellowstone National Park**

<u>Plan two (2) weeks in advance for site access</u>

Table of Contents

Title: Site-Specific EHS Plan: D12 YELL		*Date*: 02/9/2017
Author: Sarah Eastin/Tyler Shannon/Amy Jacobs		

Emergency Action (Ambulance, Sheriff, Fire, Police)

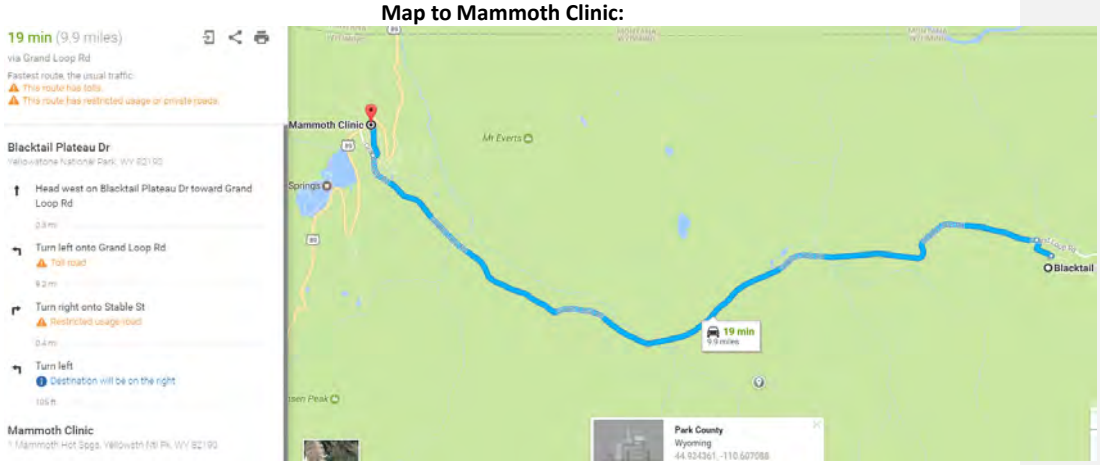
DIAL 911 or (406) 265-2775

(from cellular phone) **(from landline at Instrument Hut or from SAT Phone)**

Yellowstone County Disaster and Emergency Services
Duane Winslow, Director
217 N. 27th Street, Room 312
Billings, MT 59107
(406) 256-2775

In The Park: Yellowstone is on 911 emergency service, including ambulances. **Medical services are available year round at Mammoth Clinic (307-344-7965)**, except some holidays. Services are also offered at Lake Clinic (307-242-7241) May 13–September 24 and at Old Faithful Clinic (307-545-7325) May 13–October 2

Map to Mammoth Clinic:



<u>A SATELLITE Phone is recommended by National Park officials.</u> If a SAT phone is not available, the Daily Safety Briefing will include location of adequate cell phone service and use of available 2-way radios for communicating with other NEON employees working in the area.

Immediately call local responders for any emergency situation. Road access may be limited throughout the park due to weather, traffic, or local emergencies. An emergency situation shall include medical, traumatic, workplace violence or other situations where on-site personnel require advanced treatment or assistance. Air and ground ambulances will be dispatched based on information received by dispatchers at 911 or emergency services office. Be clear and concise when communicating with dispatcher.

Provide GPS location or physical address, if known, when reporting an emergency. If an injury or medical emergency should occur, do not move the victim unless it is necessary and safe to do so.

Closest Hospital/Emergency Facility (70 miles):

Livingston Health Care
504 South 13th Street
Livingston, MT 59047

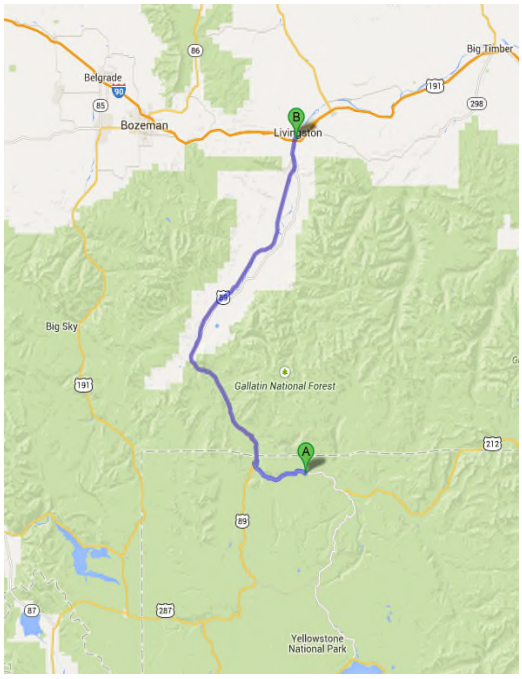
Driving directions to Livingston HealthCare

This route has tolls.

Blacktail Plateau Dr

1. Head **west** on **Blacktail Plateau Dr** toward **Grand Loop Rd** — 0.3 mi
2. Turn left onto **Grand Loop Rd** — 9.3 mi
   Toll road
3. Slight right toward **US-89 N** — 0.2 mi
4. Continue onto **US-89 N** — 0.2 mi
   Toll road
5. Turn right to stay on **US-89 N** — 5.2 mi
   Partial toll road
   Entering Montana
6. Turn left onto **US-89 N/S 2nd St** — 53.2 mi
   Continue to follow US-89 N
7. Turn right onto **W Crawford St** — 0.2 mi
8. Take the 2nd right onto **S 13th St** — 266 ft
   Destination will be on the right

Livingston HealthCare
504 South 13th Street
Livingston, MT 59047



NEON Point of Contact List

POINT OF CONTACT	ROLE ON PROJECT	CONTACT INFORMATION
Amy Jacobs	Manager of Field Operations D12/15	Phone: (385) 235-7967 Mobile: (850) 449-3904 ajacobs@battelleecology.org
Sean Hauser	Assistant Manager of Field Operations	Phone: Mobile: shauser@battelleecology.org
Sarah Eastin	Permit Coordinator, NEON, Inc.	Office: (720) 921-2609 seastin@battelleecology.org
Tyler Shannon	Safety Specialist (primary)	Office: (720) 921-2614 Mobile: (970) 420-4830 tshannon@battelleecology.org
Skip Sowards	Safety Specialist (alternate)	Office: (720) 330-1534 Mobile: (720) 201-6511 ssowards@battelleecology.org
Heidi Reed	Safety Specialist (alternate)	Office: (720) 836-2413 Mobile: (970) 589-7938 hreed@battelleecology.org
Tim Lucera	Manager of Safety	Office: (720) 746-4918 Mobile: (303) 359-7994 tlucera@battelleecology.org

Yellowstone Point of Contact List

POINT OF CONTACT	POSITION	CONTACT INFORMATION
Erik Oberg	Acting Natural Resource Management Specialist	Office: 307-344-2511 Mobile: 202-439-7328 erik_oberg@nps.gov
Doug Madsen	Outdoor Recreation Planner	Office: 307-344-2017 doug_Madsen@nps.gov
Stacey Gunther	Research Permit Office	Office: 307-344-2239 stacey_gunther@nps.gov

Site Details and Stipulations

All visits are coordinated with the NEON permitting office.

Be aware that access roads may be impassable due to poor weather conditions, traffic status, or other local emergency. Establish Journey Management Plan before leaving for the site. Always be prepared for changing weather.

Site Specific Access Requirements

This site is a National Park, it is managed by the National Park Service and it is open to the public. Communication/Check-in/Check-out process may be required by the park for accessing the site. Contact the Domain Support Facility for latest process prior to entering the park.

U.S. Citizenship

U.S. citizenship is not required.

Site Specific Travel Information

Any site visits or travel dates need to be coordinated in advance with NEON Permitting and D12 Assistant Manager of Field Operations.

Site Activity Coordination

Site activities need to be coordinated through NEON Permitting.

Environmental Protection

Archaeological Guidelines

(Applies during construction) If unanticipated cultural resource discoveries are made during construction, NEON and its contractors will halt construction. Contact NEON Permitting immediately to report the discovery and location of any special artifacts. Artifacts are not to be moved from their original found location.

Trails/Roads

No new roads will be constructed. Do not leave roads/trails and only turn around in designated areas. Please adhere to any National Park signage or road closures.

Dig Approval

Contact NEON Permitting and the National Park Service permit representative prior to scheduling any dig activities.

Rare/Threatened/Endangered Species

Will be assessed and determined during the Environmental Assessment (EA) process.

US Fish and Wildlife (Section 7) Concurrence

Environmental Assessment in progress, concurrence will be made with agencies when this EA is complete.

Vegetation Survey
Vegetation Survey completed in July 2014 and available upon request.

Wetlands Survey
Specific activities may require additional permitting from the National Park Services. If a permit is not required for NEON activities, NEON personnel will take every precaution to avoid impacting known wetlands. Actions that will be taken to reduce or eliminate damages to wetlands include:

- Not driving vehicles into or on fragile areas near the designated wetlands.
- Not performing sampling or equipment cleaning in or near designated wetlands.
- Not allowing contractors, visitors or other employees to enter or work in or near designated wetlands.
- All equipment that will be located near the wetlands will be inspected for invasive species.

Security

Host Requirements
There are no gates near the project site at this time. Yellowstone requests that wildlife be considered in every activity and equipment checked often for interactions or potential entanglements.

Escorts
Escorts are not required but may be necessary under certain circumstances. NEON will keep in contact with Yellowstone staff and coordinate for the duration of the project. NEON will also follow all Park guidance and regulations. Unless otherwise approved will be operating under the assumption that our traditional 2 person rule may not be adequate for employee safety in case of a wildlife encounter and thus NEON will maintain at least a 3 person rule when visiting or performing work on site. 1 of those people should act as a shuttle to get employees as close as possible to the site, while minimize walking, and then act as a wildlife watch over the other members of the party. All members of a part should maintain close proximity to each other, never deviating more than a few yards from one another.

Check-In
Check- In with the Park's RPRS system will be completed with the D12 FOPS Assistant Domain Manager. Please advise staff 2 weeks prior to a planned site visit. You will also be required to coordinate with NEON permitting staff when your site visit is complete. Permitting or Domain Staff will check out NEON visitors in the Park RPRS system. It will be the visitor's responsibility to ensure they have obtained the proper paper permits and other documentation from NEON permitting, each year a new permit is issued. One person on the team visiting needs to be on the permit and this permit should be kept with the team at all times.

Visitors
Site visitation must be coordinated in advance with NEON Permitting and D12/15 Manager of Field Operations. NEON research activities that are introduced at a later date must be coordinated in advance with NEON Permitting and with Yellowstone National Park Permit Specialist.

Visitors are allowed at NEON locations with permission only.

General Requirements

LUA Information/Requirements

- Signed: N/A Land Use Agreement will be completed after Environmental Assessment is complete.
- Commencement date:

FCC/FAA Determination

Determination not complete until Tower is approved.

Collaboration

Staging

Unknown at this time, this will be determined when Environmental Assessment is finalized.

Parking

Parking is allowed in designated areas only. The use of shuttles may be necessary for field activities located away from designated parking areas (currently at NEON tower site and BLDE site).

Rest Room Facilities

There are not any rest room facilities available on site or near the tower or instrument hut, except during construction activities. Be prepared to bring portable restroom facilities. The closet facilities post-construction are located at Mammoth Hot Springs.

Vehicles (will apply during construction)

- Fueling and other mechanical operations will be performed at the designated parking area.
- All equipment will be inspected for invasive plant material, leaks, drips, or malfunctions prior to bringing into the park.
- Spills will be cleaned up as soon as practical and will be reported immediately to NEON Safety, NEON supervision and to the host, as needed. See Attachment 4.

Data Collection

The Operations Field Safety and Security Plan (NEON.DOC.004316) contain specific safety plans for all activities that teams will perform, please refer to this document. NEON also has written plans for all specific tasks (i.e. Small Mammal Handling) which will be provided to those collecting data and accessing the site.

Annual Report

An annual report is due to Yellowstone National Park permitting office by December 31st each year. NEON visitors to Yellowstone may need to provide additional requested information at years end.

Potential Site Hazards

All employees should be aware that very large, potentially dangerous mammals live inside Yellowstone National Park. These include Moose, Elk, Bison, Grizzly Bear, and Wolves. Do not aggravate the animals and be cautious while driving through the park. If the animals affect work activities, contact your supervisor, the host and the Permit Specialist. Any interactions with a bear must be documented and reported to the rangers in the park as soon as possible. The NEON tower is located within a Bear Management Area (BMA) that has annual closure from March 10-June 30th. No persons shall enter the tower site during this closure. BLDE is also located within this BMA however access is restricted to occasional site visits as required by NEON activities. If you have a need to access BLDE during this closure time you must contact the D12/15 Manager of Field Operations to coordinate access availability and measures[AJ1].

Most of the issues involving Moose, Elk and Bison are associated with motor vehicle incidents. Use caution when driving through the park. Be especially careful at dusk and dawn when the animals are on the move.

Earthquake Safety

Other natural hazards that are common in the park are earthquakes. Earthquakes can happen at any time throughout the year. Before an earthquake occurs, sites should plan for the hazard and know what to do if an earthquake shakes the ground violently. There is little to no warning for earthquakes so this review should be done every day during the Daily Safety Briefing. Make a determination of a safe place to go where heavy objects won't fall on top of you and determine where a safe muster point is away from other potential hazards. Check radios, cell phones, and satellite phones before work begins each day to assure good communications for emergencies.

If you are working on a tower during an earthquake, drop to your hands and knees. Cover your head and neck with your arms and **HOLD ON** to any sturdy structure until the shaking stops! Stay away from the tower stairway where large objects can fall down and strike you.

Towers are structurally built to withstand high seismic activity. When working on towers where seismic activity is rated "High", **DO NOT** put heavy objects overhead and keep all objects on the tower and inside the Instrument Huts well secured against unexpected movement.

If you are working inside the Instrument Hut, move away from the data tower and stay out of compressed gas room. If available, crawl under a desk or table. **DO NOT** try to exit the hut while the shaking is going on as the compressed gas cylinders may be damaged during the shaking. The compressed gas cylinder room should be kept free of loose materials and equipment and all cylinders shall be secured firmly in the rack, at all times. NEON does not have any flammable or combustible gases stored inside the Instrument Huts; however, the compressed gases in use can damage the cylinders and can be a projectile hazard.

If you are working outside and away from a NEON or park structure, avoid areas where rocks or trees can fall on top of you. Get down onto your hands and knees and cover yourself with hands, arms, backpacks, blankets, or tarps.

Once the shaking has stopped, assess your immediate safety and if you or others have any injuries. Look for a safe way out through debris but be aware of weakened trees in the forest. **EXPECT AFTERSHOCKS!**

Drop, cover, and hang on whenever there is additional shaking, even though the aftershocks are commonly less violent than the original quake. Look for and extinguish small fires in the area, if it is safe to do so. Fire is a common hazard after an earthquake.

Go to the designated muster point and alert your co-workers, park officials, and your supervisor when it is safe to do so. Use the telephone only for emergency calls. Be prepared for phone service and electric service inside the hut to be inoperable. Stay away from damaged areas and be careful when driving. Roads may have been knocked out or may have significant damages.

Before going back to work after an earthquake, put on long pants, long-sleeved shirts, and gloves to protect yourself from broken glass or other sharp objects. Always use extra caution when opening drawers or cabinets as objects may have shifted and could fall out on top of you. Use a gas sniffer to examine entire length of compressed gas lines and cylinder valves. Safely de-energize damaged gas lines and repair as quickly as possible. Stay away from damaged areas unless your assistance has been specifically requested by responders. Leave the muster point only when authorities say it is safe to do so.

After an earthquake, **DO NOT** access the NEON tower until a structural investigation has been performed to determine integrity of the tower.

Tower

All standard tower access requirements apply (see EHS Safety Policy and Program Manual).

Weather

- During the summer months, daytime temperatures average in the 70's. Nighttime temperatures can drop below freezing during the summer.
- Winter temperatures range from 0 – 20^{o} F.
- Snow totals can reach 150 inches.
- Windy conditions should be expected.
- ALWAYS be prepared for weather changes.

Summer storms here can produce thunder and lightning. Due to the high lightning potential in the area, employees should carry personal lightning detectors (available from NEON Safety). Employees should seek shelter inside the cab of a vehicle, in a grounded structure, in the NEON Instrument Hut, or should crouch as low as possible whenever lightning is detected in the 6-12 mile range. DO NOT crouch below the tall trees in the area. The trees can be struck by lightning. Based on Lightning Safety Facts (NOAA), if thunder can be heard there is a risk of lightning. This risk remains for up to 30 minutes after the last lightning strike has been seen or thunder has been heard. When thunder is heard, immediately look for a safe place, no matter what the distance detector may be showing.

Wildland fires have been started by campers and by lightning strikes. These fires can easily get out of control. Employees will heed any alerts and warnings in the area issued by local law enforcement agencies. If an evacuation is mandated, the employees will leave the area as prescribed by the enforcing agency and then will contact their immediate supervisor and NEON Safety Specialist.

Fire

- Smoking is prohibited on the property.
- Employees will not discard spark-producing trash before fully extinguishing the potential.
- If a wildfire starts, and you can access your vehicle, do so. Either on foot or in your vehicle; proceed into the wind to the maximum extent possible to avoid the flames and immediately contact local authorities.

***NOTE: Always report fires to the local fire response team. Always get help responding to grassland fires as quickly as possible. The responders may have a significant distance to travel for fire response.**

Wildlife/ Large Mammals/Insects

Wildlife/Mammals: Grizzly Bear, Black Bear, Coyote, Fox, Weasel, Skunk, Opossum, White-tailed Deer, Mule Deer, Elk, Bison, Moose, Wolves

NEON personnel will not disturb the wild animals and will make every attempt to work away from nesting and feeding areas. Most are relatively shy and should not pose a hazard to the employees; however, all animals can become a nuisance and/or aggressive when hungry or when introduced to human food. Trash, to include food and human wastes, shall be cleaned up immediately and packed out of the area at the end of each day. DO NOT approach wild animals for any reason. Injured or sick animals can be extremely dangerous and should be avoided at all times.

Employees are **required** to complete Bear Awareness Safety Training[AJ2] prior to working within the park and shall have **bear spray readily available at all times** while working in the park. Bear spray is available through[AJ3] the Domain Support Facility in Bozeman or Park Rangers. Contact a Yellowstone representative for assistance in obtaining Bear Spray prior to working in the field, if you arrive on site without a supply of spray. **ALWAYS** carry spray where it can be retrieved quickly such as on your chest on hip. **DO NOT** carry the aerosol spray inside a backpack where it is difficult to retrieve. Respect BMA (Bear Management Area) closure areas as bear activity may be high within these areas[AJ4][AJ5]. All food and drinks should be maintain in bear-safe containers and sacks at all times.

Insects: Ticks, Mosquitoes, Flies
A repellant should be used in accordance with manufacturer's recommendations.

Snakes: Prairie Rattlesnake

- Can be more than 48 inches in length
- Greenish gray to olive green, greenish brown, light brown, or yellowish with dark brown splotches down its back that are bordered in white
- Only dangerous venomous snake in the park
- Lives in the lower Yellowstone River areas of the park, including Reese Creek, Stephens Creek, and Rattlesnake Butte, where the habitat is drier and warmer than elsewhere in the park
- Usually defensive rather than aggressive
- Only two snake bites are known during the history of the park

See Attachment 3 for Snakebite Information

Host Safety Requirements

Seismic Risk
High (See Earthquake Safety above)

Flood Plain

1. All personnel must be wearing a personal flotation device (PFD) prior to entering a stream which is higher than mid-calf.
2. A minimum **3-person rule** shall be strictly enforced. No work shall be done in a stream alone.
3. A stream shall not be entered if an employee feels unsafe due to incoming weather, unpredictable presence of wildlife, water velocity or depth, etc.
4. A stream shall not be entered that is equal to velocity times depth $\geq$ 10 ft^2/second.
5. All employees shall have access to a form of communication with other team members such as a two-way radio.
6. Technicians should be aware of any site-specific hazards and to the waters of that particular location (i.e. current status, tidal charts, etc.)

Required PPE
All standard PPE requirements apply (see EHS Safety Policy & Program Manual).

Employees **SHALL** wear hi-visibility vests or clothing at all times.

Emergency Equipment

- Standard Emergency Preparedness equipment will be required for field use.
- Each motor vehicle used for the field work will be equipped with standard safety equipment, including a fire extinguisher, a 5-gallon bucket of water, and a shovel.

Safety Management[AJ6]

The following general guidelines will be applied while working in the field at Yellowstone National Park or Blacktail Deer Creek Aquatic site:

- NEON employees are required to attend New Employee Safety Orientation and Field Safety and Security Training through the NEON Safety Department or Field Operations, prior to deploying to the field sites. This training includes the following:
    - First Aid/CPR/AED certification with annual refresher training
    - Hazard Communication 2012
    - Zoonotic Disease Transmission Safety
    - Vehicle Safety
    - UTV operations, as needed
    - Bear Safety (in accordance with Yellowstone National Park Bear Safety requirements)
    - Journey Management/Planning to include communications training
- Journey Management:
    - It is required that all field personnel designate an emergency contact (e.g., supervisor, co-worker) that they will check-in with at the beginning and end of each field day or session. This designated emergency contact will know the trip details and will contact their immediate supervisor, emergency services (911) and the Yellowstone Research Permit Office (307-344-2239) in the event field staff fails to make contact at the end of the day or reporting period.
- NEON contractors shall be vetted by the NEON Safety Department for training and safety program requirements.
- NEON contractors shall attend Bear Awareness Safety Training, in accordance with Yellowstone National Park Bear Safety requirements.
- A Tailgate Safety briefing must be conducted daily at the beginning of field work.
- Each person should have radio or cell phone contact if visual contact is not possible while working at the site.
    - Daily Safety Briefing will include Emergency Contact and Emergency Action Plan
- 2-person rule shall be followed at all times.
    - It is best to travel and work with larger groups in Yellowstone. See Attachment 1, Staying Safe in Bear Country.
- Drink water. Electrolyte solutions may be useful if employees are walking for more than 1 hour; however, the best hydration fluid for working in this environment is water. Employees should have a minimum of 8 ounces of water per hour to drink while working.
- Be aware of co-worker status. Effects from heat-related illnesses can oftentimes be reduced if signs and symptoms are recognized and if HELP is sought immediately.
- Long pants, shirts with sleeves, sturdy work or hiking boots, and hat are required clothing for working in the area.
- Be prepared for changing weather. Dress in layers and have dry clothing available at all times.

