National Park Service
U.S. Department of the Interior

Mount Rainier National Park
Washington

Mount Rainier National Park
Lahar Detection System Environmental Assessment

May 2021

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Mount Rainier National Park

Environmental Assessment

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INTRODUCTION

Mount Rainier is an active volcano located in Mount Rainier National Park (MRNP or park) near the growing Seattle-Tacoma metropolitan area. The mountain poses significant volcanic, landslide, and flooding hazards to park visitors, National Park Service (NPS) employees, and neighboring communities. Lahars, or volcanic mudflows, are the primary volcanic hazard with potential to impact people living, working, or recreating in or near the park.

In 2008, the United States Geological Survey (USGS) issued a recommendation that Very High Threat volcanoes[1] such as Mount Rainier (Ewert et al. 2005; Ewert et al. 2018a) should have 12 to 20 seismic and Global Positioning System (GPS) stations located within 12 miles of the volcano (Moran et al. 2008) to provide reliable early warning in the event of future volcanic unrest and eruption. The actual number of required stations within that broad range is dependent upon many factors that are specific to each volcano, especially the size of the volcano. For example, to achieve the same monitoring capabilities at Mount Rainier as at Mount St. Helens, more stations would be required because Mount Rainier is a larger volcano. The Mount Rainier network of monitoring stations consists of 18 seismic and 6 GPS installations located within 12 miles of the summit, including 13 seismic and 6 GPS sites inside the park (some seismic and GPS stations are collocated; 15 total monitoring sites are in MRNP). The current network has been sited and equipped to monitor unrest associated with a volcanic eruption.

In addition to addressing the need to improve the volcano monitoring capabilities of the Mount Rainier monitoring network, another important consideration at Mount Rainier is mitigating hazards from debris flows and lahars. Although most large lahars have occurred in association with Mount Rainier eruptions (e.g., Sisson and Vallance 2009; Scott et al. 1995), recent scientific studies have shown that the west flank of Mount Rainier is potentially vulnerable to a large-scale collapse that could occur without eruption and that could produce a large lahar down the Puyallup River, Mowich River, and/or Tahoma Creek drainages (Finn et al. 2001; Reid et al. 2001). These lahars would reach residential areas inside the park in about 10 minutes and residential areas outside the park in 20 to 60 minutes. To mitigate this hazard, the capability to rapidly detect debris flows and lahars without producing false alarms is needed so that authorities inside and outside the park have as much time as possible to evacuate residents, staff, and visitors.

The capability to rapidly detect debris flows and lahars requires a different configuration of equipment than what is currently in place. Most of the proposed monitoring sites are on the southwest side of the park to provide the capability of detecting and tracking debris flows and lahars down the Tahoma Creek drainage, where large lahars can reach residential areas in as little as 10 to 20 minutes. This includes several sites located alongside the Tahoma Creek drainage. Although these sites would be normally quite noisy (and much less useful for volcano monitoring), their proximity to Tahoma Creek would provide information that is critical for situational awareness about if a lahar is moving down that drainage and, if so, how fast it is moving, how far it will go downstream, and how soon it might reach residential areas. Lastly, all

[1] Based on the USGS ranking system, which describes an individual volcano's hazard potential and the exposure of people and property to those hazards, "Very High" is the highest threat level. The hazard factors include volcano type, eruptive history, explosiveness, time between eruptions, types of hazards from past eruptions, and effects of the hazards. Also included is an analysis of what the volcano is doing at present, with a focus on seismicity, ground deformation, and degassing (Ewert et al. 2018a).

of the proposed sites would have infrasound instruments, which have been shown around the world to be effective in detecting subaudible soundwaves created by moving surface flows such as debris flows and lahars (e.g., Allstadt et al. 2018). Infrasound can be significantly disrupted by topography; therefore, multiple stations within each drainage are needed for reliable detection of infrasound generated by debris flows and lahars.

New installations proposed in MRNP include locations that are within the designated boundaries of the Mount Rainier Wilderness. These lands must be managed pursuant to the 1964 Wilderness Act, which normally prohibits permanent installations. Sites proposed also include areas within or adjacent to the Mount Rainier National Historic Landmark District (NHLD) and are subject to the review process in Section 106 of the National Historic Preservation Act. Some of the proposed locations also include potential habitat for federally listed species pursuant to the Endangered Species Act. Species with the potential to be affected by the proposed expansion and maintenance of the USGS lahar detection system include the northern spotted owl (*Strix occidentalis caurina*) and marbled murrelet (*Brachyramphus marmoratus*). Gray wolf (*Canis lupus*), whitebark pine (*Pinus albicaulis*), and special status species other than northern spotted owl and marbled murrelet are addressed in Appendix C.