- Tower Access PPE includes the use of hard hat with chin strap (or helmet), hi-visibility/reflective vest, safety glasses, full-body harnesses, lanyards, ascenders, DEUS® Rescue Device, hard-toed work boots, and gloves.
    - Access to the towers will require a Permit-to-Work at Heights approved by the tower controller.
    - Employees will be trained in Fall Protection and Tower Access Safety, at a minimum.
    - A rescue plan will be prepared and may include rescue by certified NEON employees.
    - No work will be performed on the outside of the tower structure (work will be confined to the interior of the tower) without approval by NEON Safety Department.
- Sunscreen should be used abundantly and frequently applied throughout the day.
- A repellant should be used in accordance with manufacturer's recommendations and in accordance with NEON Science.
- Call early for local emergency services and for emergency medical services. Response time can be slow if roads are restricted, blocked or impassable.
- **DO NOT** offer services to others on or near the work site unless you have specific training required for the task (i.e., towing or jump-starting vehicles). DO NOT tow non-NEON vehicles using NEON owned trucks or NEON rented trucks.
- No hunting or fishing allowed on the site by NEON employees.

Attachment 1

Staying Safe in Bear Country!

There is an average of one bear attack in the park each year. In 2011, in separate incidents, two visitors were killed by bears inside the park. Another person was killed in 2014. **Avoidance of encounters is the best way to ensure your safety!**

Safe traveling in bear country begins before you hit the trail:

- Minimize "attractants" at all times.
- Keep all food and drinks in bear-resistant bags and containers.
- Dispose of food and drinks in bear-proof garbage cans away from where you will be performing work. DO NOT FEED ANY WILDLIFE!
- Do not litter. Pack-in and pack-out all equipment and materials every time.
- No hunting, trapping or fishing (beyond what is required in protocols). Firearms are not aloud.
- Check-in at Mammoth Ranger Station prior to performing work. Check-out once work is completed. Be observant of any emergency warning about specific wildlife observed in the area and any closures.
- Report all wildlife sightings, confrontations, injuries, property damage and potential developing conflicts. Any incident above and beyond a sighting should be promptly reported to the nearest ranger station (most commonly Mammoth) or by calling 307-344-2162, and report details to your Domain Manager (or designee).
    - For sightings visit: https://www.nps.gov/yell/learn/nature/wildlife-sightings.htm to report the sighting.
- Bears will guard and defend carcasses against other scavengers or humans. Dead ungulates will attract and hold many bears near the carcass site. It is risky to approach a carcass; many bears may be bedded nearby just out of sight. If you find a fresh dead ungulate carcass that still has a lot of meat remaining, quickly take a GPS point for reference if possible, and leave the immediate area by the same route you approached the carcass from. Report all carcasses to the nearest ranger station or visitor center.
- Check-in at Mammoth Ranger Station prior to performing work. Check-out once work is completed. Be observant of any emergency warning about specific wildlife observed in the area and any recent bear activity or closures before hiking or setting up a work task[AJ7].
- Respect closure periods within Bear Management Areas as well as posted closure which may lie outside BMAs
- NEON employees traveling to and working in Yellowstone National Park will complete Bear Awareness Safety Training prior to working in the park[AJ8].
- See the bear before you surprise it. Watch for fresh tracks, scat, and feeding sites (diggings, rolled rocks, torn up logs, ripped open ant hills).
- When hiking, make noise, to alert Bears to Your Presence. When hiking, periodically yell "Hey Bear" especially when walking through dense vegetation or blind spots, or when traveling upwind, near loud streams, or on windy days. Avoid thick brush whenever possible. In Yellowstone National park bears hibernate for approximately 5 months each year and have only 7 months of active time to obtain all of their nutritional needs. Therefore, a bear with its head down feeding may not see you as you as quickly as you would think. Pay attention and see the bear before it sees you and before you surprise it, slowly and quietly back away the way you came. Move when the bear's head is down, but stop moving when the bear lifts its head to check its surroundings.
- Avoid Hiking/Working alone. Whenever possible hike/work in groups of three (3) or more people—91% of the people injured by bears in Yellowstone since 1970 were hiking alone or with only one hiking partner; only 9% of the people injured by bears were in groups of three or more people[AJ9]. Keep group

members in tight proximity of each other. Avoid performing work or hiking more than a few feet from the next group member. Never hike or work alone!

- Bear Spray should be attached to each person at all times. Avoid putting spray in packs where it can be misplaced or difficult to have prepared when necessary.
- The hot summer season is the period when grizzly bears are most active.
- **DO NOT RUN!**

Safety equipment checklist should include (but not limited to):

Group:	Got It!
First Aid Kit	
Satellite Phone	
Navigation	
Individual:	
Bear Spray!!!	
Walkie-Talkie Radio	
Water/Sports Drinks	
Food & snacks packed in canisters (not bags) and/or bear sacks designed to prevent wildlife	
Sunscreen	
Chapstick	
Whistle	
Gloves, glasses, boots, hardhat and/or other required PPE	
Hiking pole	
Backpack	
Extra pair of dry clothes/shoes (during winter)	
Snow Shoes (during winter)	

Attachment 2

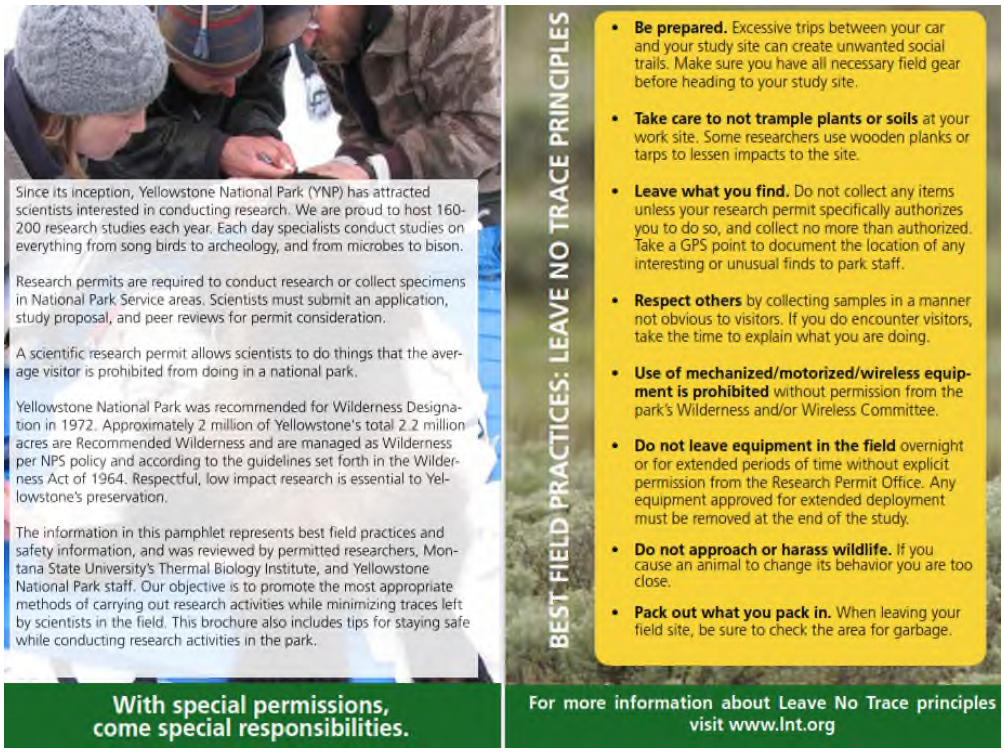
Blacktail Bear Management Area - Closed March 10th to June 30th

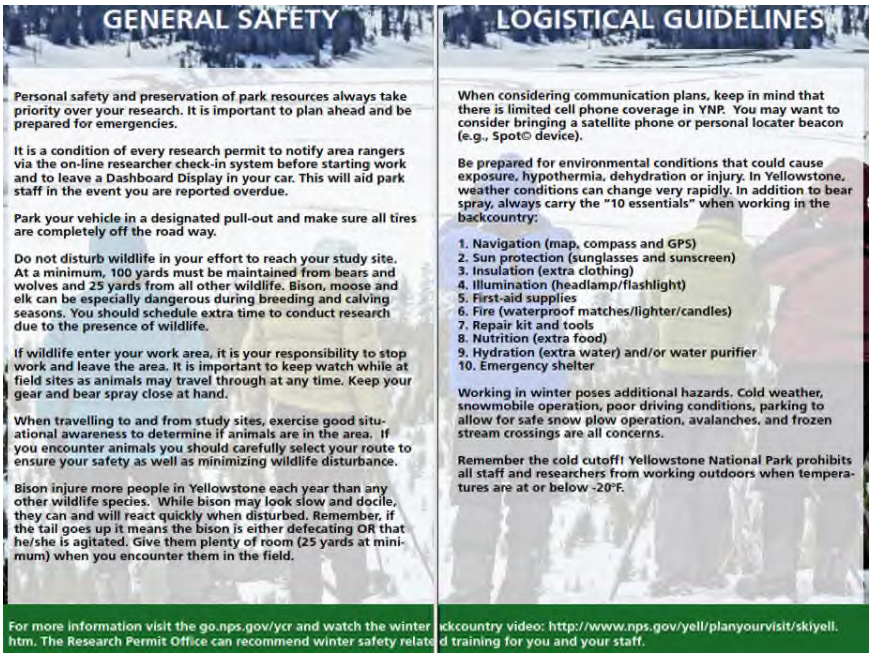
NEON Tower Site

Yellowstone Bear Management Plan:

https://www.nps.gov/yell/learn/nature/upload/YNP_Bear_Management_Plan.pdf

Attachment 3
Resource Protection and Safety Considerations in Yellowstone National Park:
A Guide for Research Scientists




GENERAL SAFETY
Personal safety and preservation of park resources always take priority over your research. It is important to plan ahead and be prepared for emergencies.
It is a condition of every research permit to notify area rangers via the on-line researcher check-in system before starting work and to leave a Dashboard Display in your car. This will aid park staff in the event you are reported overdue.
Park your vehicle in a designated pull-out and make sure all tires are completely off the road way.
Do not disturb wildlife in your effort to reach your study site. At a minimum, 100 yards must be maintained from bears and wolves and 25 yards from all other wildlife. Bison, moose and elk can be especially dangerous during breeding and calving seasons. You should schedule extra time to conduct research due to the presence of wildlife.
If wildlife enter your work area, it is your responsibility to stop work and leave the area. It is important to keep watch while at field sites as animals may travel through at any time. Keep your gear and bear spray close at hand.
When travelling to and from study sites, exercise good situational awareness to determine if animals are in the area. If you encounter animals you should carefully select your route to ensure your safety as well as minimizing wildlife disturbance.
Bison injure more people in Yellowstone each year than any other wildlife species. While bison may look slow and docile, they can and will react quickly when disturbed. Remember, if the tail goes up it means the bison is either defecating OR that he/she is agitated. Give them plenty of room (25 yards at minimum) when you encounter them in the field.
LOGISTICAL GUIDELINES
When considering communication plans, keep in mind that there is limited cell phone coverage in YNP. You may want to consider bringing a satellite phone or personal locater beacon (e.g., Spot© device).
Be prepared for environmental conditions that could cause exposure, hypothermia, dehydration or injury. In Yellowstone, weather conditions can change very rapidly. In addition to bear spray, always carry the "10 essentials" when working in the backcountry:
1. Navigation (map, compass and GPS)
2. Sun protection (sunglasses and sunscreen)
3. Insulation (extra clothing)
4. Illumination (headlamp/flashlight)
5. First-aid supplies
6. Fire (waterproof matches/lighter/candles)
7. Repair kit and tools
8. Nutrition (extra food)
9. Hydration (extra water) and/or water purifier
10. Emergency shelter
Working in winter poses additional hazards. Cold weather, snowmobile operation, poor driving conditions, parking to allow for safe snow plow operation, avalanches, and frozen stream crossings are all concerns.
Remember the cold cutoff! Yellowstone National Park prohibits all staff and researchers from working outdoors when temperatures are at or below -20°F.
For more information visit the go.nps.gov/ycr and watch the winter
kkcountry video: http://www.nps.gov/yell/planyourvisit/skiyell.
htm. The Research Permit Office can recommend winter safety relate
d training for you and your staff.


TO REDUCE THE CHANCE OF A NEGATIVE ENCOUNTER WITH A BEAR
BE ALERT: See the bear before you surprise it. Watch for bear sign such as tracks, scat, and feeding sites.
AVOID WORKING AT DAWN, DUSK, OR AT NIGHT: During the hot summer season these are the periods when grizzly bears are most active.
WORK CLOSE TOGETHER OR IN GROUPS: Space yourselves close together (50 feet or closer) or in groups or 3 of more people when working and hiking.
DON'T EXPECT BEARS TO NOTICE YOU FIRST: A bear with its head down feeding may not see you as quickly as you would think. Pay attention, see the bear before it sees you and before you surprise it.
MAKE NOISE, ALERT BEARS TO YOUR PRESENCE: When hiking, periodically yell "Hey Bear" especially when walking through dense vegetation or blind spots, when traveling upwind, near loud streams, or on windy days. Avoid thick brush whenever possible.
AVOID CARCASSES: Ungulate carcasses are a highly preferred food source that bears will guard and defend against other scavengers or humans. Dead ungulates will attract and hold many bears near the carcass site. It is risky to approach a carcass; many bears may be bedded nearby just out of sight. If you find a carcass leave the immediate area by the same route you approached the carcass.
STAY WITH YOUR GEAR: Don't leave your packs, lunches, food, or beverages unattended as they may attract and hold bears at the site.
CLOSE ENCOUNTERS WITH BEARS IN YELLOWSTONE HAVE RESULTED IN DEATH AND INJURY TO BOTH HUMANS AND BEARS.
BEAR SAFETY
THE BASICS OF BEAR PEPPER SPRAY
PROVEN EFFECTIVE: In a study in Alaska, bear pepper spray was effective in stopping aggressive behavior in grizzly bears in 92% of the incidents where it was used.
EASY TO USE: Unlike a firearm, you don't have to be a good shot with bear spray. All you need to do is put up a cloud of bear spray between you and the charging bear. Precise aim is not necessary.
PRACTICE: Use inert bear spray to practice quick drawing bear spray from its holster, removing the safety tab with your thumb, and firing. Practice firing inert bear spray with the wind at your back, into a head wind, and with a cross-wind so that you understand how bear spray is affected by the wind.
KEEP IT READILY ACCESSIBLE: Bear spray must be immediately accessible in a quick draw holster, not stored in your pack.
WHEN TO SPRAY: Start to spray the charging bear when it is about 40 - 50 feet away.
Bear Spray is NOT a substitute for common sense - use bear safety protocols as your first line of defense!

Attachment 4
SNAKEBITE INFORMATION AND PLANNING

Snakes may be found in just about every natural habitat. They make their homes in trees, shrubs, soil, ponds and lakes.

- If you encounter a snake, LEAVE IT ALONE! Most are non-aggressive but if they feel threatened, may attack. Snake bites can be deadly.
- Wear long pants, gaiters, and boots taller than the ankle when working in the woods.
- Avoid tall brush and deep, dark cracks or crevices.
- Make plenty of noise and vibration when walking and working.
- Wear work gloves.
- Be aware rattlesnakes do not always make noise.

If you are bitten by a snake or if a co-worker is bitten by a snake, stay calm and seek medical treatment immediately. Call 911 from your cell phone or company radio to contact park dispatch so emergency medical services can respond quickly. The only acceptable treatment for a venomous snake bite involves the use of anti-venom. It must be administered as early as possible and can only be done in a hospital setting.

Snakebite symptoms:

- You may see marks in the skin and there will likely be a discharge of blood from the wound with some localized swelling.
- There will be severe pain around the bite site.
- Convulsions may occur along with, blurred vision, weakness, dizziness, and fainting.

Treatment:

- Get away from the snake, identify the snake if possible.
- Take a picture, if able to do so safely, to use for identifying the snake at the hospital.
- Do not approach a snake or attempt to pick it up.
- Limit the patient's movement.
- Call 911 from a cell phone and STAY CALM while waiting for emergency medical services.
- DO NOT elevate the area or limb that was bitten. Keep it below the level of the heart, if possible.
- Limit activity to keep heart rate low.
- Remove tight fitting clothing near the bite site.
- Wash the bite area with water and soap, if available.
- Watch for the development of shock.
- ALWAYS seek medical attention!
- DO NOT cut or suck on bite area or use ice or alcohol.
- No tourniquets or constricting bands should be applied.
- DO NOT apply ice to affected area.

Attachment 5
Spill Response and Clean-up Procedures

In the event of a chemical spill, the individual(s) who caused the spill is responsible for prompt reporting and proper clean-up, if capable. Immediately attend to victims, if it is safe and if you are trained to do so (See Safety Data Sheet for more information).

The following are general guidelines to be followed for a chemical spill.

1. Immediately alert area occupants and supervisor, and evacuate the area, if necessary.
2. If a volatile, flammable material is spilled, immediately warn everyone, control sources of ignition and ventilate the area.
3. Don personal protective equipment, as appropriate to the hazards. Refer to the Safety Data Sheet or other references for information.
4. Using the chart below, determine the extent and type of spill. If the spill is large, contact HAZMAT Response at 911.

Category	Size	Response	Treatment Materials
Small	up to 300cc	chemical treatment or absorption	neutralization or absorption spill kit
Medium	300 cc - 5 liters	absorption	absorption spill kit
Large	more than 5 liters	call NEON Safety/ 911	outside help

8. Prevent environmental release. Spill socks and absorbents may be placed around area, as needed.
9. Contain and clean-up the spill according to Safety Data Sheet.
    a. Distribute loose spill control materials over the entire spill area, working from the outside, circling to the inside. This reduces the chance of splash or spread of the spilled chemical.
    b. Many neutralizers for acids or bases have a color change indicator to show when neutralization is complete.
10. When spilled materials have been absorbed, use brush and scoop to place materials in an appropriate container.
11. Contact NEON Safety for advice on storage and packaging for disposal.
12. Decontaminate the surface where the spill occurred using a mild detergent and water, when appropriate.

Report all spills to NEON Safety, Supervisor and Site Host, as applicable.

Attachment 6

ACKNOWLEDGEMENT OF UNDERSTANDING/COMPLIANCE

DOMAIN: 12

SITE: Yellowstone National Park

I understand as an employee, the EHS Site Specific Program above and the included site stipulations are to be read and complied with while performing my duties at this site.

If I require additional information or if I have any questions, I will immediately contact my immediate supervisor or EHS Representative, where applicable. Failure to follow these rules may result in disciplinary action up to and including termination, in accordance with Human Resources' Policies and Procedures.

Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date

Appendix 7
Biological Assessment and Letter of Concurrence

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National Park Service
U.S. Department of the Interior
Yellowstone National Park
Wyoming

National Ecological Observatory Network
Domain 12 – Proposed Site

Biological Assessment

February 14, 2017

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List of Acronyms

°F	degrees Fahrenheit
AOP	Airborne Observation Platform
AOS	Aquatic Observation System
BA	Biological Assessment
BMA	Bear Management Area
BMP	Best Management Practices
BO	Biological Opinion
DFIR	Double Fence Intercomparison Reference
Domain 12	Northern Rockies Domain
DPS	Distinct Population Segment
ESA	Endangered Species Act
fDOM	fluorescent dissolved organic matter
FR	Federal Register
GPS	Global Positioning System
GYA	Greater Yellowstone Area
IACUC	Institutional Animal Care and Use Committee
mi^2	square miles
NEON	National Ecological Observatory Network
NFPA	National Fire Protection Association
NPS	National Park Service
NSF	National Science Foundation
PAR	Photosynthetically Active Radiation
Park	Yellowstone National Park
PVC	polyvinyl chloride
RPO	Research Permit Office
SOP	standard operating procedure
TOS	Terrestrial Observation System
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
UTV	Utility Task Vehicle

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Table of Contents

Figures

Tables

1. INTRODUCTION

Yellowstone National Park (referred to herein as "the Park") has received a proposal from the National Ecological Observatory Network, d/b/a Battelle Ecology, Inc. (NEON) to create an ecological research and monitoring site on Blacktail Deer Plateau. The project involves the installation of infrastructure including a tower, soil sampling plots, instrument hut, and aquatic monitoring equipment. Plots would be established in the study area to collect data on biogeochemical cycles, infectious diseases, and a suite of local taxa to characterize patterns, dynamics, and linkages in terrestrial ecosystems over a 30-year period. An annual flyover with small aircraft would collect airborne observations.

NEON is a continental-scale ecological observatory, funded by the National Science Foundation (NSF), which intends to provide data to understand ecological change over time, including the impacts of climate change, land-use change, and invasive species on ecological systems. NEON has been designed to collect instrument and observational data over the next 30 years and make those data freely available. NEON is supported through the NSF Major Research Equipment and Facilities Construction Program. The National Science Board and Congress approved funds to create the national observatory in 2011.

In designing a continental scale ecological observatory, NEON partitioned the United States into 20 eco-climatic "Domains," which represent a range of soils, vegetation, landforms, and climates. NEON would collect physical, chemical, and biological data at each terrestrial and/or aquatic site (streams, rivers, or lakes) within these Domains. NEON plans to construct a total of 81 sites (47 terrestrial sites [20 and 27 relocatable sites] and 34 aquatic sites [20 and 14 relocatable sites]); "relocatable sites" would move approximately every five to ten years.

The Park has been proposed as the site for the Northern Rockies Domain (Domain 12). Under NEON's design framework, this would be a wildland site and in place within the observatory for 30 years. The Park was proposed due to its wild landscape and representativeness of the Northern Rockies landforms, vegetation, soils, climate, and ecosystem. NEON would collect site-based data about climate and atmosphere, soils, streams, infectious diseases, and a variety of organisms. Data that would be gathered at this proposed location are fundamental in understanding the connectivity of the ecology among NEON Domains and in revealing immediate ecosystem responses to stressors. The information and data collected would be available through NEON's online portal that would enable the Park, as well as scientists, educators, planners, decision makers, and other members of the public, to map, understand, and better predict the effects of human activities on ecological systems and effectively address critical ecological questions and issues.

The purpose of this Biological Assessment (BA) is to address the potential effects of the proposed research site on the gray wolf (*Canis lupus*), grizzly bear (*Ursus arctos horribilis*), and Canada lynx (*Lynx canadensis*) and its designated Critical Habitat. The proposed action may affect, but is not likely to adversely affect the gray wolf and grizzly bear, and would have no effect on Canada lynx and its designated Critical Habitat.

2. CONSULTATION HISTORY

The following three consultations have occurred in the Park in recent years:

Programmatic Biological Assessment: Yellowstone Park Road Reconstruction and Maintenance, 2008-2028. Consultation completed September 2010.

This BA and subsequent Biological Opinion (BO) addressed potential impacts to grey wolves, grizzly bears, and Canada lynx resulting from park-wide road construction and maintenance. Since grizzly bears were delisted when the original BA and BO were completed, a second BA and BO were completed. The first BO resulted in a determination that the "effects of the proposed project on gray wolves are not likely to jeopardize the continued existence of this species." The incidental take associated with the project was estimated up to 40 wolves over a 20-year period. A "not likely to adversely affect" determination was made for the Canada lynx.

The second BO focused solely on the grizzly bear and resulted in a determination of "not likely to jeopardize the continued existence of the grizzly bear." This allowed for a park-wide take of "no more than 6 grizzly bears (adult or juvenile) within any consecutive 3-year period, or 36 grizzly bears total, will be taken during the remaining 18 years of the 20-year proposed project as a result of vehicle mortality…"

Lake Comprehensive Plan/Environmental Assessment, May 2011. Consultation completed January 2011.

This Environmental Assessment implemented a comprehensive plan for the Lake developed area, incorporating and replacing past planning documents. The plan proposed actions to improve visitor and employee facilities in the Lake area. Consultation resulted in concurrence on a determination of "not likely to jeopardize the continued existence of the gray wolf or grizzly bear." The BO allowed for an incidental take of no more than four gray wolves and four grizzly bears in the 20-year period of the plan.

Commercial Stock Outfitter Concession Contracts Environmental Assessment, 2014.

This BA addressed the potential effects of the Commercial Stock Use Plan on species and their Critical Habitat. The proposed action was to allow, and provide opportunities for, visitors to experience the backcountry of the Park while utilizing guided saddle and pack stock tours while protecting the natural and cultural resources of the Park. The proposed project activities were determined to have no effect on Canada lynx or its designated Critical Habitat. Overnight visitor use of the backcountry in the Park is not expected to vary significantly because total overnight use is limited by the number of backcountry campsites. However, day use may increase and therefore the potential for grizzly bear-human interactions may continue to increase. Despite mitigation measures, the proposed action "may affect, and is likely to adversely affect the grizzly bear and includes the take of no more than 2 grizzly bears over a period of ten years as a result of the proposed action."

3. DESCRIPTION OF THE ACTION AND ACTION AREA

The proposed NEON Domain 12 site action area comprises the tower site and an aquatic site and would be installed in the Northern Range of the Park, approximately 70 miles south of Livingston, Montana, and 9 miles east of Mammoth Hot Springs. Data on aquatic and terrestrial biota, including soils, would also be collected in the vicinity of the tower and aquatic sites, and an annual flyover would be conducted to collect ecological data remotely.

The proposed tower site is located 0.3 miles south of Grand Loop Road near the intersection with Blacktail Plateau Drive (Figures 1 and 2A). Aquatic observations would be collected at an aquatic site on nearby Blacktail Deer Creek, approximately 2.5 miles west of the proposed tower location (Figure 2B). Terrestrial observations would be made within the project area boundary (Figure 3). Soil sampling would be conducted in the vicinity of the tower.

The proposed action described herein is based on Action Alternative Option 2: Tower Height of 59 feet, analyzed in the NEON EA. Under this option, the NEON tower would maintain the same location, site design and infrastructure, and operations as described under Option 1: Tower Height of 70.5 feet. A lower tower height would conform to the tower height threshold outlined in the Wireless Communications Services Plan that the Park adopted in 2009 (NPS 2009) which states that towers should not exceed heights greater than 20 feet above the surrounding tree height. Applications for towers greater than this threshold are required to provide an explanation of why a shorter installation is not feasible. In this case, the lower tower height would reduce the number of environmental parameters collected by NEON and then made available to the scientific community, decision makers, planners, the Park, and the public.

3.1 Atmospheric and Soil Instrumentation

Once constructed, the tower would be visited by two NEON personnel, approximately every two weeks, to ensure computers, sensors, and other equipment is functioning properly and to conduct routine maintenance. The sensors on the tower would collect measurements related to meteorology, radiation, atmospheric chemistry and air quality, dust and aerosols, carbon dioxide, water, and energy fluxes. Sensors in each of the five soil array plots would continuously collect data related to temperature, moisture, carbon dioxide concentration (modeled to soil respiration), radiation, and possibly root growth. Access to the tower and soil-sampling array would be accomplished via the existing Frog Rock Pit Road two-track corridor from the west and then via an unimproved access path (1.5-foot wide foot trail) from the two-track south to the tower and soil sampling array. The access path would be co-located with temporary construction access (8 feet wide) to reduce impacts to vegetation and soil and minimize post-construction rehabilitation efforts (Figure 2A). Field crews would be instructed to stay on the unimproved access path to access site infrastructure.

Infrastructure at the tower site would include:

- Tower with sensors and communications satellite dish;
- Access:
    - Footpath
    - Construction laydown area/staging and parking area *(co-located)*
- Electrical service conduit;
- Auxiliary portal;
- Instrument hut;
- Precipitation collection system with fencing, known as a Double Fence Intercomparison Reference (DFIR);
- Soil Sampling Plots:
    - Power distribution via five device posts that would support power/communication
- Soil horizon pit (temporary).

A conceptual design layout of the proposed tower site with proposed components is illustrated in Figure 2A.

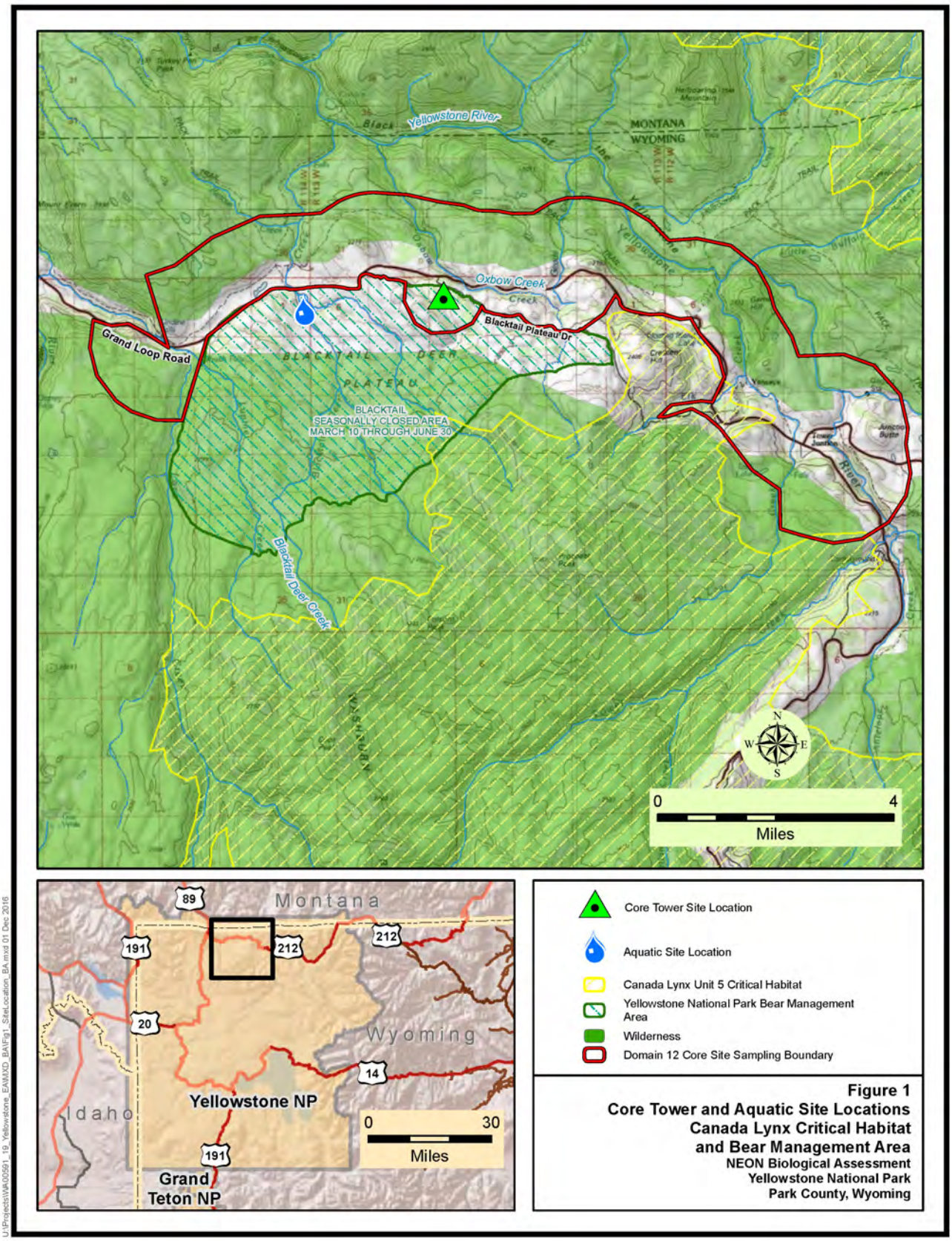
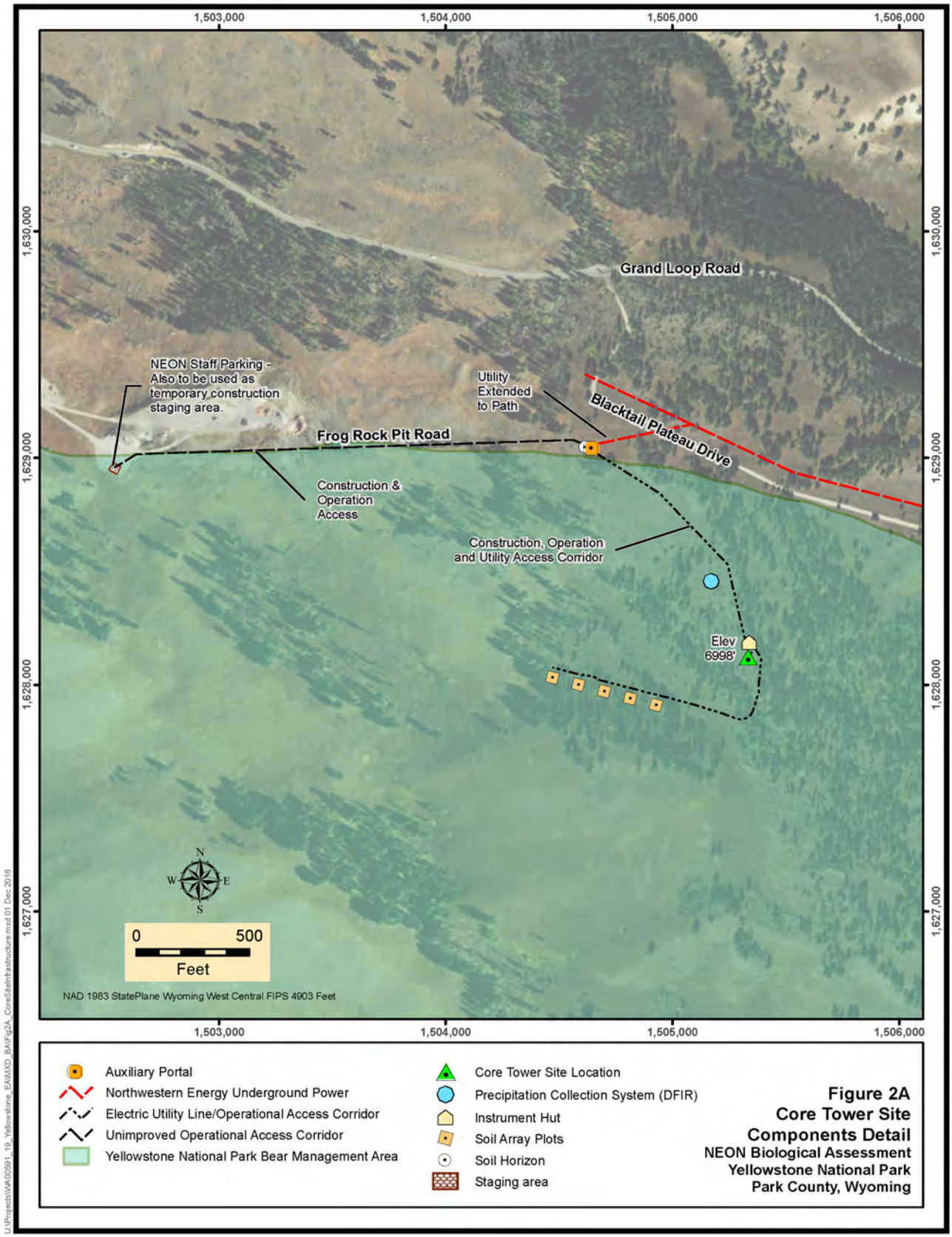


Figure 1
Core Tower and Aquatic Site Locations
Canada Lynx Critical Habitat
and Bear Management Area
NEON Biological Assessment
Yellowstone National Park
Park County, Wyoming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Grand Loop Road
NEON Staff Parking - Also to be used as temporary construction staging area.
Utility Extended to Path
Blacktail Plateau Drive
Frog Rock Pit Road
Construction & Operation Access
Construction, Operation and Utility Access Corridor
Elev 6998'
N
W
E
S
0
500
Feet
NAD 1983 StatePlane Wyoming West Central FIPS 4903 Feet
Auxiliary Portal
Northwestern Energy Underground Power
Electric Utility Line/Operational Access Corridor
Unimproved Operational Access Corridor
Yellowstone National Park Bear Management Area
Core Tower Site Location
Precipitation Collection System (DFIR)
Instrument Hut
Soil Array Plots
Soil Horizon
Staging area
Figure 2A
Core Tower Site
Components Detail
NEON Biological Assessment
Yellowstone National Park
Park County, Wyoming
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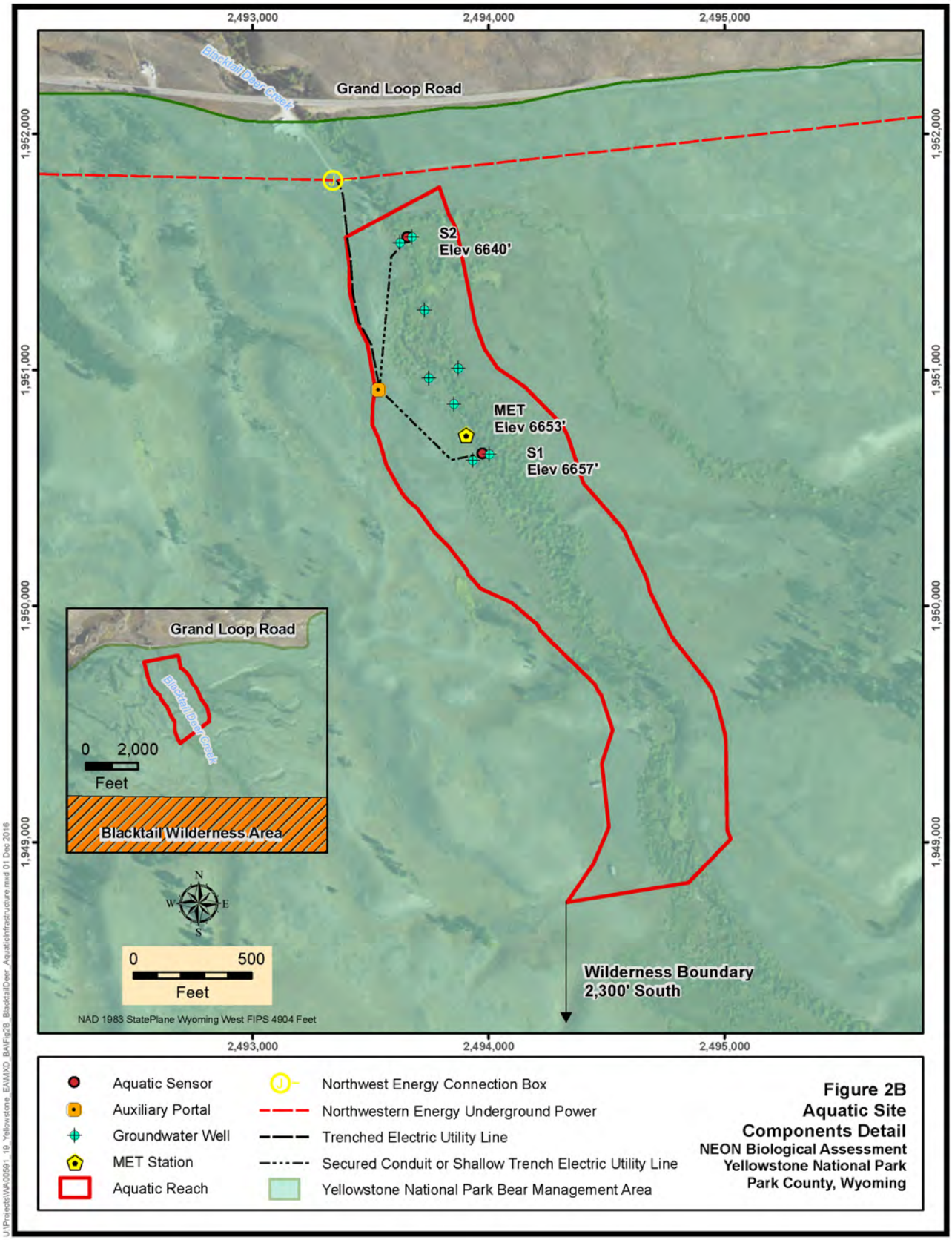
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Blacktail Deer Creek
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Grand Loop Road
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Blacktail Wilderness Area
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NAD 1983 StatePlane Wyoming West FIPS 4904 Feet
Wilderness Boundary
2,300' South
Aquatic Sensor
Auxiliary Portal
Groundwater Well
MET Station
Aquatic Reach
Northwest Energy Connection Box
Northwestern Energy Underground Power
Trenched Electric Utility Line
Secured Conduit or Shallow Trench Electric Utility Line
Yellowstone National Park Bear Management Area
Figure 2B
Aquatic Site
Components Detail
NEON Biological Assessment
Yellowstone National Park
Park County, Wyoming
U:\Projects\WA00591_19_Yellowstone_EAMXD_BAIFig2B_BlacktailDeer_AquaticInfrastructure.mxd 01 Dec 2016

Tower

Several pieces of monitoring equipment would be mounted on a lattice tower (59 feet tall), including basic air quality monitors, soil respiration monitors, physical and canopy measurements, eddy covariance instruments, advanced air quality instruments, dust sensors, and a 10-foot-tall lightning rod designed to meet the following National Fire Protection Association (NFPA) codes: NFPA 780 for building/structural lightning protection and NFPA 70 for electrical systems grounding. The lightning rod would increase the overall height of the tower by 10 feet. The tree canopy at present is approximately 40 feet tall at the site.