The 12 proposed sites (1 of which is a replacement to an existing site) have the potential to affect historic properties and/or wilderness character in MRNP and warrant further analysis, tribal consultation, and public involvement to support informed decision making. The NPS is preparing this environmental assessment (EA) to facilitate National Environmental Policy Act (NEPA) review and agency decision making.

Figure 1 shows the project area and the locations of existing monitoring sites and proposed monitoring sites.

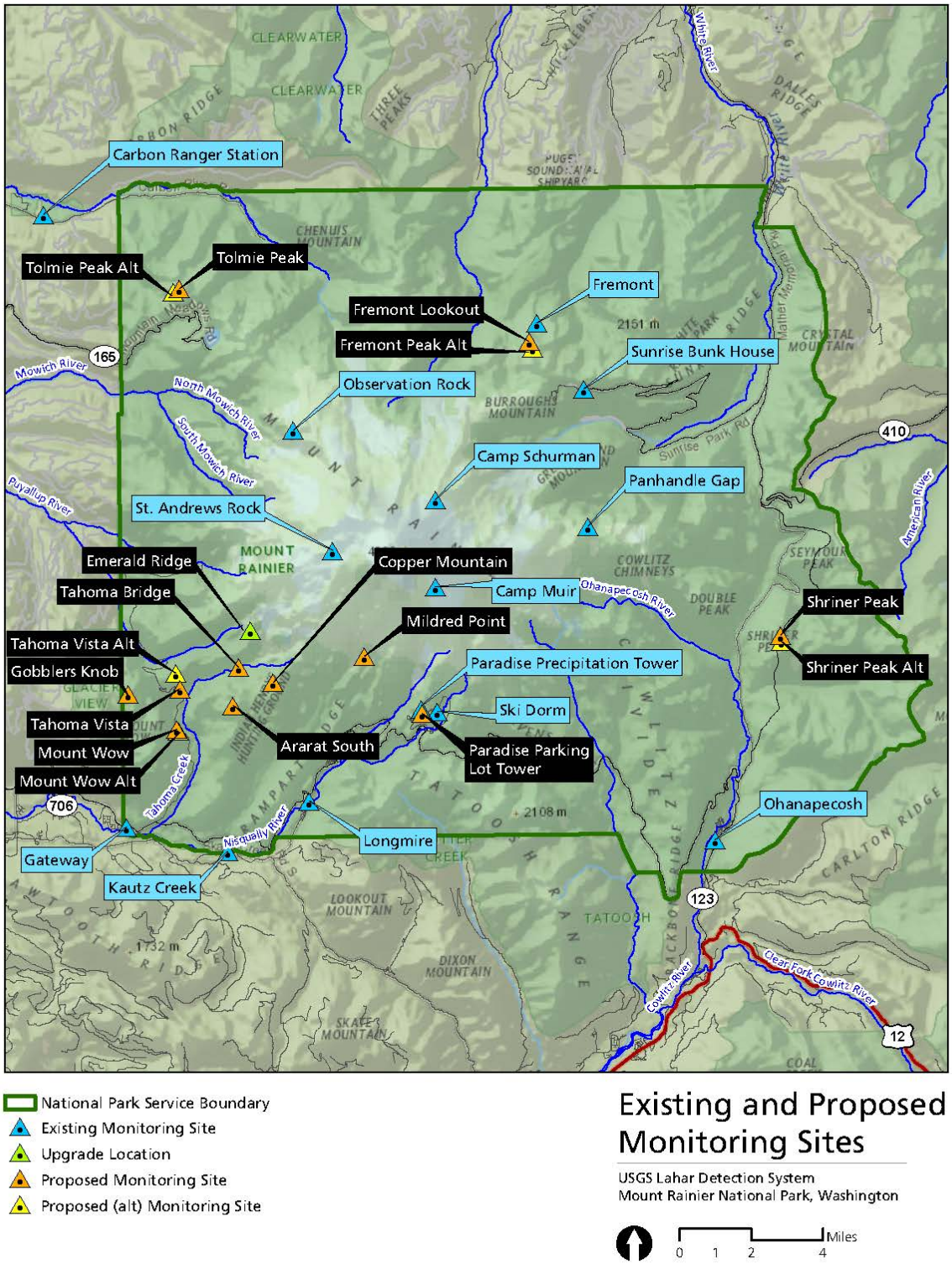

Figure 1. Project Area Map.