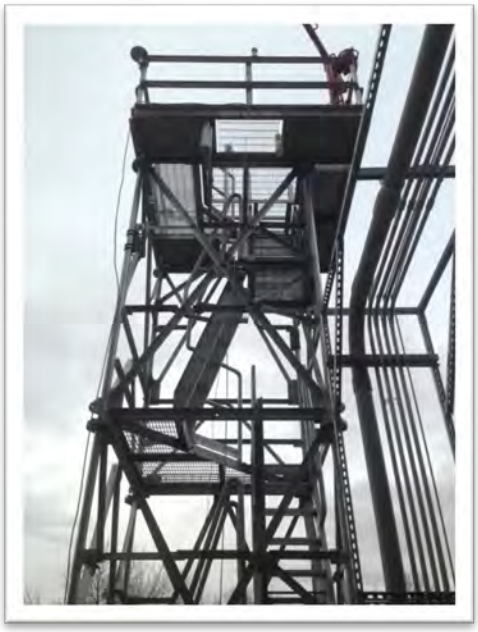


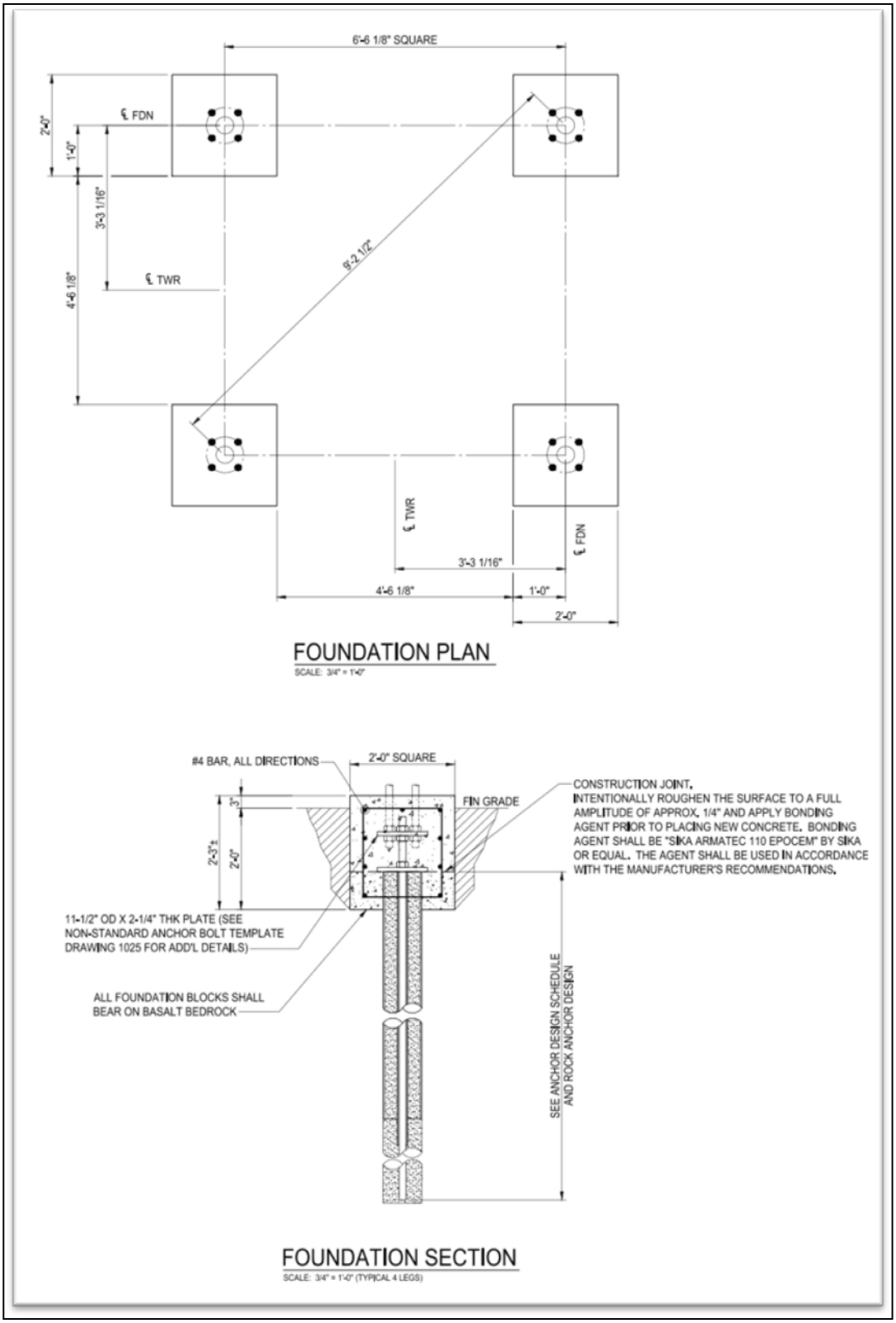
Photo 1: Representative Photo of Ladder System

Digital communication and uploading and/or retrieval of data would be accomplished by mounting a small satellite dish (approximately 3 feet wide) to the tower. This standardization ensures consistent constructability and interchangeability with all other NEON towers across the country and is designed to provide accurate scientific ecosystem measurements.

The tower would have a dull galvanized steel finish or be painted to blend in with surrounding trees and vegetation. An internal ship ladder system would be installed within the tower to provide access and increased safety for monitoring personnel (Photo 1). The tower foundation would utilize rock anchors with concrete caps. Each concrete cap would measure approximately 2 feet long x 2 feet wide x 27 inches deep. There would be one of these at each of the four anchors (16 square feet each) (Schematic 1). The base of the tower would be gated to prevent entry from unauthorized persons and restrict wildlife.

Photo 2 provides an image of a similar tower for reference.

Photo 2: Representative Photo of Similar Tower



Schematic 1: Schematic of foundation plan and section

Auxiliary Portal and Electrical Service

The auxiliary portal is the location where the power line transitions from public to private. This would be the location of the transformer, disconnect, and meter. The auxiliary portal (100 square feet) would be located along the Blacktail Plateau Drive, the nearest point of power to the site, and would be used to supply power for the project. An electrical and communication service conduit would either be buried or placed (and anchored in some cases) on the ground surface and hidden within rocks and vegetation to reduce visual detection within the area. Electrical conduits would originate to the north of the tower and terminate at the soil sampling array.

Instrument Hut

An instrument hut would be located near the base of the tower to house electronic instrumentation and other equipment associated with the tower, as well as tools, safety equipment, and other items for use during operations. The design would utilize a high performance, foam insulated, steel face panel modular structure that could be delivered in pieces and bolted together providing a tight assembly capable of withstanding temperature, humidity, rain/snow, and wind conditions.

The instrument hut would be constructed with the overall goal of blending into the surroundings by painting the outer façade to blend in with the shadows under the trees per Park specifications (i.e., there is no reflectivity). The instrument hut would be 10 feet x 21 feet (210 square feet) supported by a foundational footing that the structure itself rests upon. The foundational footing would be affixed to the underlying bedrock prior to being covered to a minimum of 50 percent of its height (i.e. maximum of 1 foot remaining exposed above the surface). There would be a boardwalk around the hut for access to each doorway and an air conditioning unit condensation trench (1 foot x 6 feet); the boardwalk would be 46 inches wide all the way around the hut including ramps.

Precipitation Collection System with Fencing (Double Fence Intercomparison Reference)

A standard precipitation collection system or DFIR (Photo 3) would be deployed near the proposed site tower location (Figure 1). This assembly contains a weighing-type precipitation collector, one metal altar shield, and two double wooden octagonal fences following U.S. Climate Reference Network specifications. Deployment of wind shields and fences would improve the ability to measure both liquid and solid precipitation without contamination from horizontal winds. The fencing would measure 5.75 feet high and would be placed in a 26-foot-diameter circle (531 square feet). To conceal the infrastructure and reduce visual detection, the DFIR would be located within an area of trees (Figure 2A); however, approximately three trees would be removed to meet the open air requirements of the equipment.

Photo 3: Representative photo of a Double Fence Intercomparison Reference

The structure (shape and dimensions) of the DFIR fence would be designed to ensure accurate precipitation measurements. Alteration of the shape and dimensions of the DFIR fences would critically impact the accuracy of the measurements; however, additional fencing would be installed around (outside) the DFIR based on discussions with the Park to discourage entry by animals.

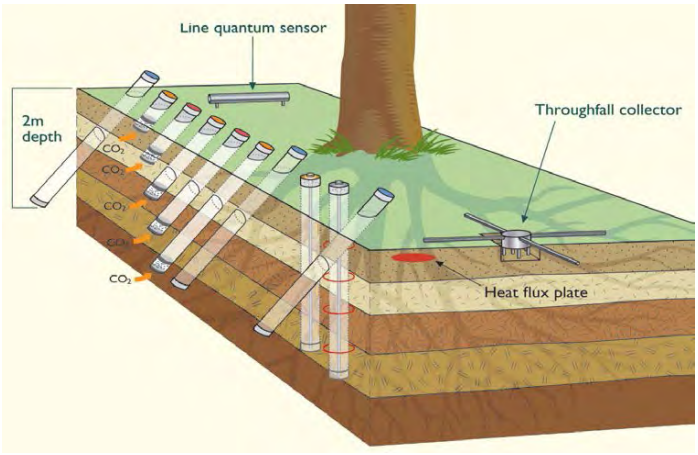
Soil Sampling Plots

The soil sampling plots would extend southwest of the tower, there would be five soil array plots arranged out from the tower generally in the direction of the prevailing wind (Figure 2A). A total of 10 to 12 bore holes (Schematic 2) per plot would be dug. The length of each plot would be approximately 600 feet. Each hole would be nominally 2.5 inches in diameter and either vertical or tilted to a 45-degree angle, depending on what kind of information or data is meant to be collected from that particular borehole. Depth is site specific, and would be based on the soils present. Ideally, bore holes would reach depths of approximately 6 feet or until bedrock is encountered. Each plot would have several in-ground and aboveground sensors installed. The soil array boreholes would be constructed using a portable Utility Task Vehicle (UTV) mounted soil coring drill, which is a hydraulically powered direct push soil probing machine that utilizes both static force and percussion to drive steel boring rods into the sub-surface. The UTV is a six-wheeled, lightweight, all-terrain vehicle that has its and the drills weight dispersed across the six wheels thereby minimizing impact to the vegetation. Other measures to minimize UTV disturbance would be implemented (e.g. ramps for uneven terrain, and careful planning of access routes). The individual boreholes for sensors would be placed to avoid sensitive areas, as necessary.

The sensors would capture several soil, plant, and air measurements including temperature, moisture content, and carbon dioxide levels. There would be a soil array device post adjacent to an unimproved access footpath to delineate the location of each plot. These posts also provide power and communications to the sensors/instrumentation in the soil plot. The posts would measure 54 inches tall with two sign post mounts extended to a depth of 4 feet below grade. Disturbance associated with the soil sampling plots would be approximately 1,346 square feet (Figure 2A).

Soil Horizon Pit

A soil horizon pit 6 feet x 6 feet (36 square feet) and up to a maximum depth of 7 feet would be excavated. The pit would be reinforced with an Occupational Safety and Health Administration approved safety trench box, surrounded by signage with “do not enter” and/or barrier to prevent entry, and covered with plywood when not in use. The plywood cover would prevent animals from entering. This pit would be open for approximately one week to collect soil samples and label the horizons. The soil horizon pit would be dug with a small rubber tracked excavator under the guidance of a scientist that would be on-site to monitor and guide the excavation. The excavated soil would be placed on tarped 0.75-inch plywood and surrounded by erosion fencing to minimize impacts to surrounding vegetation. Upon completion of the scientific work, the soil horizon pit would be backfilled, attempting to place soils back into their original horizons.



Schematic 2: Representative illustration of Soil Array

Access

The access to the proposed site would be signed, designating the area for administrative use only, to deter unauthorized access by visitors. Access paths onsite would be designed to direct NEON personnel along preferred access routes for construction and operational use. An 8-foot-wide temporary corridor would be placed for construction, while a footpath for operations and long-term use would be reduced to 1.5 feet. The path would be approximately 2,396 feet long. A previously cleared area near the Frog Rock gravel pit, west of the proposed tower site, would serve as a staging/parking area (1,600 square feet) (Figure 2A). After the construction phase, this area would become the long-term parking area for operations personnel and reduce new disturbance at the site. The tower and associated infrastructure would be accessed from the west via Frog Rock Pit Road from the designated parking area (Figure 2A).

Summary

The footprint of the site infrastructure would total 0.13 acres, as follows in Table 1.

Table 1: Long-term Ground Disturbance by Infrastructure at Tower Site

Component	Area (square feet)
Tower Foundation	16.0
Unimproved Access Footpath and Electrical Power (co-located)	3,594.0
Instrument Hut	210.0
Auxiliary Portal	100.0
Soil Sampling Array	1,346
Precipitation Collection System (DFIR)	531.0
Soil Horizon Pit	36.0
TOTAL	5,833 (0.13 acres)
Infrastructure Footprint as Percent of Total Site Area	1.6%

3.2 Aquatic Instrumentation

Aquatic sites represent continental ecological variability, such as various geomorphologic and hydrologic regimes and land use types, and would provide data that capture variability and improve ecosystem-level understanding. NEON uses a standardized, consistent sampling strategy across field sites, time, and focal species. Field operations crews collect observational data at regular intervals to complement data collected by automated in situ aquatic sensors.

Infrastructure at the aquatic site would include:

- In-stream sensor suites containing two water quality sensors;
- Meteorological station;
- Groundwater observation well network; and
- Electrical power.

A conceptual design layout of the proposed aquatic site is illustrated in Figure 2B.

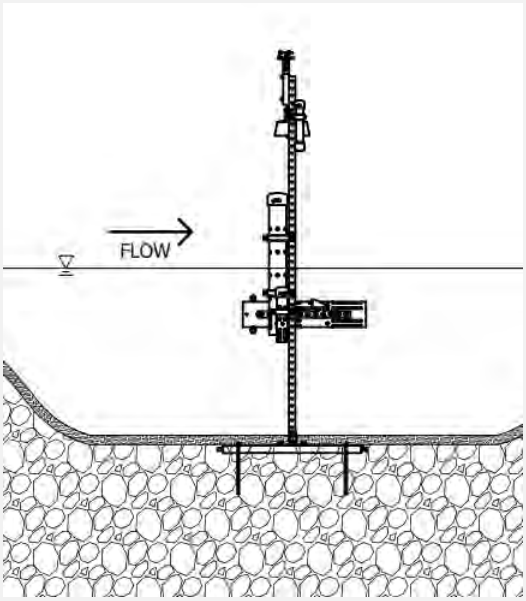
Schematic 3: Representative schematic of Meteorological Station

Meteorological Station

A meteorological station would be located in the near-stream environment to capture local climate representative of the stream. The meteorological sensors include temperature, relative humidity, barometric pressure, 2-D wind speed and direction, net radiometer, and Photosynthetically Active Radiation (PAR). The sensor suite would be mounted on a tripod frame (Schematic 3) that would be anchored to the ground by way of five guy wires, each guy wire would be anchored using a 0.5-inch x 30-inch galvanized ground anchors, and each foot of the tripod would have two 24-inch stainless steel rebar stakes to provide additional stability. Three primary guy wires would be installed at a height of just under 10 feet and extend to the ground at 45 degrees. The remaining two guy wires would be installed at a height of about 9 feet and extend at 60 degrees. These were designed to meet environmental requirements for wind and ice loading, while at the same time meeting the requirements for sensors. The sensors would be located at a height of approximately 9 feet from the ground. The total diameter of the meteorological station would be 90 inches.

In-stream Sensors

Two in-stream sensor suites *(sensor set 1 – S1 and sensor set 2 – S2)* would be mounted on a metal post with a maximum height of 7 feet above the stream bed and with a basket base of 24 inches x 36 inches (16 square feet total). The sensors measure temperature, conductivity, pH, chlorophyll, fluorescent dissolved organic matter (fDOM), dissolved oxygen, nitrate, and surface water level. In addition, a PAR sensor would be located at the top of the stream sensor infrastructure. The sensors and infrastructure would be installed by hand and may require the use of a hammer to secure the 18-inch stakes that would be required to secure the equipment. More specifically, a fence post pounder may be used, in addition to a long bar to drive in auger style ground anchors, and a sledge hammer for other anchors. Power would be installed as well using a trencher or a mini excavator. Infrastructure would remain during the winter season and could tolerate minor surface ice, however, to preserve the integrity the sensors they may be removed during this season if necessary. An illustration of an in-stream sensor is provided in Schematic 4.



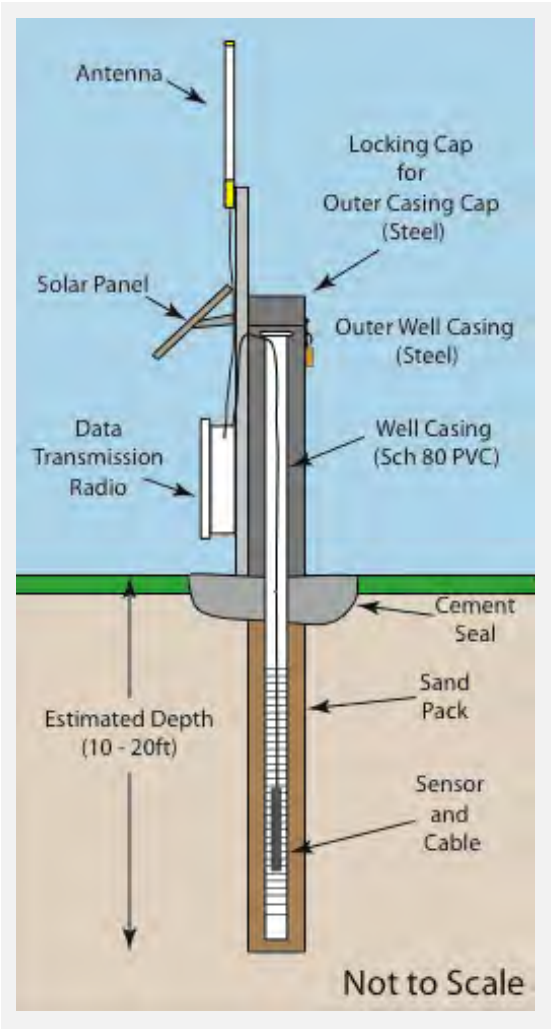
Schematic 4: Representative schematic of in-stream sensor

Stream stage (water level) would be measured manually using a staff gauge. The staff gauge measurements would be used in combination with the automated measurements made by the pressure transducer located on the in-stream infrastructure (S1/S2) to provide near-continuous measurements of stream discharge. Staff gauge installation would utilize a metal post driven into the stream bed (up to 2 feet) and would have a metered ruler attached to the post. The overall above grade height of the staff gauge would be less than 6 feet.

A camera would be utilized to record photos of site conditions several times per day. The camera is positioned such that the field of view captures information about the water state in the channel (flowing, frozen) and secondarily the state of vegetation. A single camera system would be utilized and would be located very near one of the in-stream infrastructure locations (within 30 feet of either S1 or S2). Camera mounting infrastructure would utilize a small metal post driven in to the near-stream shore (approximately 5 to10 feet back from the stream edge) and set in a small concrete pedestal (Schematic 5). Power and communications for the camera would come from direct, wired connection to one of the field device posts for the in-stream infrastructure.

Schematic 5: Representative schematic of Camera

The camera forage would provide near-surface remote sensing of canopy phenology (cyclic and seasonal natural occurrences, especially in relation to climate and plant and animal life). This imagery, along with a nationwide network of phenology cameras would contribute to the efforts of scaling remotely sensed satellite-based data with ground-based cameras. Additionally, areas in particular within the imagery would be analyzed with a computer algorithm to calculate and various vegetation indices. Though the imagery would be published via the Internet, it would be focused mainly on the upper canopy and not directed at areas where Park visitors would frequent. There would be an additional camera that would be directed at three snow stakes located within 16 feet of the tower; the imagery from this camera is used to determine snow depth; it would have a limited field of view. All photos would be streamed, stored, and archived at NEON to maintain a consistent approach to data collection across the observatory.



Schematic 6: Representative schematic of General Well Design

Groundwater Well Observation Network

The groundwater well observation network at the site would consist of eight wells. A set of groundwater wells would be installed in the stream riparian corridor and concentrated near in-stream sensor sets S1 and S2 (Figure 2B). The groundwater well locations would be selected to provide a spatial geometry suitable for the examination hydrologic exchange processes between the stream surface water and surrounding groundwater. Six wells would be located near the stream, within 20 feet of the streams edge, and two wells would be located approximately 50 to 100 feet from the streams edge. This would allow for observations of both *near stream* and *far stream* water chemistry and hydrologic gradients. The wells would be drilled to a few feet below the season low water table elevation; anticipated well depths range from 8 to 15 feet below ground surface. Wells closer to the stream would generally be on the shallower end of the range, and the further ones would likely be deeper.

Access to the site would be via the existing gravel road directly to the west of the stream to access lands near where the wells would be installed, and then overland travel would occur to reach each well location. Travel between wells would be via nearly direct paths between each well site, with care taken to avoid damage to vegetation.

All drilling equipment would be carried by hand along the stream corridor (i.e., hand drill, tools and other equipment, including a portable drilling system) and pathways would be selected to achieve the objectives of the work, but with focus to minimize disturbance to the vegetation.

Minor adjustments to the exact locations of the wells may occur during the drilling process due to the potential for hitting rocks in the subsurface. Hand tools and the portable drilling system (a small track mounted drill rig) would be used to drill the wells, and then sensors placed by hand during the course of approximately one week; a designated trail would not be established, but care would be taken not to trample existing vegetation. The general well design is shown in Schematic 6, and the well design meets the construction requirements for groundwater observation wells in the State of Wyoming. Neither permits nor a licensed well driller are required for installation/construction of the observation wells in the State of Wyoming; however, for safety, a locking metal outer protective shell, surrounding the polyvinyl chloride (PVC) well, set in a small concrete pad would be utilized.

Protection for the well and groundwater comes from a few above grade components. Each well would have a small (15 inches square x 6 inches thick) cement pad poured at grade surrounding an outer metal casing that is used to provide impact protection to the PVC well casing and security for restricting well access through a lockable lid. The outer metal casing would be made of an aluminum shell (4 inches x 4 inches x 5 feet tall) which would be partially buried (2 feet) in the well bore and stabilized by the cement pad. The overall height of the outer casing would be 36 inches above grade. NEON would assume all risk to equipment if damaged by wildlife.

Data transmission and power supply for the wells would come from a solar powered radio system, which would provide wireless power to the sensor and send the data back to the NEON aquatic power and communications portal at the site. Each of the eight wells would be outfitted with a power/radio system. A battery would be included, capable of supplying power to the system for 2 to 3 months between recharges. A small solar panel (27 inches x 20 inches) would be attached to the well casing and used to provide additional power to the battery. Sensor

maintenance would occur roughly 2 times per month for the first few months and then would likely be reduced to one time per month

The total overall height of each groundwater well radio system would be up to 69 inches above grade. The main portion (outer casing/radio) of the above ground infrastructure would be kept below 36 inches above grade and only a metal support and antenna would extend above this, to minimize visual impacts to Park visitors.