PURPOSE AND NEED

PURPOSE AND NEED FOR THE PROJECT

The purpose of the USGS proposal is to mitigate human risk by reducing the amount of time it takes for an alert to be sent out to potentially affected populations and communities after a lahar has been generated. Upgrades to the lahar detection and monitoring system are needed to improve the safety of people in and adjacent to the Mount Rainier Wilderness and to provide an unparalleled opportunity to observe and measure ongoing geological processes and how they change before an eruption.

Establishment of the lahar detection system at Mount Rainier is needed to fulfill the requirements of the John D. Dingell, Jr. Conservation, Management, and Recreation Act of 2019 (Dingell Act). The Dingell Act directs the USGS to establish a system, to be known as the National Volcano Early Warning and Monitoring System, "to monitor, warn, and protect citizens of the United States from undue and avoidable harm from volcanic activity." In addition, the Robert T. Stafford Disaster Relief and Emergency Assistance Act (a 1988 amended version of the Disaster Relief Act of 1974) states that "the President shall insure that all appropriate Federal agencies are prepared to issue warnings of disasters to State and local officials" and "the President shall direct appropriate Federal agencies to provide technical assistance to State and local governments to ensure that timely and effective disaster warning is provided." The director of the USGS, through the Secretary of the Interior, has been delegated the responsibility to issue disaster warnings "for an earthquake, volcanic eruption, landslide, or other geologic catastrophe."

Following review of the USGS proposal, the NPS's decision would be to either approve the permit as proposed, reject the permit, or issue a permit with modifications to the USGS proposal.

PROJECT OBJECTIVES

In addition to the purpose and need, the park identified objectives for the project, which include the following.

Objective 1

Provide year-round monitoring capability to inform hazard notification systems.

Objective 2

Ensure structural integrity of monitoring stations to minimize failure due to site conditions (e.g., wind, snow, and ice).

Objective 3

Install and maintain sites in a manner that avoids or minimizes disturbance to park resources and values, including nesting northern spotted owls and marbled murrelets, wilderness character, and the Mount Rainier NHLD.

ALTERNATIVES

Four alternatives are carried forward for analysis in this EA: Alternative 1 – USGS Proposed Action, Alternative 2 – No Action, Alternative 3 – Alternative Monitoring Sites, and Alternative 4 – Reduced Number of Monitoring Sites (NPS Preferred Alternative). These alternatives are summarized below. The USGS developed detailed Project Proposal Review forms for each proposed monitoring station under the USGS Proposed Action (Appendix B). During development and consideration of the USGS Proposed Action, the NPS also considered other alternatives that were dismissed due to unacceptable resource impacts or because they did not meet the purpose and need for the project (see *Alternatives Considered but Dismissed* below).

ALTERNATIVE 1 – USGS PROPOSED ACTION

The USGS Proposed Action is the result of a collaborative effort to consider project impacts while developing recommendations for each site. The USGS Proposed Action includes the addition of 12 monitoring stations on Mount Rainier. As described in Appendix B, the Fremont Lookout, Shriner Peak, and Tolmie Peak stations would function primarily as telemetry nodes for future stations installed along the Carbon, White, Ohanapecosh/Cowlitz, and Mowich River drainages in the event of future volcanic unrest at Mount Rainier and would not repeat data from any current or proposed stations. Instead, these installations would be part of a telemetry backbone that would enable rapid installation of new real-time monitoring stations along the White River drainage, something that would be required to help mitigate lahar hazards along the White River if Mount Rainier were to start exhibiting signs of volcanic unrest. The remaining nine stations would be installed to increase rapid detection along the west flank of Mount Rainier, which is the most vulnerable to a large lahar down the Puyallup River, Mowich River, or Tahoma Creek drainage.

For the purposes of this EA, it is estimated that the monitoring stations would be in place for about 30 years. The installations have no planned removal date but would be expected to be replaced in the future as new technology becomes available. It is expected that the project footprint would become smaller over time with technological advances. Should temporary installations be necessary in the future, these would be addressed under a separate permitting and compliance process.

Common Elements of Proposed Monitoring Stations

Several USGS Proposed Action monitoring stations have common elements in their design, installation, construction timing, or maintenance, which are described below. Table 1 provides a summary of the equipment type and key resource conditions for each proposed monitoring station, at the end of this section on page 12.

Proposed Monitoring Stations – Hut Enclosures

Several of the proposed monitoring stations would be free-standing hut enclosures with varying dimensions (with a maximum dimension of 60 inches by 60 inches by 80 inches). The huts would typically have a disturbance footprint of about 10 feet by 10 feet. Figure 2 shows a representative

schematic of a typical hut enclosure. Figure 3 and Figure 4 illustrate typical hut enclosures and other equipment that have been installed on or near other volcanoes.

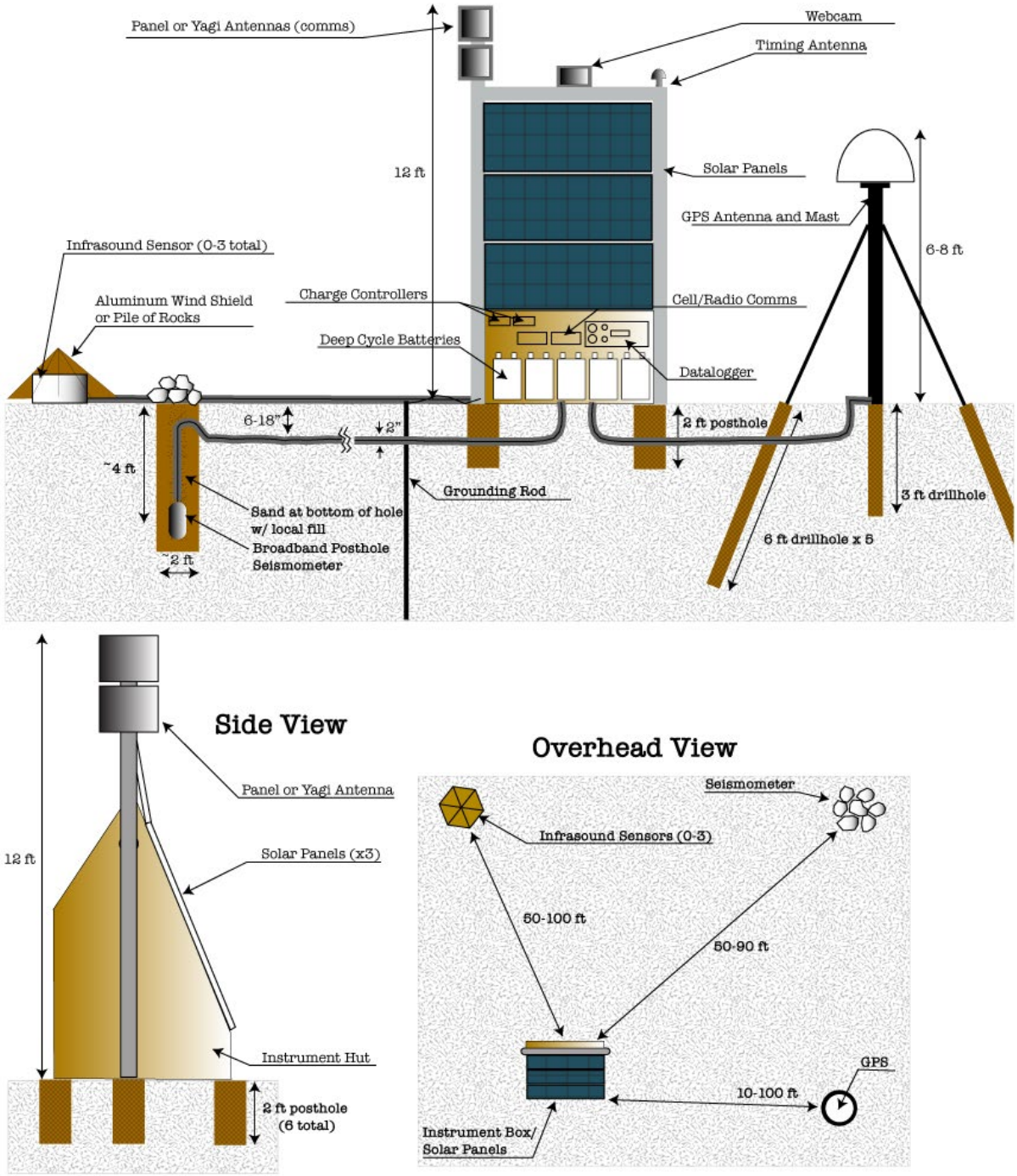

Figure 2. Representative Hut Enclosure.