The outer casing would be a metal tube 6 inches in diameter. Water would be extracted two times per year from four of the eight wells using a pump that could be carried to the well for each sampling event. A detailed illustration of the well design is provided as an Appendix in the NEON EA.

The Park would also require that all observation wells be plugged and capped when not in use. Likewise, well installation would follow procedures to reduce visibility by Park visitors, e.g., equipment would be painted to blend with surrounding vegetation, non-reflective finishes would be used, and installations would be kept as low as possible, screened from view by using existing vegetation.

Auxiliary Portal and Electrical Service

The auxiliary portal is the location where the electric power line transitions from public to private. This would be the location of the transformer, disconnect, and electric meter. The auxiliary portal (100 square feet) would be located in between the Upper Blacktail Cabin Road and the creek corridor (Figure 2B) and would be used to supply power for the aquatic site (Figure 2B).

An electric utility line would be buried from a Northwest Energy connection box south of Grand Loop Road to the Axillary Portal within the existing roadbed or adjacent to the road. From the axillary portal, power would either be placed into a secured conduit at ground level or placed in a shallow trench and buried to the in-stream sensors. The meteorological station would be wired directly to the electrical power supply.

Each well would be fitted with a solar panel (27 feet x 27 feet), and be equipped with batteries as well, which would be housed in the enclosure mounted to the well casing, to provide power to the sensor and a radio to transmit data wirelessly. Digital communication and uploading and/or retrieval of data would be accomplished by mounting a small satellite dish to the power and communications portal located near the access road.

Access

Proposed access for the aquatic site would be via Grand Loop Road then south on an existing maintained road used to access the Blacktail Cabin. Operational access would originate from Upper Blacktail Deer Road; however, no designated footpath would be created. Operational crews would be advised to tread lightly in and around existing vegetation taking care not to create social trails. Parking for NEON staff would occur in a small parking lot just off of Grand Loop Road. Parking may be allowed at the Upper Blacktail Cabin during construction only in coordination with the Park.

Summary

The footprint of the site infrastructure would total 0.07 acres, as follows in Table 2.

Table 2: Long-term Ground Disturbance by Infrastructure at Aquatic Site

Component	Area (square feet)
In-stream Sensors	16.0
Meteorological Station	28.0
Groundwater Wells (8 wells)	13.0
Auxiliary Portal	100.0

Table 2: Long-term Ground Disturbance by Infrastructure at Aquatic Site

Component	Area (square feet)
Electrical Power (Trenched along the roadway)	1,089.0
Electrical Power (Secured conduit or shallow trench)	1,782.0
TOTAL	3,028.0 (0.07 acres)
Infrastructure Footprint as Percent of Total Site Area	0.07%

3.3 Construction

Construction would take approximately four to six months for a crew of six to ten contract workers plus oversight by NEON personnel. Construction personnel would be housed offsite and would travel to and from the site together to minimize the number of vehicles; approximately two to four pick-up truck vehicles would be required. All work would be carried out during daylight hours.

At the tower site, a temporary construction road with a width of 8 feet would be strictly adhered to by NEON. This temporary road would not exceed 8 feet in width and would be rehabilitated after construction (Figure 2A). An access pedestrian trail on this alignment would remain for the operations phase. Equipment and materials would be hand-carried or brought to the site by small vehicles such as all-terrain vehicles using the existing road or temporary construction access to reduce erosion, compaction, and overall disturbance at the site. Approximately 100 all-terrain vehicle trips per week for approximately four months would be required to transport materials to the project area. Construction equipment would also include mini-excavators and a skid-steer for hauling material (e.g., concrete, larger pieces of infrastructure) could be utilized for the duration of the construction phase.

At the aquatic site (Figure 2B), equipment would be carried by hand to the installations sites. Drilling for wells would be conducted using a hand drill and other portable equipment carried or wheeled into the site, no vehicle access would be allowed and no new construction (temporary) roads or footpaths would be established.

All fueling activities would occur in the staging/parking areas (Figures 2A and 2B) and crews would be required to utilize spill containment during these activities. A number of mitigation measures, standard operating procedures (SOPs), and Best Management Practices (BMPs) would be integrated into design and construction to minimize the degree and/or severity of adverse effects; these are described later in this chapter under *Mitigation Measures*.

3.4 Operations

All site structures and equipment are proposed to be constructed and installed in 2017 and would remain in place for 30 years. A Domain Manager based in Salt Lake City, Utah, would oversee all activities at the site. An assistant manager and all other NEON personnel would be based out of Bozeman, Montana. Operations at the site would include five categories described below: Maintenance of atmospheric and soil instrumentation, maintenance of aquatic instrumentation, aquatic observations, terrestrial observations, and airborne operations. A number of mitigation measures, SOPs, and BMPs would be implemented to minimize the degree and/or severity of adverse effects; these are described later in this chapter under *Mitigation Measures*.

Maintenance of Atmospheric and Soil Instrumentation

Once constructed, the tower would be visited by two NEON personnel, approximately every two weeks to ensure computers, sensors, and other equipment is functioning properly and to conduct routine maintenance as necessary.

The sensors on the tower would collect more than 200 measurements related to meteorology, radiation, atmospheric chemistry and air quality, dust and aerosols, carbon dioxide, water, and energy fluxes. Sensors in each of the five soil array plots would continuously collect data related temperature, moisture, carbon dioxide concentration (modeled to soil respiration), radiation, and possibly root growth. Access to the soil-sampling array would be accomplished via an unimproved footpath. Field crews would be instructed to stay on the unimproved access path that would extend from the tower and instrument hut.

Maintenance of Aquatic Instrumentation

The in-stream instrumentation discussed previously would monitor water temperature, dissolved oxygen, turbidity, pH, conductivity, fDOM, nitrate, and PAR. Near-stream instrumentation would monitor groundwater temperature, level, and conductivity; air temperature; precipitation; barometric pressure; PAR; net radiation; wind speed and direction and would also be fitted with a camera. During the growing season, access to the sensors and infrastructure would be required every two weeks to perform maintenance procedures.

Aquatic Observations

The Aquatic Observation System (AOS) would include data collection of the following: algae, aquatic macrophytes, bryophytes and lichens, aquatic microbes, aquatic invertebrates, fish, sediment chemistry, and water chemistry. The in-stream instrumentation discussed previously would monitor water temperature, dissolved oxygen, turbidity, pH, conductivity, nitrate, and PAR, which represents the fraction of sunlight with a spectral range, among other items. Near-stream instrumentation would monitor groundwater temperature, level, and conductivity; air temperature; precipitation; barometric pressure; PAR; net radiation; wind speed and direction and would also be fitted with a camera. During the growing season, access to the sensors and infrastructure would be required every two weeks to perform maintenance procedures (Table 3).

A subset of 4 of the 8 groundwater wells would be sampled for groundwater chemistry twice per year (spring, fall) to examine seasonal variation. The same wells would be sampled each time, unless a well becomes damaged or is dry, and then a different well would be selected and sampled. In general both of the far from the stream wells and two of the near stream wells would be sampled. Groundwater sampling would also occur within a day of surface water chemistry sampling to provide a snapshot of water chemistry concentrations spanning from the stream channel, through the hyporheic zone (a region beneath and alongside a stream bed, where there is mixing of shallow groundwater and surface water), and out to the groundwater zone. Extraction of groundwater for obtaining samples would follow low flow methods and total extraction of water from each well would be around 4 to 8 gallons; for a total groundwater extraction of around 30 to 60 gallons per year from the full well network.

Surface water chemistry would be measured throughout the year at each site, up to 26 times per year in streams. Shallow groundwater would be sampled up to two times per year in up to eight shallow groundwater wells. Water would be shipped to a NEON outsourced facility for measurement of nutrients, basic water parameters, dissolved gases, and stable isotopes. Sediment chemistry would be measured up to three times per year. Samples would be collected by Domain personnel or seasonal field personnel and shipped to a NEON outsourced facility for analysis. Collected sediment would be analyzed for chemical constituents including inorganics, organics, and nutrients as well as physical grain size.

Reaeration (i.e., gas exchange), a key parameter in the measurement of stream metabolism, is the movement of oxygen from the atmosphere into the water, and is measured as the net rate (i.e., gain and loss of oxygen) at which gas exchanges across the air-water interface. During each reaeration sample date (up to 10 times per year), two to three people would collect data for the reaeration rating curves using a simultaneous and continuous injection of both an inert gas (sulfur hexafluoride, when possible) and a conservative tracer (Chlorine- or Bromine-). Sulfur hexafluoride has minimal bio-uptake and is deemed safe for aquatic life. The conservative tracer is dripped into the stream at a known rate (based on discharge). The inert gas is bubbled into the stream water at the same location and time at a rate of 100 to 200 milliliters per minute. NEON staff would collect water and dissolved gas samples at four locations downstream of the tracer input. Water travel time from the most upstream site to the most downstream site would be approximately 15-45 minutes, but is site specific. Discharge is the volume of water moving down a stream or river per unit of time would be measured by using a handheld flow meter. The development of discharge rating curve is completed biweekly (up to 26 times per year).

The data collected from fish sampling would provide biodiversity information indicating ecosystem health, as well as length and weight, which can indicate fish condition or the health of the fish population. Direct current or pulsed

direct current backpack electrofishing would be used to sample fish in the stream reach. Species lists would indicate the presence of rare or invasive fish species and would be created by identifying captured fish and then returning them to the stream. If electrofishing is not effective, minnow traps may be used. Fish would be anesthetized, identified, weighed, measured, and then released. Respiration would be monitored, and fish would be returned to water and all other guidelines and protocols associated with the IACUC approved fish protocol would be followed. The aquatic site would be sampled two times per year during the growing season, roughly spring and autumn (Table 3). The stream reach is approximately 3,280 feet in length and would be sampled with the "electrofisher" via three passes over the reach. Passes would be separated by no less than 30-minute intermissions.

Aquatic invertebrates would also be sampled at the aquatic site. Stream benthic invertebrate communities are strongly affected by environmental disturbances. Benthic invertebrates would be sampled from riffles, runs, snags, and pools. Invertebrate sampling would occur three times per year: spring, summer, and autumn (Table 3) at or near base-flow conditions at eight locations throughout the stream reach. Collected specimens would be preserved and sent to a laboratory for analysis.

Periphyton (algae, cyanobacteria, heterotrophic microbes, and detritus) would be sampled three times per year from eight locations throughout the stream reach. These communities represent the base of the food web in aquatic systems. Sampling methods would include rock or wood scrubs, sand or silt sampling, or plant collection. Samples would be processed at the Domain support facility before sending to an external laboratory for analysis.

Microbes would be sampled in wadeable streams in surface water and benthic habitats. Linking microbial activity and community composition to chemistry and periphyton measurements would enable a mechanistic understanding of ecosystem function. Surface water microbes would be collected along with monthly water chemistry samples. Benthic microbes would be collected three times (roughly spring, summer, and fall) per year along with periphyton samples using a rock or wood scrub technique, or small sediment or plant collection technique. Scrub samples would be filtered through a capsule filter, while sediment or plant samples would be collected in tubes or small sampling bags. A total of eight benthic microbe samples would be collected per sampling date. Microbe samples would be sent to an external laboratory for analysis

Aquatic plants and algae would be sampled using a combination of point-transect and quadrat sampling methods to determine changes in community structure, abundance, and biodiversity over time, as well as changes in biogeochemical cycles. Aquatic plants, bryophytes, and lichens would be identified in-situ where possible. However, plants and bryophytes would also be collected in a 0.25-square-meter quadrat for biomass determination. Additional voucher specimens could be collected if a field technician is unable to make a positive identification in the field. Aquatic plant and algae sampling would occur three times per year: spring, summer, and autumn (Table 3) at 10 locations along the reach. Sampling would not occur directly following stream flooding.

AOS observations and sampling would occur along Blacktail Deer Creek between Grand Loop Road and the Upper Blacktail Cabin within an area of 96 acres (approximately 3,280 feet in length up to approximately 650 feet on either side of the creek corridor). The AOS would lie approximately 2,000 feet north of recommended wilderness (Figure 2B). No designated trails would be created to access the AOS and crews would be encouraged to tread lightly in and around existing vegetation avoiding the creation of social trails. Table 3 provides a proposed schedule for aquatic observations described above.

Table 3: Proposed Aquatic Observations Schedule

Aquatic Observations					
Item	**Sampling Duration (hours)**	**Approximate Sampling Dates (start-finish)**		**Frequency per Year**	**Number of Technicians**
Sensor Maintenance					
Meteorological	1 to 2	Jan	Dec	26	2
Groundwater Sensor	4	Jan	Dec	26	2

Table 3: Proposed Aquatic Observations Schedule

Aquatic Observations					
Item	**Sampling Duration (hours)**	**Approximate Sampling Dates (start-finish)**		**Frequency per Year**	**Number of Technicians**
Water Quality	2	Jan	Dec	26	2
Physical					
Discharge	1	Jan	Dec	24	2
Reaeration	4 to 8	Jan	Dec	6	2
Stream Morphology	10 to 40	May	Sep	Annually	2
Biological					
Aquatic Plants, Bryophytes and Lichens	3 to 8	May	Sep	3	2
Macroinvertebrates	3	May	Sep	3	2
Algal Biomass	3	May	Sep	3	2
Benthic Microbes	3	May	Sep	3	2
Fish	8 to 40	May	Sep	2	4
Surface Microbes	2 to 4	Jan	Dec	12	2
Riparian Canopy	2 to 4	May	Sep	Annually	2
Chemical					
Surface water Chemistry	1 to 3	Jan	Dec	26	2
Dissolved gas	1 to 2	Jan	Dec	26	2
Isotopes	2	Jan	Dec	26	2
Sediment Chemistry	4 to 8	May	Sep	3	2
Groundwater Chemistry	6 to 20	Jan	Dec	2	2

Terrestrial Observations

The Terrestrial Observation System (TOS) would collect data to characterize organisms and soil to investigate biogeochemical cycles, infectious diseases, and characterize local patterns, dynamics, and linkages in terrestrial ecosystems. Figure 3 provides a map of candidate TOS observation/sampling plots distributed across the proposed site. These sampling locations also include contingency plots to minimize downtime incurred by NEON personnel

should they need to reject proposed plot sites due to various reasons (overlaps with existing research, different ground cover, safety issues, accessibility problems, etc.). The TOS would encompass 17,934 acres.

The majority of the candidate plots are outside of the Bear Management Area (BMA). NEON personnel conducting on-the-ground observations would not be permitted to enter any area(s) within the BMA during restricted periods (see *Mitigation Measures*) without prior coordination with the Park. Likewise, the Park would require that sampling sites not be visited if special status species are currently using the immediate area or if other wildlife related issues arise, as these could be exacerbated by the presence of humans in the area.

The selected taxa are designed to capture a wide range of turnover time, and diverse evolution histories. Specifically, at the scale of the site, the TOS would collect observations of:

- Plant biodiversity;
- Plant biomass, leaf area, and chemical composition;
- Plant phenology;
- Bird composition and abundance;
- Ground beetle abundance and diversity;
- Mosquito phenology, abundance, and pathogens;
- Small mammal abundance, demography, and pathogens;
- Tick abundance and pathogens; and
- Soil microbe abundance, diversity, and function; and soil biogeochemistry.

NEON personnel conducting on-the-ground observations would minimize disturbance by working with the Park to identify the most appropriate measures for the sample design and foot travel. Ecologically sensitive areas identified by the Park would be avoided and plot-specific protections would be added as needed. Social trails would be minimized by reducing the amount of recurring traffic that occurs in undisturbed areas; this would be accomplished by approaching sampling plots and grids from different locations along established roads or trails and tracking each route with Global Positioning System (GPS) technology to guide subsequent trips to new areas. Field staff would not walk to single file to plots and would take care to avoid trampling vegetation (please see other applicable BMPs at the end of this chapter).

Prior to the first year of field observations, NEON personnel would visit potential areas where observations and sampling would occur. The proposed locations would meet NEON scientific and logistical criteria and would be delineated with a combination of permanent primary (one to two per plot, point, or grid) and secondary markers (three to seven per plot or grid) that would facilitate repeat visits to the plots over time. The type of marker used would be determined through consultation between NEON and the Park, though it would be kept as small as possible to reduce visibility, while still allowing plots to be found and identified by NEON staff during operations.

Observations of plant diversity would enable an understanding of local (i.e., plot) and regional (i.e., NEON site representing the Northern Rockies) temporal patterns of native and invasive plant species diversity. NEON personnel would observe the presence and percent cover of species in 3.2-foot x 3.2-foot subplots, and presence of plant species at larger scales within designated plots one time each year (Figure 3). A subset of species encountered would be collected. Some specimens would be used for training and quality purposes; others archived. Plant biomass and productivity would measure plant biomass pools and fluxes using a variety of standardized methods. Herbaceous biomass would be sampled one to two times per year, litterfall four to 12 times per year, and vegetation structure one time per year to every three years at some locations (Table 4). Additionally, below-ground biomass and foliar biogeochemistry would be evaluated once every five years, while coarse downed wood would be evaluated every three to five years. Patterns of plant phenology would also be evaluated to monitor the timing, duration, and seasonal progression of biological processes.

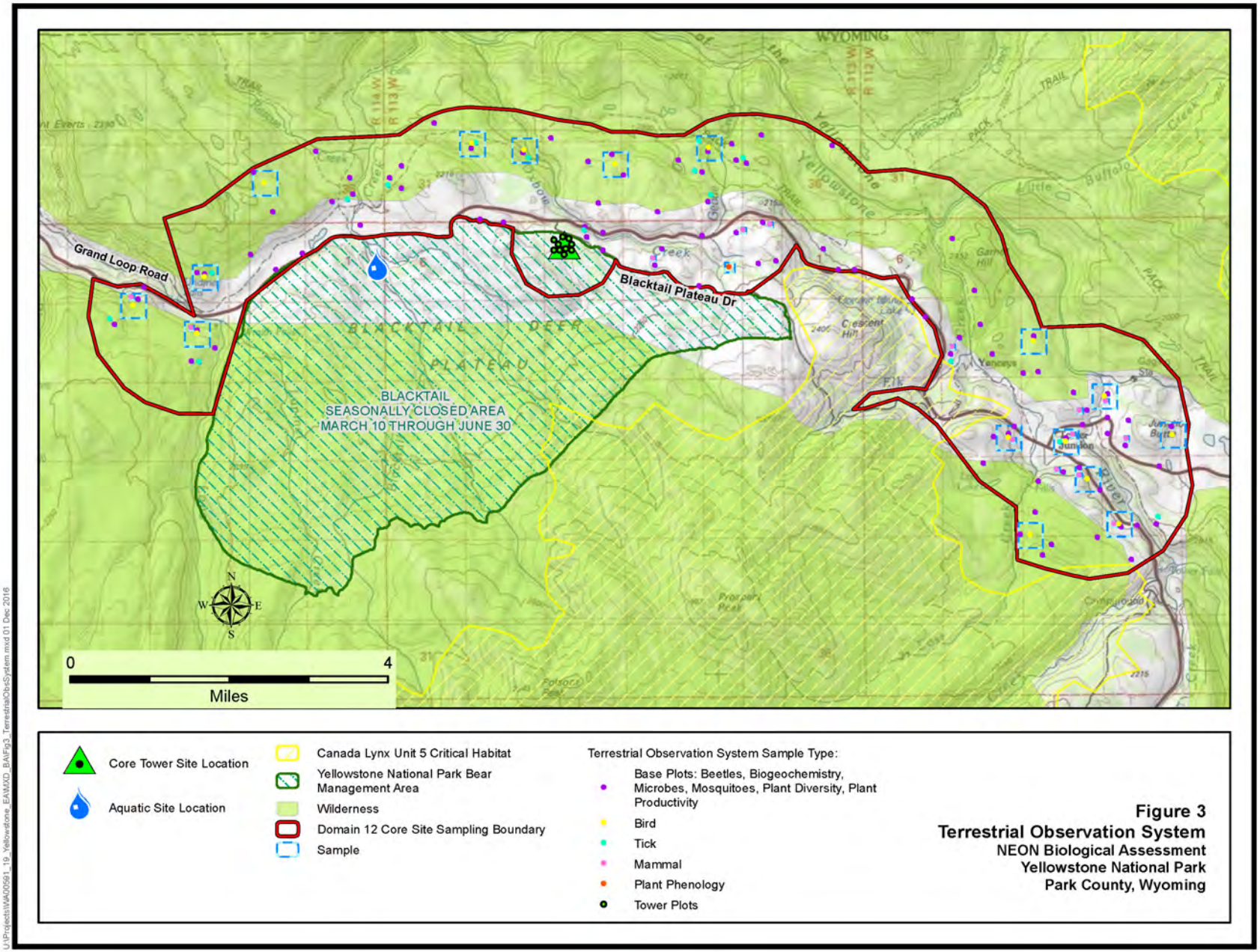


Figure 3
Terrestrial Observation System
NEON Biological Assessment
Yellowstone National Park
Park County, Wyoming

Table 4: Proposed Terrestrial Observations Schedule

Terrestrial Observations					
Item	**Approximate Sampling Dates (start-finish)**		**Frequency of Sampling Events**	**Approximate Number of Days per Sampling Event**	**Approximate Number of Technicians per Sampling Event**
Plot Establishment	Mar	Oct	Once at onset of study, minimal activity annually	14	6
Soil Biogeochemistry	Mar	Nov	1x every 6-10 years	5	2
Soil Microorganisms	Jan	Dec	3x per year	5	2
Plant Diversity	May	Aug	1x per year	28	6
Herbaceous Clip	May	Sept	1-2x per year	14	5
Litterfall	May	Nov	4-12x per year	2	2
Vegetation Structure	Sept	Feb	1x every 3 years	30	4
Belowground Biomass	May	Sept	1x every 3 years	5	2
Coarse Downed Wood	May	Sep	1x every 3 years	5	2
Foliar Biogeochemistry	June	Aug	1x every 3 years	10	2
Leaf Area Index	Apr	Oct	3 plots 12 to 20x per year; 20 Plots 1x per year	1	2
Plant Phenology	Apr	Oct	1 to 3x/week, annually	1	2
Ground Beetles	Apr	Sep	Every 2 weeks, annually	1	2
Mosquitoes	Mar	Nov	Every 2 weeks, annually	3	4
Small Mammal	Apr	Oct	6x per year	5	6

Table 4: Proposed Terrestrial Observations Schedule

Terrestrial Observations					
Item	**Approximate Sampling Dates (start-finish)**		**Frequency of Sampling Events**	**Approximate Number of Days per Sampling Event**	**Approximate Number of Technicians per Sampling Event**
Breeding Landbirds	Jun	Jul	1x per year	15	2
Ticks	Mar	Nov	Every 3 to 6 weeks, depending on tick detection, annually	1	2

NEON would target beetles, mosquitoes and ticks for invertebrate sampling. Ground beetle diversity and abundance would be sampled to capture variation throughout the seasons and from year to year. Shifts in ground beetle distribution and populations can indicate significant changes in the local ecological community. Beetles would be collected using 4 pitfall traps embedded in the ground at 10 plots (totaling 4 square feet). The traps are made from cups that are 2.7 inches in depth and 4.3 inches in diameter. The traps would use a diluted solution of non-toxic propylene glycol to preserve the samples for DNA analysis; this is non-toxic and odorless so as not to attract wildlife. The traps would be checked bi-weekly throughout the growing season (typically April through October) (Table 3). At the end of the sampling period, all trap equipment would be removed, and NEON personnel would backfill the holes in the field. Each pitfall trap is covered with a low clearance 7.9-inch x 7.9-inch hard plate cover (approximately 0.6 inches above the lip of the cup) to mitigate non-target species collection. The cover denies access to all but the smallest vertebrates; however, it is possible for very small amphibians, reptiles, and mammals to still enter the trap. As an added precaution, a threshold of 15 individuals per species, per plot, per season has been established. When 15 cumulative individuals of any given vertebrate species are captured at a single plot in one sampling season, mitigating measures based on the life history and ecology of that vertebrate species would be considered. Depending on the outcome of such an analysis, various mitigation measures may be employed and may result in actions such as small-scale temporary halts in sampling, relocations of sampling plots to alternative areas, or halts in sampling for the remainder of the season. Decisions regarding appropriate mitigation are reviewed by the Institutional Animal Care and Use Committee (IACUC) panel for the NEON project before implementation, as discussed below and in *Mitigation Measures*. NEON would seek authorization through a scientific collection application to cover the potential bycatch of small amphibians, reptiles, and mammals that may enter the pitfall traps. A copy of NEON's IACUC protocols, a list of possible bycatch species and estimated capture numbers would be available upon request.

Mosquitoes are sensitive to climate variation and they are important as disease vectors (e.g. West Nile virus and Dengue virus). Mosquitoes would be collected using carbon dioxide baited traps. These traps operate by slowly releasing carbon dioxide, mimicking the exhaled breath of an animal. The carbon dioxide attracts mosquitoes, which are drawn into the trap by a fan. Mosquito traps would be located in each of the major vegetation types. Traps would be set at ten plot locations for approximately 40 consecutive hours every other week during the field season (Table 3). During the off-season, a reduced number of traps (3) would be sampled weekly and only when temperatures exceed 39.2 degrees Fahrenheit (°F).

Small mammals and breeding landbirds are important components of virtually all ecosystems in North America. Sampling would provide consistent, comparable measures of species diversity, composition, abundance, and density, as they relate to climate, productivity, and insect abundance. For breeding landbirds, NEON would use the passive, observational point count sampling technique, with sampling occurring in the early morning within a five- to 20-day window in the breeding season (Table 3). Each sampling point would be observed for six minutes, once per year. In order to study small mammals and mammal-borne diseases, NEON would employ a mark-recapture approach following an approved IACUC sampling protocol, as discussed below and in *Mitigation Measures*. Sampling would

occur monthly at six Distributed Plots (grids) of 100 live-traps each. Each sampling period would consist of three nights of trapping at three of the grids and one night of trapping at the remaining three grids (Table 3). Sterilized sunflower seed and millet would be used to bait small mammal traps. Freeze-dried mealworms would also be added to the bait, if shrews comprise more than 20 percent of all captures (not expected).

NEON would comply with all applicable provisions of the Animal Welfare Act (Title 7 United States Code [U.S.C.] § 2131 et seq.) and the regulations promulgated there under by the Secretary of Agriculture (9 Code of Federal Regulations 1.1-4.11) pertaining to the humane care, handling, and treatment of live, vertebrate animals, as well as any other applicable federal statutes or regulations relating to the animals. NEON has prepared an Animal Welfare Assurance Plan that adheres to the "U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research and Training" and pledges to carry out its activities in accordance with several applicable guides. These include the most recent edition of the Guide for the Care and Use of Laboratory Animals published by the Institute of Laboratory Animals Research of the National Research Council, Guidelines of the American Society of Mammologists for the Use of Wild Long-term Mammals in Research, and Guidelines for the Use of Fishes in Research. NEON would acknowledge and accept responsibility for the care and use of animals involved in research activities and would make a reasonable effort to ensure that all individuals involved in the care and use of animals understand their individual and collective responsibilities for compliance with its Animal Welfare Assurance Plan and applicable laws, regulations and guidelines noted above. NEON's IACUC policies and procedures were heavily adapted from the National Park Service (NPS) IACUC, and the development of such included consultation with Dr. John A. Bryan II, the Chair and Attending Veterinarian of the NPS IACUC from 2009-2015. NEON's IACUC would be reviewed and approved annually to ensure the highest level of animal handling standards.

Ticks would be collected to improve understanding of how the presence of infectious agents (e.g. Lyme disease) changes over time within ecosystems. Ticks of all life stages would be collected March through November using a drag sampling method, pulling a 3.2-foot x 3.2-foot cloth across the ground. Sampling would occur at up to six different plot locations at each site. Sampling would occur once every three weeks or once every six weeks, depending on whether or not ticks have been detected at that site in the past year.

A one-time survey of soil physical and chemical properties would be investigated by conducting an initial soil characterization whereby up to 16 or fewer soil samples would be extracted from 10 to 20 plots within the TOS (Figure 3). Hand augers of approximately 4 inches in diameter would be used to extract the samples and examine the soils to a depth of approximately 3 feet or to bedrock, whichever is shallower.

Throughout operations, soil will be collected at 10 plots within the TOS area 3 times a year for the 30-year life of the project. Three samples per plot would be collected to a depth of up to 12 inches using a small (1-4") hand auger.

Table 4 provides a proposed schedule for terrestrial observations described above.

Airborne Operations

NEON's Airborne Observation Platform (AOP) would use small aircraft outfitted with remote sensing equipment (including a hyperspectral imager, LiDAR sensor, and high-resolution camera) to fly over sites annually (Kampe et al. 2010; Krause et al. 2013). Derived data products would provide high resolution (meter-scale) information on the structure and biogeochemical properties of vegetation. Data collected by the AOP would facilitate scaling up site-based data streams. The NEON AOP would fly, on average, 3,280 feet above ground level, once per year, at or close to the time of peak vegetation greenness. Ground activities include setting up calibration tarps, a solar radiometer, and a differential GPS base station and collection of the reflectance spectra of leaves in coordination with foliar sampling (AOP ground activities may not occur every year at every site).

3.5 Reclamation

Upon completion of NEON activities at the site or loss of funding, all infrastructure features would be removed including the tower, tower pad, instrument hut, instrument hut foundation, groundwater wells, and utility conduit. All areas would be returned to as natural a condition as possible. Any materials removed during these processes would be reused, recycled, or properly disposed. Disturbed ground would be stabilized with biodegradable materials and revegetated with species native to the area, appropriate for site-specific conditions, and in coordination with the Park. Compacted soils would be loosened and scarified, then seeded and/or planted with native seed, shrubs, and trees. If needed, topsoil appropriate for the area would be brought in and spread over the loosened soil prior to revegetation activities. The Park would require that all reclamation activities would be paid for by NEON. NEON

would conform to all NPS construction BMPs (provided in the following section) and provisions outlined in a land use agreement.

4. BASELINE CONDITIONS FOR LISTED SPECIES AND CRITICAL HABITAT IN THE ACTION AREA

Yellowstone National Park identified four species within the Park that have official status under the Endangered Species Act (ESA) and that are particular concern to the U.S. Fish and Wildlife Service (USFWS 2016) for consideration in context of the proposed NEON Project (Table 5).

Table 5: Listed Species and Critical Habitat in the Action Area

Species or Critical Habitat	ESA Status	Status in Project Area
Gray Wolf (*Canis lupus*)	Experimental population, nonessential (in all of Wyoming)	Core, year round territory for various wolf packs since 1996. There have been dens on Blacktail Plateau adjacent to the proposed NEON construction site since 1996
Grizzly Bear (*Ursus arctos horribilis*)	Threatened	Present in Domain and the Proposed NEON Project area which overlaps with a Bear Management Area
Canada lynx (*Lynx canadensis*)	Threatened	Generally rare in Park
Critical Habitat for Canada Lynx	Designated, See Figure 1	The proposed NEON site is almost entirely outside Canada lynx Critical Habitat

Note: Table Based on USFWS 2015.

4.1 Gray Wolf

Ecology

Gray wolves are native to the Greater Yellowstone Area (GYA). Historically hunted for their hides and as predators, they were eliminated from the ecosystem by the 1930s. The USFWS released an Environmental Impact Statement on wolf reintroduction in May 1994. In 1995 and 1996, 31 gray wolves from Canada were released in the Park, 14 wolves in 1995 and 17 wolves in 1996 (Phillips and Smith 1996).

Gray wolves are not restricted to specific habitat. Rather, they inhabit areas with plentiful prey, principally ungulates. Wolves spend almost their entire active life hunting or eating. Most of the active time is spent traveling in search of food (Armstrong et al. 2011).

Wolves in the Park primarily feed on elk, with bison comprising a minor portion of kills. Counts of elk spending winter in or near the Park have deceased about 80 percent since 1995 when wolves were initially reintroduced (Metz et al. 2012). Bison are larger than elk and employ group defenses that make them more difficult to kill (Smith et al. 2000). However, predation has become a larger factor for bison subsequent to the successful wolf and grizzly bear recovery efforts (Smith et al. 2004). Wolves tend to kill more bison during winters with deep and prolonged snow pack that render malnourished animals more numerous and vulnerable. Wolves also kill more bison as bison numbers increase relative to elk and there are more bison calves in the population. The effects of wolf predation on bison population growth are still relatively minor, although this could change in the future.

Conservation or restoration of top predators such as gray wolves is frequently promoted as critical to conservation of biotic communities and ecosystems. Wolves are important to maintaining species diversity and trophic structure of communities (Sergio et al. 2008). Wolves appear to have had a marked effect on altering distributions of elk in the Park, especially in the Lamar Valley, and may be driving a trophic cascade, affecting features of the ecosystem beyond the prey species itself, ranging from an increase in nesting songbirds to recovery of woody vegetation from heavy browsing (White et al. 1998, Smith 2005).

Wolf population and pack numbers have stabilized since 2008. At the end of 2016 (when the Park officially reports annual numbers to USFWS), there were approximately 108 wolves living in 11 packs in the Park (seven packs of which counted as breeding pairs) (D. Stahler, personal communication, 26 January 2017). In December of 2013 there were at least 95 wolves in 10 packs and one group (eight packs of which counted as breeding pairs, defined by a minimum of two adults traveling with two pups by year's end) living primarily in the Park. These numbers exceed the 83 wolves and six breeding pairs observed during December 2012, but are similar to the previous three years when about 100 wolves were counted. Wolf numbers in the park have decreased by about 50 percent since 2007. The decrease was less in the interior of the Park than in northern Yellowstone, probably because wolves in the interior supplement their diet with bison. At the population level, litter size and survival have decreased with increasing wolf population size and canine distemper outbreaks (Stahler et al. 2013).

At least one member of most packs is radio-collared, allowing NPS and USFWS personnel to monitor the movements of most packs. Throughout 2015 and into 2016, the territory of several wolf packs, including the 8-Mile, and Prospect Peak packs, overlapped on the Blacktail Deer Plateau and adjacent areas. The Prospect Peak pack currently dens during the spring and summer at a site on the Blacktail Deer Plateau.

Status and Distribution

On September 23, 2014, the Federal District Court for the District of Columbia vacated the delisting of wolves in Wyoming under the ESA. The effect of the decision is the reinstatement of federal protections that were in place prior to the 2012 delisting, and wolves are again listed as a nonessential experimental population in all of Wyoming. This action provides wolves with protection under the ESA, with defined exceptions for situations where there is injury to livestock or humans. In National Parks and wildlife refuges, nonessential experimental populations are treated as threatened species, and all provisions of Section 7 of the ESA apply (50 Code of Federal Regulations 17.83(b)).

The gray wolf is circumpolar in the Northern Hemisphere, and historically it had one of the largest geographic ranges of any mammalian species. Gray wolves formerly occupied most of western and central North America except for much of coastal California and the deserts of Baja California. Over much of their range in the United States, the animals were eradicated, to eliminate depredation of livestock.

Currently the Northern Rocky Mountain wolf population encompasses parts of Montana, Wyoming, Idaho, Washington, and Oregon. As of December 2015, there were at least 1,704 individuals in 282 packs in the Northern Rocky Mountain Distinct Population (USFWS et al. 2016). This population has exceeded its recovery goals since 2002. By every biological measure, the Northern Rocky Mountain wolf population is recovered and remains secure.

Long-term, the USFWS expects the entire Northern Rocky Mountain population to maintain a long-term average size of around 1,000 wolves. These wolves represent a 400-mile southern range extension of a vast contiguous wolf population that numbers over 12,000 wolves in western Canada and about 65,000 wolves across all of Canada and Alaska.

4.2 Grizzly Bear

The Park completed an Environmental Impact Statement for a grizzly bear management program specifically designed to recover the declining subpopulation of grizzly bears inhabiting the Park (NPS 1982).

Proposed NEON activities at and around the tower site overlap the Blacktail BMA. The Blacktail BMA is 12,336 acres and has a seasonal closure on human activity from March 10 to June 30; there are 8,722 acres of BMA 5 in the proposed NEON Domain site (Figure 1).

The purpose of BMAs is to reduce human impacts on bears in high-density grizzly bear habitat. Eliminating human activity in specific areas prevents human/bear conflicts and provides areas where bears can pursue natural behavioral patterns free from human disturbance. Restrictions on human activities include: seasonal area closures and trail closures, a minimum party size of four or more people, and travel limited to daylight hours or to established trails.

Management of grizzly bears in the Park has been successful in enabling grizzly bear recovery and reducing both bear-human conflicts (e.g., property damage, incidents of bears obtaining human food, bear-inflicted human injuries) and human-caused bear mortalities in the Park (Gunther 1994, Gunther and Hoekstra 1998, Gunther et al. 2000).

Ecology

Grizzly bears require large areas to secure food and shelter. Their home ranges average 50 to 500 square miles. Long distance movement increases the risk of contact with highway crossings, hunters, recreationists, and a variety of other human congregations.

Within these home ranges the grizzly bear uses a diverse mixture of forests, wet meadows, grasslands, and riparian habitats. Grizzly bears generally prefer large, remote areas of habitat for feeding, denning, and reproduction that are isolated from human development (USFWS 1993). They require dense forest cover for hiding and security. In the Yellowstone ecosystem, lodgepole pine (*Pinus contorta*) forests are a large and dynamic part of grizzly bear habitat.

The grizzly bear is an opportunistic omnivore that feeds on a wide variety of plants and animals. Grizzly bears in the GYA have the highest percentage – 30 to 70 percent – of meat consumption in their diet of any inland grizzly bear population (Hilderbrand et al. 1999). Meat in the grizzly bear's diet varies by season and available forage. Ungulates are an especially important food source for bears in the spring and fall (Knight et al. 1984), and consumption of these carcasses in the Park is well documented (Podruzny and Gunther 2001).

Grizzly bears also eat small mammals such as voles and pocket gophers; however, these mammals form a relatively minor portion of the bear's diet. Spawning cutthroat trout in streams surrounding Yellowstone Lake have been documented as an important food source for grizzly bears (Mattson and Reinhart 1995). However, non-native lake trout (*Salvelinus namaycush*) and whirling disease caused by an exotic parasite (*Myxobolus cerebralis*) have significantly reduced the native cutthroat trout population and associated bear fishing activity (Koel et al 2005a, 2006). Drought may also be contributing to the decline of the Yellowstone Lake cutthroat trout population (Koel et al 2005b). The army cutworm moths that congregate in alpine talus areas and feed on alpine flowers provide important dietary fat in the fall, when grizzly bears are preparing for hibernation, and are also positively correlated with bear reproductive success (Mattson et al. 1991, Bjornlie and Haroldson 2001). During times of great moth abundance, White et al. (1999, as cited in Robison et al. 2006) estimated a grizzly bear may eat up to 40,000 moths per day and more than one million per month, representing 47 percent of its annual caloric budget. Army cutworm moth congregation sites are in remote areas with reduced human-bear conflicts. Grizzly bears will also eat ants (Mattson 2001) and earthworms (Mattson et al. 2002).

The grizzly bear makes use of a variety of vegetation food sources. Whitebark pine seeds are an important fall source of food for grizzly bears (Mattson and Reinhart 1997). Bears consume whitebark pine seeds contained in red squirrel cone caches. Studies show that in years when the whitebark pine seed crop is low, there is an increase in human-bear conflicts (Haroldson et al. 2003). This is likely due to bears seeking alternative food sources, such as exotic clover species (Reinhart et al. 2001) and yampa (*Perideridia gairdneri*) that occur at lower elevations and closer to humans. In addition to supplying a food source high in fat, whitebark pine seeds also serve grizzly bears by keeping them occupied at high elevations far from intense human use. Other grizzly bear seasonal foliage use includes roots (Mattson 1997), graminoids, horsetail, forbs, and fruits (whortleberry and huckleberry) (Knight et al. 1984, Mattson et al. 1991). Bears also eat mushrooms, especially during years when whitebark pine cone production is poor.

In 2012, the Interagency Grizzly Bear Study Team estimated the total GYA population to be 610 bears, although different statistical methods suggest there may be as many as 718 bears in the GYA (Haroldson and Frey 2013). In 2014, the grizzly bear population in the GYA was estimated to range between 674 and 839 (IGBST 2015). Intensive management has resulted in the GYA population increasing at a rate of 4 to 7 percent per year since the early 1990s. Schwartz et al. (2006) concluded that grizzly bears are probably approaching carrying capacity inside the Park. Their conclusion resulted from the analysis of survivorship of cubs and yearlings, and of independent bears.

Status and Distribution

Historically, the grizzly bear ranged from the Great Plains to the Pacific Coast and from the northern United States border with Canada to the southern border with Mexico. Currently in the contiguous United States, the grizzly population has been reduced to roughly 2 percent of its former range. It currently only occupies portions of British Columbia and Alberta, Canada and portions of Montana, Idaho, Wyoming, Washington, and Alaska.

The grizzly bear was listed as threatened in the lower 48 states in 1975 [70 Federal Register (FR) 69858] due to concerns about the bear's population status throughout its remaining range. The Yellowstone area population had been reduced to 229 to 312 individuals (Knight and Eberhardt 1985). The first grizzly bear recovery plan in 1982 identified five ecosystems thought to support the species within the conterminous United States, including the GYA. The Yellowstone grizzly bear population is discrete from other grizzly populations, has markedly different genetic characteristics, and exists in a unique ecological setting where bears feed primarily on terrestrial mammals (Mattson 1997, 70 FR 69865).

The population fluctuated but tended to increase through time. In 1996, Eberhardt and Knight (1996) estimated the GYA population to consist of 245 – 390 individuals. The Interagency Conservation Strategy team estimated the population size to be 365 grizzly bears in the GYA in 2001. In 2012 estimates ranged 610-718 bears (Haroldson and Frey 2013), and 2014 estimates put numbers between 674 and 839 individuals (IGBST 2015). Intensive management and habitat improvement resulted in the GYA population increasing at a rate of 4 to 7 percent per year since the early 1990s.

In response to the trend, the USFWS proposed to delist the grizzly from the ESA on November 17, 2005 (70 FR 69854) and to manage the species by establishing a Distinct Population Segment (DPS) of the grizzly bear for the GYA. As part of this proposal, grizzly bear habitat security in the Primary Conservation Area encompassing the GYA (USFWS 1993) would be achieved by managing motorized access which: (1) minimizes human interaction and reduces potential grizzly bear mortality risk, (2) minimizes displacement from important habitat, (3) minimizes habituation to humans, and (4) provides habitat where energetic requirements can be met with limited disturbance from humans (70 FR 69867). To prevent habitat fragmentation and degradation, the number and levels of secure habitat, road densities, developed sites, and livestock allotments would not be allowed to deviate from 1998 baseline measures (70 FR 69882). A ruling to delist the grizzly bear became effective April 30, 2007, but a 2009 order enjoined and vacated the delisting of the GYA grizzly population. In 2016, with population numbers persisting over 700 individuals, the USFWS again proposed that the grizzly be delisted.

The range of the grizzly bears in GYA has increased dramatically, as evidenced by the greater than 50 percent increase in occupied habitat since the 1970s (Schwartz et al. 2006, Bjornlie et al. 2014). The most recent estimate of the known area occupied by grizzly bears in the GYA is approximately 19,413 square miles (mi^2), an increase of 6,125 mi^2 from 13,288 mi^2 reported in the year 2000. The increase in distribution likely reflects bears continuing to expand into suitable but unoccupied habitats on the edge of their current distribution, as well as increased sampling. Because of the methods used to determine known area occupied, occupancy beyond this perimeter cannot be ruled out.