Figure 3. Photo of an Existing Hut Installation in Alaska.

Figure 4. Photo of the actual hut design that would be used on Mount Rainier. Note that the third (top) solar panel would only be used at Ararat South, Copper Mountain, and Mildred Point.

Proposed Monitoring Stations on Historic Fire Lookout Towers

In Alternative 1, monitoring stations are proposed to be mounted on historic fire lookout towers within the park: Fremont Lookout, Gobblers Knob, Shriner Peak Lookout, and Tolmie Peak. Proposed nonhistorical elements common to each proposed fire lookout include the following (see also Appendix B):

- Two solar panels installed with a combined size of about 116 inches by 52 inches by 4 inches mounted on the south-facing portion of the roof.
- Solar panel conductor wire routed from the roof and into the fire lookouts through a small hole that would need to be drilled unless existing ingress could be found.
- Flexible solar panels installed on the existing shutters that are placed over the windows during the winter.
- A small 3-inch by 3-inch by 2.5-inch Global Navigation Satellite System (GNSS) timing antenna would be installed at all four lookout towers under an eave, which would only be visible if standing directly beneath the eave.
- All electronic equipment would be housed in the basement of the fire lookouts, which are not accessible to the public.

New antenna masts are proposed for Fremont Lookout and Gobblers Knob, and new antennas are proposed to be added to existing masts at Gobblers Knob, Tolmie Peak, and Shriner Peak. Three antennas would be added to an existing telephone pole at Shriner Peak including a cable trench from the pole to the structure. Two solar panels would be added to existing solar panels on the east-facing roof at Gobblers Knob (as well as the addition of new solar panels on the south-facing roof). A buried seismometer and data cable trench are proposed for Gobblers Knob, Shriner Peak, and Tolmie Peak, which would require burying the seismometer about 30 feet from the structure and excavating a trench to extend the data cable to the structure and into the basement.

Table 1 on page 12 summarizes the elements proposed on these lookouts, and although the proposed installations are slightly different for each structure, a representative schematic of a fire lookout tower monitoring station is illustrated in Figure 5.

A webcam would be mounted just above the hut at the proposed Copper Mountain monitoring site. All hut installations would have the timing antenna and the 900 MHz radio antenna on the top of the enclosure. Solar panels would be mounted to the hut.