4.3 Canada Lynx

Ecology

Lynx habitat is described as boreal forests that have cold winters with deep snow and support a snowshoe hare prey base. Primary lynx habitat is lodgepole pine, subalpine fir and Engelmann spruce. Other vegetation types, when interspersed within subalpine forests, may also contribute to lynx habitat, including cool, moist Douglas fir and aspen forests. Lynx need mature forest with a dense understory cover of large woody debris and saplings for denning (Claar et al. 1999). Mature conifer forest with thick deadfall provides denning sites, security, and thermal cover for kittens. Smaller stature, early succession forests are required for hunting (Koehler and Brittell 1990), although denning habitat with dead and down material and structural layers composed of seedlings and saplings also provides foraging habitat. In general, habitats that favor snowshoe hare will provide optimal foraging habitat.

Lynx are a prey specialist, largely dependent on snowshoe hares, and usually occur in the habitats where snowshoe hares are most abundant (Claar et al. 1999). Lynx are adapted to survival in deep soft snow regions, such as the higher elevations in the northern Rocky Mountains. Physical adaptations to deep snow give lynx a competitive advantage over other predators, including the coyote, bobcat, and mountain lion. Outside of regions with deep snow, these generalist predators are believed to exclude lynx through effective competition for food resources.

Data on lynx-human encounters suggest that lynx are generally tolerant of continued human presence, human scent, disturbance, and agricultural or housing development (Brand and Keith 1979, Fortin and Huot 1995, Staples 1995, Aubry et al. 1999). Apps (1999) reported that lynx in the southern parts of their range, including the lower 48 states, are generally more sensitive to road fragmentation of habitat, which causes relative scarcity of ideal habitat and reduced prey availability compared to that available to lynx in the boreal forests of Canada and Alaska.

Observations in Washington found that U.S. Forest Service logging roads that were little used in the summer but frequently used by snowmobiles in the winter, and roads less than 15 meters wide, did not appear to affect lynx movements or habitat use (Koehler and Brittel 1990, McKelvey et al. 1999). While little-used roads do not appear to affect lynx, research in the southern Canadian Rockies indicates that wider, more heavily used paved roads may influence lynx spatial organization, and lynx appear to avoid crossing highways (Apps 1999). Thus, lynx movements in the lower 48 states may be restricted by roads and highways due to direct avoidance of larger roads and significant habitat alteration and fragmentation. Ruediger (1996 unpublished report) found that traffic volumes were also a factor. Traffic volume that exceeded 2,000 to 3,000 vehicles a day impacted lynx behavior.

Status and Distribution

Based on declining populations and continuing threats from logging, recreation and development to their remaining habitat, Canada lynx were listed as threatened in the lower 48 states in March 2000 (65 FR 16052). South of the Canadian border, lynx are listed in 14 states that support boreal forest types and have verified records of lynx occurrence: Colorado, Idaho, Maine, Michigan, Minnesota, Montana, New Hampshire, New York, Oregon, Utah, Vermont, Washington, Wisconsin, and Wyoming.

The USFWS announced January 13, 2015 that it will be conducting a Five-Year Status Review under the ESA for the contiguous United States DPS of the Canada lynx. The Five-Year Status Review will clarify the extent, magnitude, and nature of the threats to the lynx DPS so that recovery planning may target those specific threats.

Canada lynx once ranged throughout the boreal forests of North America from Alaska to Canada and into the northern United States. Evidence of lynx in the Park comes from three primary sources including about 216 winter tracking surveys (conducted during winters of 2001 to 2004 and covering 1,043 total miles); 118 lynx hair-snare transects deployed Park-wide during the summers of 2001 to 2004; and from historic sightings. The hair-snare survey found DNA and track evidence for three lynx, a female and two kittens, all east of Yellowstone Lake (Murphy et al. 2005, Murphy et al. 2006). This area also contained the highest indices of abundance for snowshoe hare and red squirrel, which form a large percentage of lynx diets (Koehler and Aubry 1994, Sunquist and Sunquist 2002). The authors note that lynx in other areas of the Park could have escaped detection, but they believe that lynx are primarily found in the east sector of the Park. Lynx are also occasionally sighted in other areas of the Park. Lynx were spotted at Indian Creek (just south of Mammoth) and in the Beryl Springs area (between Norris and Madison). Park-wide, only four lynx sightings have been reported by visitors in the last 10 years. Population numbers are unknown.

4.4 Canada Lynx Critical Habitat

The USFWS designated Critical Habitat for lynx on February 27, 2009, with a revision September 25, 2013. Five lynx critical habitat units were selected in the United States that provide adequate habitat elements for lynx. Lynx Critical Habitat Unit 5 falls partially within the GYA and is slightly over 6 million acres. Approximately 927,000 acres of this unit are within the Park. Unit 5 overlaps the southeastern edge of the proposed NEON Domain site (Figure 1).

4.5 Other Species to Consider

Nesting birds occur in the proposed NEON site boundary, and are protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. Golden eagles, red-tailed hawks, and prairie falcons are known to nest in the area. However, details on their natural history relative to the NEON site are not known (number of nesting pairs, etc.).

5. BEST MANAGEMENT PRACTICES, MITIGATIONS, AND CONSERVATION MEASURES

A number of BMPs, mitigations, and SOPs would be integrated into design, construction, operations, and reclamation of the site to minimize the degree and/or severity of adverse effects. They are listed by topic category.

Additionally, conservation measures designed to reduce the chances of grizzly-human conflicts including property damages; incidents of bears obtaining anthropogenic foods; bear-inflicted human injuries; and the bear management

hazings, translocations, or removals resulting from these conflicts are implemented to mitigate the impacts of NEON in Yellowstone National Park.

Park Operations, including Health and Safety

1. Construction and operation protocols would adhere to NEON's Operations Field Safety and Security Plan (NEON EA) and include language stating that all personnel would avoid contact with wildlife to ensure a safe, clear distance. In consultation with Park staff, appropriate interpretive signage would also be installed in and around the site to increase awareness of research activities taking place and restrictions, as applicable.
2. The Park would require NEON to follow protocol outlined in a Field Safety and Security Plan, to identify hazards and potential hazards that exceed the safety standard requirements of the Occupational Safety and Health Administration and the Neon's Site Specific Environment/Health/Safety Policy and Program Manual.
3. As requested by the Park, NEON personnel would communicate daily field sampling activities to the Park.
4. Car- and/or van-pooling would be implemented to minimize the number of vehicles travelling within and to/from the Park.
5. The Park would require all NEON employees and contractors be housed outside of the Park.
6. Long-term use of plot markers would be based on site conditions and Park preferences and recommendations. Potential markers could include aluminum stakes, PVC stakes, wooden stakes, or buried magnetic markers.
7. The Park would require NEON to avoid entry into the BMA (Figure 1) when restrictions are in place; however, in situations where a work-around is not feasible, exceptions to the restriction would be considered. As this area is close to the road, entry may be granted for a short-duration, upon coordination with the Park.
8. NPS fire response or defense of infrastructure or instrumentation in the event of a wildland fire would not be required as NEON's objective is to monitor natural occurrences at wildland sites. This would alleviate potential increased workloads on wildland fire crews, unless NPS determined human life or other health and safety concerns superseded this protocol.
9. All research conducted in the Park is vetted through the Park's Research Permit Office (RPO). All additional research requests associated with the proposed NEON site would be submitted through the RPO for proper approvals and permits prior to conducting work. Information is available at: http://www.nps.gov/yell/naturescience/howtoapply.htm.
10. In addition to obtaining a research permit, the Park would require NEON to follow all research permit conditions and provide the necessary information to the Park so that proper review could be conducted. The Park may require a separate land use agreement that would articulate the responsibilities of each party for the duration of the project.
11. The Park would require NEON to obtain all permits and/or agreements with NPS prior to the commencement of construction.

Topography, Vegetation, Water Resources, Geology, and Soils

1. Standard BMPs would be applied during construction of the tower and associated infrastructure to prevent soil erosion and sedimentation of creeks and streams, including implementation of an erosion, sedimentation, and pollution control plan, silt fencing, retention areas, energy dissipaters, slope breaks, conservation of top soil, and use of geotextile blankets or jute mesh on slopes.
2. The Park would require that Park geologists be contacted and drilling stopped if water temperatures of 50 °F or greater are encountered at depths greater than 5 feet with regard to the ground water monitoring wells at the proposed aquatic site.
3. The proposed parking area would occur within already disturbed areas of the Frog Rock Pit/Construction Staging Area; therefore, no new ground disturbance for parking would occur.

4. No off-road travel during construction or decommissioning phases would be allowed by vehicles without prior approval by Park personnel.
5. An unimproved footpath would be utilized to access the tower, instrument hut, and soil sampling array. Unimproved footpath widened during construction would be restored to a width of 18 inches during operations.
6. The Park would require temporary surface disturbance created during construction be revegetated with local, native, weed-free seed mix upon completion of construction related activities.
7. In an effort to combat the introduction of weeds during construction, crews monitored by NEON and the Park would "peel back" existing topsoil and vegetation. To the extent possible this material would be saved and replaced as part of rehabilitation efforts after construction activities are completed. At the discretion of the Park, NPS crews may be employed to re-seed or supervise re-seeding efforts by NEON staff or contractors prior to winter months with native seed gathered onsite or from adjacent sites; mulch may also be required. NEON would monitor revegetation activities during operations and coordinate any further efforts necessary with Park staff.
8. Some social trails would likely develop from accessing TOS plots and aquatic monitoring equipment. To minimize the potential creation of such trails, NEON personnel would tread lightly and avoid repeated travel by the same routes when implementing protocols where designated footpaths do not exist.
9. Approximately three trees would need to be removed in order to create the required cleared space for the DFIR near the tower site. Tree cutting selection would be conducted in coordination with the Park.
10. All equipment ground-disturbing activities required for construction would be required to be clean (i.e., free of mud, dirt, and other debris that could contain or hold seeds) prior to entering the Park.
11. Where soil is removed as part of the TOS collection, soil in and around the resulting 1-4" hole would be lightly compressed at the surface allowing the holes to refill with native material. Due to the freeze/thaw cycle in the Park, it is anticipated that only a small depression would remain after one to two seasons.
12. Certified seed-free mulch as well as certified weed free gravel, rock, and soil backfill material would be used to minimize the potential spread of exotic or invasive plant species following construction.
13. The Park would require NEON provide prompt control of invasive exotic species that become established on areas disturbed during construction. NEON would be required to work with the Park Weed Coordinator and adhere to the Invasive Vegetation Management Plan (2013). NEON would incur the costs associated with these activities.
14. If noxious weeds are found in the proposed project areas, the Park weed coordinator, in consultation with NEON personnel, would determine whether weed treatment is needed prior to construction or during subsequent operation of the facility.
15. Aquatic sampling of benthic invertebrates, aquatic plant, and algae would not be conducted directly following stream flooding when flow rate exceeds channel capacity.
16. NEON personnel would install groundwater wells using a small track mounted drilling rig, taking care to avoid Blacktail Creek. Additionally, the meteorological station would be mounted on a tripod and would be set away from the stream.
17. The in-stream sensors at the aquatic site would be placed within the creek bed by hand to minimize stirring up sediment in the creek bed.
18. The Park would require NEON to take full responsibility for reclamation and restoration activities, even if funding should be lost at some point in the future, to return the sites to pre-existing conditions.
19. Upon decommissioning, the Park would require NEON to remove all infrastructure. Reclamation and revegetation of the site would be accomplished with native species. A bond may be required to ensure this work prior to construction.

Wildlife Resources

1. No trees with active bird nests would be removed during bird breeding season (season dates to be defined by Park personnel). If construction is scheduled to occur during bird nesting periods, in compliance with the Migratory Bird Treaty Act, any trees to be removed would be first checked to guarantee they do not contain active bird nests. Likewise, the ground surface would be checked for ground-nesting bird nests prior to initiation of ground-disturbing activities. Should an active nest be located in trees or on the ground, Park personnel would be consulted as to how to proceed.
2. Utility conduit would be installed in accordance with Park guidelines and recommendations to reduce ground disturbance and deter wildlife interactions. Conduit would be buried where trenching would result in minimal resource damage and revegetation would be successful. Conduit would be anchored to the ground when not buried (e.g. rocky areas with near-surface bedrock).
3. Structures to deter nesting and perching would be installed on the tower to discourage nesting raptors. The landscape within 0.5 miles of the proposed tower would be inventoried for raptor nests in coordination with the Park. Construction would be timed and/or conducted to mitigate potential disturbance or destruction of any active raptor nests (January 1 to August 31) within a 0.25-mile radius (for hawks), a 0.50-mile radius (for eagles), and any migratory bird nests within the immediate vicinity (May 15 to August 1).
4. If construction activities are initiated during avian nesting times, sweeps for nesting birds would be conducted within 72 hours of construction. If any are located, those areas would be avoided or construction delayed until songbirds fledge. Monitoring of active nests and noise mitigation would be employed as necessary in coordination with the Park as to not disturb nesting eagles or raptors.
5. NEON would be required to work closely with the IACUC office to remain in compliance with collections, archives, and animal-handling standards for the duration of the project based on approved protocols. NEON has already coordinated with IACUC for all sites located in National Parks (i.e., Yellowstone, and Great Smoky Mountains National Parks), and would need to obtain approval from both the IACUC and NPS (Yellowstone National Park).
6. Since 1996 gray wolves have traditionally denned on Blacktail Plateau adjacent to the proposed NEON construction site. Should an active den be located within a range of possible disturbance (as determined by Park staff), Park personnel would be consulted as to how to proceed. Plots within the BMA (Figure 1) in the vicinity of the tower would not be sampled when closures and/or restrictions are in place (March 10 through June 30 closure for Blacktail Deer Plateau, Figure 1), to provide protection for wolf packs that may have established dens during that period.
7. The Park would require that plots not be visited if special status species are currently using the immediate area or if other wildlife related issues arise as they could be impacted by the presence of humans in the area.
8. The Park would require NEON to avoid entry into the BMA (Figure 1) when closures and/or restrictions are in place (March 10 through June 30 closure for the Blacktail Management Area); however, in situations where a work-around is not feasible, exceptions to the restriction would be considered by the Park. As this area is close to the road, entry may be granted for a short-duration, upon coordination and approval from the Park.
9. The Park would require NEON to contact the Park's RPO prior to each sampling season for designation and visiting of observation/sampling plots distributed outside of the BMA to discuss any potential issues with sensitive species or wildlife in general.
10. The Park would require NEON to re-evaluate sampling methodology and protocols or employ adaptive management techniques in coordination with the Park if unanticipated interactions with wildlife occur.
11. The Park would require NEON to adhere to the principles and practices of bear safety and education, proper food storage, and sanitation at the NEON facility and while conducting field work in the action area. Such principles and practices include: bear awareness education to all staff and contractors about the causes of bear-human conflicts and how humans can modify their behavior to prevent conflicts from occurring; all garbage cans and dumpsters at the NEON facility are constructed of a bear-proof design; regulations prohibiting people from feeding bears are strictly enforced; maintain and enforce current park speed limits;

and adhere to temporary closures of backcountry trails and survey sites in the action area when warranted by the presence of concentrated bear and wolf activity or large ungulate carcasses that are a known carnivore attractant.

Visual Resources/Visitor Experience

1. The small parking lot just off of Grand Loop Road would be located in an administrative area not open to the public. No camping or recreational vehicles are allowed in this area. The area would be signed to state: No Camping, No Recreational Vehicles Allowed, per NPS review and approval.
2. The Park would require the tower and instrument hut surface be painted to minimize potential visual contrast.
3. The electrical conduits would be either installed above ground or buried depending upon site and subsurface conditions in order to minimize impacts at the direction of Park management and site conditions.

Wilderness

1. Aquatic sensors and groundwater wells would be located outside of the Recommended Wilderness.
2. Sampling would be scheduled to minimize the number of trips to the site.
3. No material would be left at the AOS or TOS plots aside from the plot markers (previously described), beetle cups, mosquito traps, mammal traps on nights they are out, tree tags, and litter traps.
4. The Park would require NEON to develop a protocol and site-specific plan that specifies actions to minimize trailing and trampling at sites prior to construction and operations.

6. EFFECTS OF THE ACTION AND DETERMINATIONS

This section analyzes direct, indirect, and cumulative impacts of the proposed action. Direct effects result directly or immediately from the proposed action on the species. Indirect effects are effects that are caused by, or result from, the proposed action and occur later in time (after the proposed action is completed), or at a distance from the proposed action area. Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Cumulative impacts are the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions. There are no state, tribal, local, or private inholdings within the Park boundary; therefore, there are no additional non-federal actions likely to occur within the Park. Foreseeable future actions may include increases in Park visitation and associated effects from vehicles, roads and recreational use, as well as road reconstruction and maintenance, fuels reduction projects, and management of other wildlife species.

6.1 Gray Wolf

Direct and Indirect Effects

Wolf packs have denned on Blacktail Plateau since 1996. Potential effects from the proposed action are: (1) disturbance of denning females and young offspring between April 1 and June 31 when pups are most vulnerable; (2) in rare circumstances, death from the management removal of wolves that become conditioned to human foods; (3) potential changes in the quality of habitat due to NEON infrastructure; (4) potential small changes in food availability due to possible displacement from human activity; (5) short term temporary displacement from habitat from human activity at sampling sites and infrastructure; and (6) minor changes in the frequency of human-wolf encounters with staff conducting sampling activities on Blacktail Plateau. The timing of the BMA restrictions and closures as well as many of the BMPs will mitigate impacts to breeding and denning wolves as well.

Cumulative Effects

This proposed NEON project is entirely within the Park. There are no private inholdings within the boundaries of the Park. Therefore, there are no state, tribal, local, or private actions likely to occur within the action area Domain. State managed hunting of wolves north of the project area outside the park could remove individuals from packs whose territory use includes the project area, but small hunting quotas are set to minimize significant population level impacts to YNP's wolf population. Hazing efforts are carried out by Park personnel to discourage wildlife (e.g., bears, wolves, and coyotes) from becoming habituated or posing a safety risk to humans.

Determination

With appropriate mitigation, including honoring of the seasonal restrictions and closures in the BMA, NPS has determined that the action **may affect, but is not likely to adversely affect the gray wolf**.

6.2 Grizzly Bear

The primary concerns for grizzly bears are associated with recreational activities, and they are the same as those with developed sites: displacement, direct mortality from bear/human encounters and habituation of bears to humans (Joslin and Youmans 1999, White et al. 1999, USFWS 2002). Snowmobiling is restricted to existing roads used by cars in summer.

There were 55 known and probable mortalities in the GYA during 2012; 34 were attributable to human causes. None of the human-caused mortalities occurred inside of the Park. Due to current bear management practices, there have been relatively few human-caused grizzly bear mortalities inside of the Park over the last 30 or so years despite both increasing human visitation and an increasing grizzly bear population.

The Park is committed to keeping human-caused grizzly bear mortality as low as possible. Grizzly bear-human conflicts often lead to human-caused bear mortality. Preventing bears from obtaining anthropogenic foods is the foundation of the NPS's strategy for reducing grizzly bear-human conflicts. This is accomplished through education of Park visitors, including contractors, use of bear-proof food and garbage storage facilities, and strict enforcement of bear-related food and garbage storage regulations. The grizzly bear management program currently being implemented by the Park has been highly effective at minimizing bear-human conflicts and human-caused bear mortality.

Direct and Indirect Effects

Human developed sites such as the NEON project could impact bears through temporary or permanent habitat loss and displacement, unsecured bear attractants, and disturbance due to human presence, noise, and smell. The primary concerns for grizzly bears with respect to developed sites are habituation of bears to humans and food conditioning (Mattson et al. 1987). These bear/human encounters frequently lead to bear mortality. Habituation occurs when grizzly bears encounter humans or developed sites frequently and without negative consequences such that the bears no longer avoid humans and areas of human activity (USFWS 1993). Food conditioning occurs when grizzly bears receive human-related sources of food and thereafter seek out humans and human use areas as feeding sites (USFWS 1993). Gunther (1994) noted that grizzly bear management in the Park has shifted from problems involving food-conditioned bears to problems involving habituated (but not food-conditioned) bears seeking natural foods near developed sites or along roadsides.

The Domain proposed NEON site overlaps the Blacktail BMA (Figure 1). The NEON site would coincide with 4.5 percent (566 acres) of the Blacktail BMA (12,336 acres). The actual impact footprint represents a very small proportion of the BMA near Grand Loop Road. The effect of habitat loss is negligible from loss of habitat or changes to the quality of habitat.

The potential effects to grizzly bears from the proposed action area are: (1) in rare circumstances, death from the management removal of bears that become conditioned to human foods; (2) changes in habitat quality due to soil compaction and introduction of exotic plant species in areas around the site; (3) short term temporary displacement from habitat; and (4) minor changes in the frequency of human-grizzly encounters. With implementation of the listed BMPs the potential for a grizzly-human conflict is reduced but the potential still exists.

Cumulative Effects

As stated above, this project is entirely within the Park. There are no private inholdings within the boundaries of the Park, therefore there are no state, tribal, local, or private actions likely to occur within the action area.

Park visitation remains one of the major factors affecting the grizzly bear in the action area. Based on current recreation and human population growth trends, the number of people recreating in grizzly bear habitat is expected to increase (USFS 2006, Cordell et al. 2008, NPA Data Services 2009, USFS 2009). In 2015, the Park recorded a record 4.1 million visitors. Average annual recreational visitation has increased each decade from an average of 7,378 visitors per year during the late 1890s to 3,300,000 visitors/year in the 2000s. The decade 2000 to 2009 was the first in history of the Park that visitation did not increase from the previous decade. Average annual backcountry user nights have remained fairly static since the 1970s, ranging from 39,280 to 45,615 user nights. In addition to the potential increase in human-grizzly interactions, vehicle traffic may affect grizzly bears directly (injury or death) or indirectly by altering behavior (displacement and avoidance).