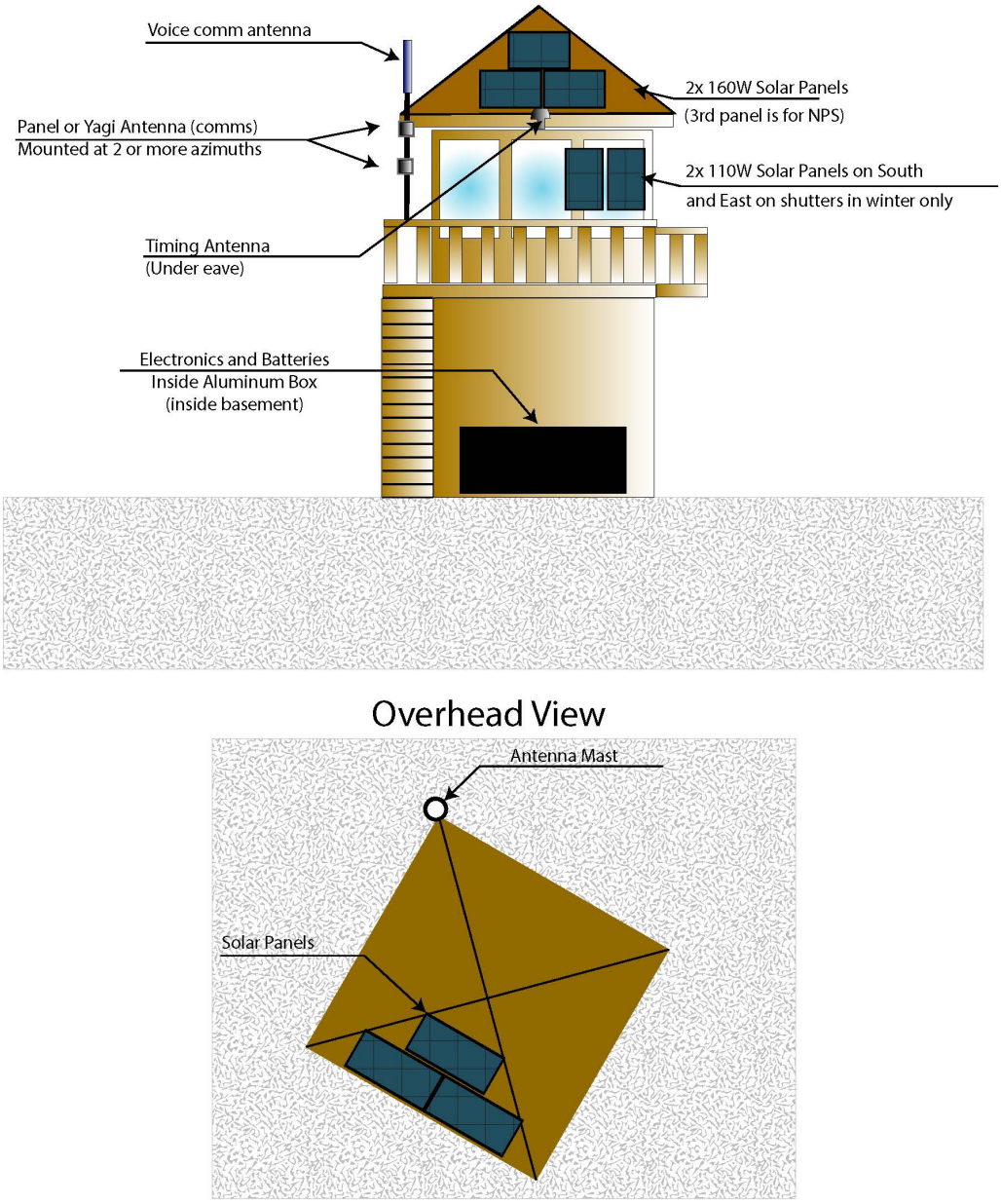

Figure 5. Representative Proposed Historic Fire Lookout, Monitoring Station Elements.

Helicopter Use for Installation

Several of the sites, as indicated in Table 1 on page 12, would require the use of helicopters for initial installation and subsequent maintenance. Installation would require up to seven round trips to each project location by a small helicopter carrying sling loads. Light helicopters would be used, such as A-Stars, Bell Jet Rangers, or Hughes 500 series. Helicopters would take off from the Kautz Helipad (limited availability from May through September) or the Sunrise parking area (only available in late September/October).

Installation flights would occur over a two-month period (September and October 2021), with installations potentially extending into September and October 2022 if weather or other conditions do not allow for completion of installations in 2021. Sites would be evaluated one year post-installation to determine if active restoration is needed to restore natural conditions at monitoring sites. Should revegetation be necessary, helicopter flights may be required to transport seedlings to areas where transport on foot is infeasible. This would require up to two flights per site where active revegetation is needed – one flight to deliver seedlings and one flight to remove supplies after planting. With the addition of potential flights for revegetation, up to eight total round-trip flights would be needed for each site for installation. Flight time would be about 1 to 2 hours per day at each site over a period of 2 days or about 32 to 63 hours of flight time over about 18 to 22 days during installation over a 2-month period (September and October; excluding weekends) each year for 2 years. The total number of flights for installation would vary by alternative, as shown in Table 2.

Helicopter Use for Maintenance

Sites would typically be accessed by foot for routine tuning and maintenance, but additional helicopter flights would be required for anticipated equipment and battery replacement, requiring four round trips per site every 5 years. Tuning refers to unexpected adjustments or repairs to stations within the first two years after installation. The USGS has found that some sites require tuning after installation, which sometimes requires helicopter use to deliver heavy or bulky equipment, or to remove damaged equipment.

Additional flights may also be needed if urgent repairs are required and foot access is not available, for example during winter months when crews would not be able to safely access the site on foot due to inclement weather. Transport of personnel by helicopter would occur in emergency situations when repairs are needed to avoid diminished monitoring capability. An initial flight with personnel may be required to assess the situation, followed by an additional flight once the needed equipment has been determined. In all cases, the USGS would strive to minimize the number of helicopter flights. Based on their experience with other installations, the USGS estimates up to two helicopter flights may be needed annually for emergency maintenance. The sites that would require helicopter access in these situations include Ararat South, Copper Mountain, Emerald Ridge, Gobblers Knob, Mildred Point, and Tahoma Bridge. The other sites including Mount Wow, Tahoma Vista, and Paradise Parking Lot Tower could be accessed by foot or vehicle and would not require emergency helicopter access. Sites including Tolmie Peak, Fremont Lookout, and Shriner Peak would not require emergency helicopter access because they are not mission critical for maintaining constant lahar detection capability. Flights for emergency repairs could potentially occur in months other than September and October.

For example, under the USGS Proposed Action, about 243 maintenance flights would be performed over a period of 30 years with about 122 to 243 hours of flight time for maintenance flights over a period of 30 years. Flights for tuning and emergency repairs are included in this total.

For comparison, the total number of flight hours in the park from 2015 to 2019 averaged 142 flight hours per year, consisting mostly (about 95 percent) of small helicopters, and a very small proportion (less than 5 percent) consisting of large helicopters such as CH-47 Chinook and Blackhawk. From 2009 to 2019, the USGS flew 47 total helicopter sling loads to six existing monitoring stations in the park. Table 3, Summary of All Alternatives, includes a summary of helicopter flights under each alternative.

Construction Timing

Construction of USGS Proposed Action monitoring stations would occur in September and October of 2021, possibly extending to September and October of 2022 if logistical or weather-based complications impart significant delays to USGS installations in 2021. Construction is typically completed in two to three days per site, but could last as long as one week depending on site conditions and weather. Helicopter activity is typically confined to short periods on the first and last days of installation.

Maintenance Activities

Maintenance would be performed as needed, including an initial station check one to two years after initial installation and routine battery swaps every five years. Helicopter-supported maintenance activities would be performed after Labor Day, although unexpected outages may require emergency repairs at other times of the year. See *Helicopter Use* for the number of maintenance flights annually.

Best Management Practices

Best Management Practices (BMPs) and mitigation measures to reduce project construction and maintenance impacts are listed in Appendix A.

Table 1. Summary of Proposed Monitoring Stations.

									Historic Lookout Towers			
		Ararat South	Copper Mountain	Emerald Ridge	Mildred Point	Mount Wow	Paradise Parking Lot Tower	Tahoma Bridge	Tahoma Vista Overlook	Fremont Lookout	Gobblers Knob Lookout	Shriner Peak Lookout	Tolmie Peak Lookout
	Location												
	In Wilderness?	X	X	X	X			X		X	X	X	X
	In NHLD?					X			X	X	X	X	X
	On Historic Structure or Near Developed Area?					X			X	X	X	X	X
	Alternative Site Available (Alternative 3)?					X			X	X		X	X
	Structure Type												
	Hut Enclosure (60"x60"x80", with solar panel(s); not to exceed 9' high)	X	X	X	X	X	Small (12"x9"x7") enclosure at base of tower	X	X				
Historic Lookout Towers	**Roof Solar Panels (58"x26"x2" - requires rail mounts and roof holes)**									X	X	X	X
Historic Lookout Towers	**Solar Panel Conductor Wire to Existing Conductor Pole (with possible new hole entry)**									X	X	X	X
Historic Lookout Towers	**GNSS* Antenna (3"x3"x2.5" under eave)**									X	X	X	X
Historic Lookout Towers	**Solar Panels (installed on existing shutters in the winter)**									X	X	X	X
	GNSS Antenna(s) Mast (<8'; <100' from site with cable trench; antenna is also larger)		X										
	New Mast (less than 12' tall with radio antennas – 12"x12"x6")	X	X	X (15' tall)	X	X	No – Installation of 1 or 2 antennas on existing tower	X	X	X	New mast and mounting of 1 or 2 antennas on existing mast	No – Installation of 3 antennas on existing telephone pole	No – Installation of 2 antennas on existing mast