Ongoing administrative activities such as road reconstruction and maintenance, backcountry operations, hazing activities, and facilities maintenance would continue to have adverse effects on grizzly bears. These activities would cause temporary displacement from disturbance, and feeding and resting behavior may be interrupted. Most facilities maintenance would take place in developed areas, but effects beyond developed areas could occur from noise and human presence. Park visitation is expected to increase each year as a result of population growth in nearby communities and elsewhere. Recreational use such as fishing, camping, and hiking would continue Park wide and could result in adverse effects to grizzly bears.

Fuels reduction projects typically focus around developed areas and facilities. Reduction of fuels, through mechanical or controlled burns, may temporarily displace bears or eliminate some habitat. However, many of these areas are already managed to reduce grizzly bear occurrences and bears are often hazed, particularly from the highly developed and high human use areas.

Determination

With appropriate mitigation, including honoring of the seasonal restrictions and closures in the BMA and implementation of all project BMPs, NPS has determined that the action **may affect, but is not likely to adversely affect the grizzly bear**.

6.3 Canada Lynx and Canada Lynx Critical Habitat

Direct and Indirect Effects

Winter recreational activities have the greatest effect on lynx habitat (USFWS 2009). As stated in the 2009 Environmental Assessment for designation of lynx Critical Habitat: “Recreational facilities designed for summer use have very little effect on lynx” (Ruediger et al. 2000, p. 2-9). No effects to Canada lynx as a consequence of the proposed action are anticipated based on the limited detection of lynx in the Park during formal and informal surveys (Murphy et al. 2006); limited sightings of lynx by Park visitors and employees throughout the history of the Park (Yellowstone National Park unpublished data); and habitat limitations as most of the central and southwestern portions of the Park being depauperate of snowshoe hare the lynx’s primary prey (Murphy et al. 2006). It is doubtful that lynx make use of the proposed NEON Domain project site at all.

The proposed action would not affect a measurable amount of the Critical Habitat in Unit 5, nor affect the function of the Critical Habitat unit and the Primary Constituent Elements (i.e., snowshoe hare and denning habitats, and matrix conditions).

Cumulative Effects

This project is entirely within the Park and land outside of the park immediately adjacent to the project is U.S. Forest Service lands. There are no private in holdings within the boundaries of the Park. Therefore, there are no state, tribal, local, or private actions likely to occur within the action area.

Determination

NPS has determined that the proposed project activities would have **no effect** on Canada lynx or their designated critical habitat.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

MAR 2 7 2017

In Reply Refer To:
06E13000-2017-I-0187

Memorandum

To: Superintendent, National Park Service, Yellowstone National Park, Wyoming

From: for Field Supervisor, U.S. Fish and Wildlife Service, Wyoming Field Office, Cheyenne, Wyoming

Subject: National Ecological Observatory Network-Domain 12 Project

Thank you for your letter of February 24, 2017, received in our office on February 28, regarding the proposed National Ecological Observatory Network-Domain 12 (Project). The Project will create an ecological research and monitoring site on Blacktail Deer Plateau, which will involve the installation of infrastructure including a tower, soil sample plots, an instrument hut, and aquatic monitoring equipment. Data will be collected on biogeochemical cycles, infectious diseases, and a suite of local taxa to characterize patterns, dynamics, and linkages in terrestrial ecosystems over a 30-year period. There will be 5,833 square feet (0.13 acre) of surface disturbance from the tower site infrastructure and 3, 082 square feet (0.07 acre) of surface disturbance from the aquatic site infrastructure. Construction of these sites will take approximately four to six months beginning no earlier than July or August of 2017. Sampling will occur year round due to the diversity of sampling needed for this Project, with between two to six technicians conducting the sampling at any given time.

We are writing in response to your inquiry related to species listed under the Endangered Species Act (ESA; 16 U.S.C. 1531 *et seq.*), species of special concern, or migratory birds. We have indicated the response we believe best meets your request using the checkboxes below.

☐ You requested a list of endangered, threatened, proposed, and/or candidate species, and designated or proposed critical habitat that may occur in the area of your Project. In an effort to expedite information sharing, we created an Information, Planning, and Conservation System (IPAC), available on-line at http://ecos.fws.gov/ipac/. IPAC can be used to identify any potential federally listed species or critical habitat in your Project area by using the "Initial Project Scoping" tool. For species identified by IPAC, you should review the recommendations and measures at http://www.fws.gov/wyominges/species_endangered.php.

☒ Based on information from your request, our understanding of the nature of the project, local conditions, and current information on federally listed species:

- ☐ We have not identified any issues relative to species or critical habitat listed under the ESA.
- ☒ The ESA does not require the U.S. Fish and Wildlife Service to concur with "no effect" determinations; however, we appreciate receiving the information used to support your conclusion.
- ☒ We concur with your "may affect, not likely to adversely affect" determination for federally listed species and designated critical habitat.
- ☒ Your Project should be re-analyzed if Project plans change, if new information on the distribution of listed or proposed species or critical habitat becomes available, or if new information reveals effects to listed or proposed species or critical habitat not previously considered.

☒ Based on information from your request, we also recommend you:

- ☒ Review your Project relative to your responsibilities under the Migratory Bird Treaty Act (see http://www.fws.gov/mountain-prairie/es/wyoming/species_Migratory.php).
- ☐ Review Avian Power Line Interaction Committee (APLIC) guidelines to avoid and minimize electrocutions and collisions (see http://www.aplic.org).
- ☐ Review your Project relative to guidelines regarding cell towers (see. http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html).
- ☐ Review your Project relative to responsibilities for wetland protection (see http://www.fws.gov/wyominges/landscapeConservation.php).
- ☐ Contact the Wyoming Game and Fish Department for measures to minimize impacts to greater sage-grouse (see http://www.fws.gov/wyominges/Species/GRSG.php).
- ☐ Take steps to conserve and protect Species of Greatest Conservation Need (see http://www.fws.gov/mountain-prairie/es/wyoming/species_concern.php).

We appreciate your efforts to conserve endangered, threatened, and candidate species and migratory birds. If you have any questions regarding this letter or your responsibilities under the ESA or other authorities, please contact Lisa Solberg Schwab of my office at the letterhead address or phone (307) 367-5340.

cc: NPS, Wildlife Biologist, Mammoth, WY (D. Stahler) (dan_stahler@nps.gov)
WGFD, Statewide Nongame Bird and Mammal Program Supervisor, Lander, WY (Z. Walker) (zack.walker@wyo.gov)
WGFD, Statewide Habitat Protection Coordinator, Cheyenne, WY (M. Flanderka) (mary.flanderka@wyo.gov)
WGFD, Habitat Protection Secretary, Cheyenne, WY (N. Stange) (nancy.stange@wyo.gov)

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Appendix 8
Map of Recommended Wilderness

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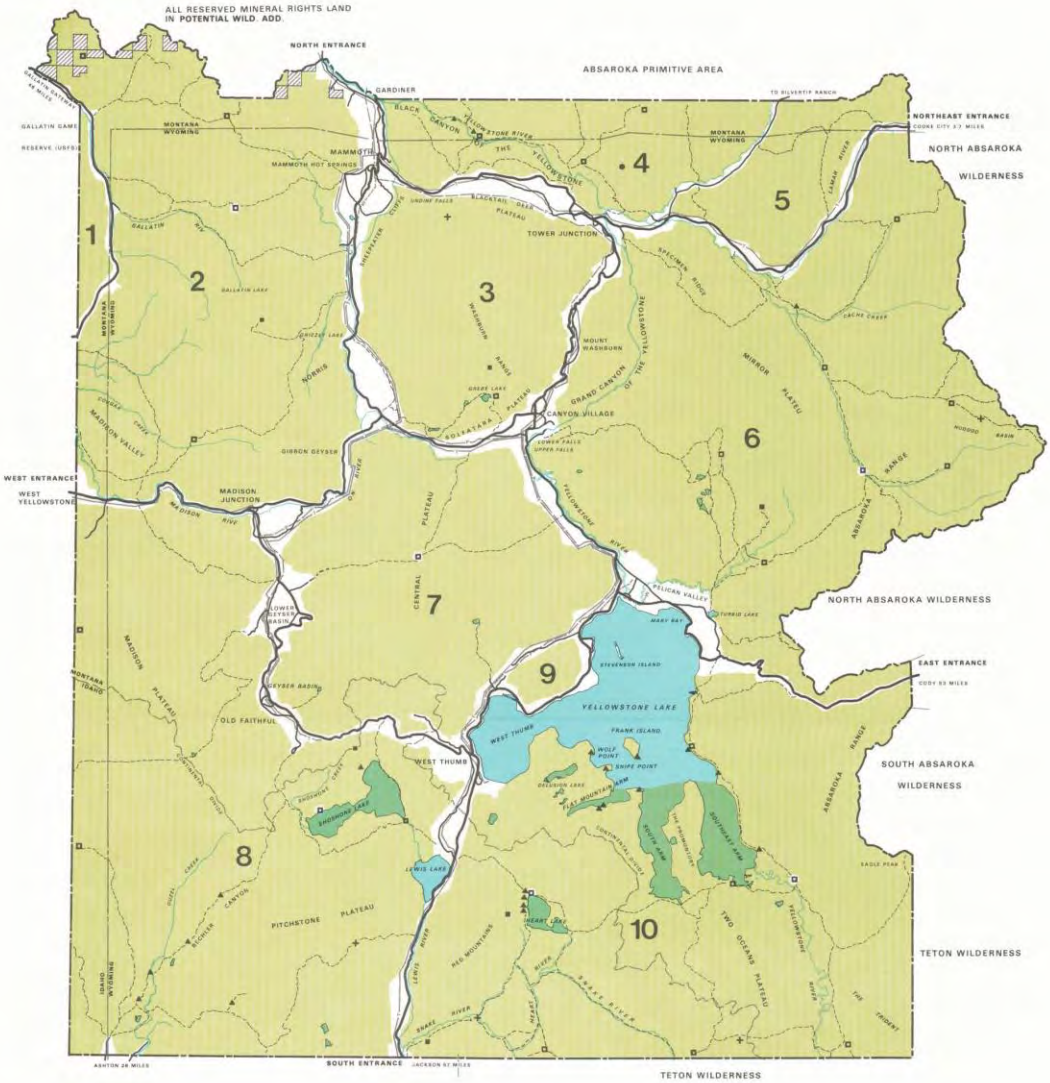

ACREAGES	
GROSS PARK ACREAGE	2,221,772.61
FEDERAL LAND	2,219,736.88
NON-FEDERAL LAND	2,035.75

UNIT	WILDERNESS
1	11,640
2	310,836
3	122,019
4	87,237
5	50,140
6	418,753
7	182,100
8	419,582
9	7,500
10	406,374
TOTAL	2,016,181 ACRES

POTENTIAL WILD. ADD. 6,040 ACRES

LEGEND

- PARK BOUNDARY
- ROAD
- TRAIL
- TELEPHONE
- POWER
- WATER
- PATROL CABIN
- CAMPGROUND
- LOOKOUT
- SNOW COURSE OR GAUGE
- MICROWAVE REFLECTOR
- FISH TRAP
- RESERVED MINERAL RIGHTS
- WILDERNESS AREA

EXHIBIT A

WILDERNESS PLAN

YELLOWSTONE NATIONAL PARK

IDAHO-WYOMING-MONTANA

0 1 2 3 MILES

101 | 20,004-A
JULY 72 | DSC

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Appendix 9
Minimum Requirements Analysis

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MINIMUM REQUIREMENT ANALYSIS WORKSHEET
YELLOWSTONE NATIONAL PARK

YELL 5/2011

PROPOSED ACTION: **30-Yr NEON Equipment Install and Sampling Activities** DATE: 2016-2046

LEAD UNIT(S): Yellowstone National Park

PART A: Minimum Requirement *(should the action be done in proposed wilderness)*

1 IS ACTION AN EMERGENCY?

YES → ACT ACCORDING TO APPROVED EMERGENCY MINIMUM TOOL CRITERIA

NO

Answer: ☐ Yes ☒ No

Explain: This action is not requested due to an immediate time constraint or due to emergency related to natural or cultural resources. The research and sampling would be done to support a continent-scale project to measure and document environmental change due to human interactions.

2 DOES ACTION CONFLICT WITH PLANNED WILDERNESS GOALS, OR FUTURE DESIRED CONDITIONS?

YES → DO NOT DO IT

NO

Answer: ☐ Yes ☒ No

Explain: Currently, there is not an approved YNP Backcountry/Wilderness Plan. Due to much of the proposed sampling area occurring within Recommended Wilderness, a Minimum Requirement Analysis is recommended.

3 IS ACTION PRE-APPROVED BY THE WILDERNESS AND BACKCOUNTRY OR OTHER PARK MANAGEMENT PLAN?

YES → DO ACCORDING TO APPROVED CRITERIA

NO

Answer: ☐ Yes ☒ No

Explain: Currently there is not an approved YNP Backcountry/Wilderness Plan. An EA for this project is being prepared and this MRA would be included in that assessment.

4 CAN ACTION BE ACCOMPLISHED THROUGH A LESS INTRUSIVE ACTION SHOULD BE TRIED FIRST? (Visitor Education…)

YES → DO IT

NO

Answer: ☐ Yes ☒ No

Explain: In order for all 20 sites (domain) across the continental US to collect data in the same and consistent fashion, equipment and techniques used at each site need to be the same. Very little variation from site to site is acceptable.

5 CAN ACTION BE ACCOMPLISHED OUTSIDE OF PROPOSED WILDERNESS ACHIEVE ITS OBJECTIVES?

YES → DO IT THERE

NO → DO PART B

Answer: ☐ Yes ☒ No

Explain: Areas outside the park were considered, but due to the fact that the site would be in operation for a 30-year time period, project proponents and park staff decided that a site within the boundaries of the park would ensure the most reliable data set over this long time-frame.

PART B: Minimum Tool *(how the action should be done in proposed wilderness)*

6	DESCRIBE, IN DETAIL, ALTERNATIVE TO ACCOMPLISH THE PROPOSED (These may include, primitive skill/tool, motorized, and/or combination (Use addition pages if necessary)		* Minimum questions to answer for each What is proposed? Where will the action take place? When will the action take place? What design and standards will apply? What methods and techniques will be used? How long will it take to complete the action? Why is it being proposed in this manner? What mitigation will take place to minimize action
	GO TO NEXT STEP		
7	EVALUATE WHICH ALTERNATIVE HAVE THE LEAST OVERALL IMPACT WILDERNESS RESOURCES, AND VISITOR EXPERIENCE **		** Minimum criteria used to evaluate each Biophysical effects Social/Recreational/Experiential effects Societal/Political effects Health/Safety concerns Economical/Timing considerations
	GO TO NEXT STEP		
8	SELECT AN APPROPRIATE, PREFERRED ALTERNATIVE	IF → REQUIRED	**9** ATTACH TO APPROPRIATE PROJECT PROPOSAL/CLEARANCE FORM FOR APPROVAL/DISAPPROVAL SIGNATURE

Alternative 1: NEON is proposing the YELL become a core site for a continental-scale ecological observatory, designed to enable understanding of the impacts of climate change, land-use change, and invasive species on ecological systems. This long-term data gathering project would span a 30-year timeframe within the boundaries of Yellowstone National Park. The project consists of placing equipment, accessing and collecting data and specimens at numerous sites, and posting this data for free use of the public on the internet. There are two sites proposed for infrastructure, the first located about 900 feet south of the Blacktail Plateau Road near its intersection with the Grand Loop Road, and the second along a 1,500 foot stretch of Blacktail Deer Creek east of the road to the Upper Blacktail Cabin. Data and specimen collection would occur at these two sites, and between 40 and 50 other sites within a 5 mile radius of the first site described above.

Components of the project:

TOWER SITE

Tower – constructed of metal lattice, either 59 or 70.5 feet in height, concrete foundation, 8.5 feet square at the base, an internal ladder, adorned with data gathering sensors.

Instrument Hut – a 10' x 21" building would be constructed to house many of the instruments for various data collection at the tower site. The building would be a single story in height and would be painted to blend (likely park service brown).

Access – A staging and stockpile site near the Frog Rock Pit during the construction phase, this will also be the area for staff parking when using the NEON site, approximately 1600 ft. construction route (8'wide road) that would be rehabbed to an 18" wide trail for access during operations.

Electric Service Portal – 192 sq. ft. connection site to commercial power. A combination of buried and above-ground conduit would contain the electric cable from this point to the tower site.

Precipitation Collection System with Fencing – A 5' – 8" tall fence in a 26' diameter circle would protect a rain gauge a few hundred feet north of the tower site.

Soil Sampling Plots – Six plots spaced approximately 100 feet apart would include 10-12 boreholes up to 6 .5 feet in depth. The diameter of these holes would be 2.5 inches in diameter and cased with PVC pipe to contain the various sensors.

Soil Horizon Pit – A six foot by six foot pit would be dug to a maximum depth of 7 feet that would be used to determine the soil horizon profile would be open up to one week. The pit would be located adjacent to the two track road that connects the Blacktail Plateau Road and the Frog Rock Pit.

AQUATIC SITE

Sensor Suites – Two sensor suites would be installed on the banks of Blacktail Deer Creek. Each of these sensor arrays would be feed by commercial grid power via above-ground cable placed in steel conduit. Underground power be trenched along the existing road accessing the Upper Blacktail Cabin.

Groundwater Well Observation Network – Eight groundwater monitoring wells would be drilled to a depth of between 10 and 20 feet. Each well would have a steel pipe with sensors mounted to it as well as a photovoltaic panel to power these sensors.
Access – would be on foot for the operations phase.

TERRESTRIAL OBSERVATION SYSTEM (TOS)
Approximately 55 sites would be located within recommended wilderness to be accessed on a regular basis to observe and collect samples. Observations would be collected of:

- Plant biodiversity;
- Plant biomass, leaf area, and chemical composition;
- Plant phenology;
- Bird composition and abundance;
- Ground beetles abundance and diversity;
- Mosquitos phenology, abundance, and pathogens;
- Tick-borne diseases;
- Soil microbe abundance, diversity, and function, and
- Soils biogeochemistry.

OPERATIONAL ACTIVITIES
All site structures and equipment are proposed to be constructed and installed in 2016 and would remain in place for 30 years. A Domain Manager based in Bozeman, Montana would oversee all activities at the core site. Additionally, all NON personnel would reside in Bozeman, Montana. The NEON observatory at the core sites would be divided into three categories or subsystems; (1) terrestrial, (2) airborne, and (3) aquatic. Sites would be visited up to multiple times per week.

CONSTRUCTION ACTIVITIES
Construction of the site would take approximately 4 months to complete. The tower site would use a temporary road that would be constructed to access the site and the staging area at Frog Rock Pit. The road would be rehabilitated prior to the winter season and reseeded at the same time. The location of this construction road would also become the access pathway to the site for operations purposes. Approximately 100 trips per week would be required between the site and Frog Rock Pit for a 4-month duration. The aquatic site would need vehicle access to drill the wells, and install the sensor arrays, and place the electric line conduit.

The activities and infrastructure that are located within recommended wilderness include the southern portion of the aquatic site (one sensor site [S1], one met station, and four groundwater monitoring wells). Most of the approximately 55 TOS sampling sites are also located in recommended wilderness and located north of the Grand Loop Road. Researchers on the ground would be accessing these sites on a regular basis throughout the year. Approximately 614 person/site visits per year for the TOS sites. The aquatic site would receive approximately 442 person/site visits per year, half of these 221 person/site visits would be to the sensor site located within recommended wilderness. A single overflight would also on an annual basis to collect atmospheric data on an annual basis.

Alternative 2: A lower tower height is the only change for a second alternative.

Alternative 3

List preferred alternative and give justification:
The preferred alternative would be to construct the site with the 59 foot tower height. To keep domains across the continent collecting data in the same manner using the same equipment and sensors, there are no changes that can be made and still keep data consistent across all domains.

MINIMUM REQUIREMENT ANALYSIS WORKSHEET
YELLOWSTONE NATIONAL PARK

YELL 5/2011

PROPOSED ACTION: **30-Yr NEON Equipment Install and Sampling Activities** DATE: 2016-2046

LEAD PERSON(S): UNIT(S): Yellowstone National Park

MRA Committee Statement:
In December 2015, the MRA Committee submitted a list of requests/questions concerning this MRA to NEON representatives. NEON's response to those questions, dated January 28, 2016, is attached.

Since development of this MRA, NEON has agreed to move the Aquatic Instrument System to a location not located within Recommended Wilderness reducing the overall impact to wilderness character of the research project.

The remaining impacts are beetle pitfall traps and a variety of plot markers. The beetle pitfall traps must be removed at the end of each sampling season (typically late September). All plot markers, tags, and flagging should be installed and camouflaged as much as possible and in line with current protocols put forth by the Yellowstone Research Review Committee. All markers must be removed at the conclusion of the 30 year study.

The MRA Committee is concerned about potential impacts from repeated site visits by NEON researchers. NEON is in the process of developing a protocol that describes specific actions to minimize trailing and trampling at sites that will be reviewed by the Research Review Committee. NEON must notify the NPS and mitigate any impacts to wildlife, vegetation, or other resources.

Any wilderness impacts associated with this project are long term, however we feel that these impacts are otherwise minimal and the long term benefits concerning climate change data will be quite beneficial to wilderness character. The MRA Committee recommends the MRA be approved with the changes to the MRA request as noted in NEONs response document.

Recommended: **RVP:** 3/8/16 **YCR:** 3.8.16 **MAINT:**

Chief Ranger Approval: 3/10/16

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