	Ararat South	Copper Moun-tain	Emerald Ridge	Mil-dred Point	Mount Wow	Paradise Parking Lot Tower	Tahoma Bridge	Tahoma Vista Overlook	Historic Lookout Towers			
									Fremont Lookout	Gobblers Knob Lookout	Shriner Peak Lookout	Tolmie Peak Lookout
Equipment to be Installed												
Equipment Box (in basement of structure or in enclosure)	X	X	X	X	X	X	X	X	X	X	X	X
Seismometer	X	X	X	X	X		X	X		X	X	X
Infrasound Array	X	X	X	X				X				
Webcam		X										
Installation Tools												
Helicopter Access Required?	X	X	X	X			X		X	X	X	X
Hand Tools?	X	X	X	X	X	X	X	X	X	X	X	X
Battery (Lithium)-Powered Tools?	X	X	X	X	X	X	X	X	X	X	X	X
Welder/ Generator?		X										
Rock Drill (Battery-Powered)?		X					X					
Other Mechanical Device?						Possible guy wires						
Disturbance												
Vegetation Removal?	X	X	X	X	X	Possibly	X	X		X	X	X
Soil Disturbance?	X	X	X	X	X	Possibly	X	X		X	X	X
Near Wetlands or Other Water Bodies?				X (985′)	X (>330′)		X (150')	X (1,200′)				
Near or Within Sensitive Species Habitat**				X (WBP)	X (NSO, MM)		X (NSO)	X (NSO, MM)	X (WBP)			
Footprint Dimensions (Hut) (six 2'-deep concrete footers; pad leveling)	X	X	X	X								

	Ararat South	Copper Mountain	Emerald Ridge	Mildred Point	Mount Wow	Paradise Parking Lot Tower	Tahoma Bridge	Tahoma Vista Overlook	Historic Lookout Towers			
									Fremont Lookout	Gobblers Knob Lookout	Shriner Peak Lookout	Tolmie Peak Lookout
Four 2'-Long x 1" Rebar to Anchor Hut (for those sites being anchored to the road)					X			X				
Four Rock Bolts Anchored to Rock							X					
Infrasound Footprint Dimensions (3-component infrasound array box, cable, and windscreen anchored with rebar - 8"x8"x6" box dimensions; 45"x45"x24" windscreen; conduit trench 2' deep)	X	X	X	X	Inside hut			X				
Seismometer Footprint Dimensions (Seismometer and Cable Trench) (4'x4' maximum with 2'-wide x 6"-wide by 18"- to 24"-deep trench)	X	X	X (3'x3'x5' deep vault w/ cable trench)	X	Inside hut		X	X		X	X	X
GNSS Footprint Dimensions (GNSS Monument) (5 support legs dug to 6' deep in bedrock)		X										
Copper Ground Rod (up to 8' deep and 4" aboveground) Hand Driven	X	X	X	X	X		X	X				

*GNSS = Global Navigation Satellite System.
**MM = marbled murrelet, NSO = northern spotted owl, WBP = whitebark pine. All sites are within or near potential gray wolf habitat.

ALTERNATIVE 2 – NO ACTION

Under the No Action Alternative, the NPS would not approve the USGS permit request to install additional lahar monitoring stations. Monitoring of volcanic activity at MRNP would be conducted at existing monitoring stations (see Figure 1). Lahar detection capabilities would remain limited on all of the drainages originating on Mount Rainier except the Puyallup River, which has updated instrumentation outside the park. Current monitoring and telemetry stations in the park include the following:

- Camp Schurman
- Camp Muir
- Carbon River Ranger Station
- Emerald Ridge
- Kautz Creek
- Longmire
- Mount Fremont (northeast of the lookout approximately 0.7 mile)
- Nisqually Gateway
- Observation Rock
- Ohanapecosh
- Panhandle Gap
- Paradise Precipitation Tower
- Ski Dorm
- St. Andrews Rock (located inside the Sunset Amphitheater)
- Sunrise

The USGS would continue to monitor volcanic activity at the seismic and GPS monitoring sites listed above and would maintain these sites as needed. From 2009 to 2019, the USGS flew 47 total helicopter sling loads to six sites, which is about 8 flights per site over 11 years. The USGS estimates that about 3 to 4 maintenance trips per site would be needed every 5 years for the six existing monitoring sites that are helicopter dependent, for a total of about 144 flights over 30 years.

ALTERNATIVE 3 – ALTERNATIVE MONITORING SITES

Alternative 3 would be similar to Alternative 1 – USGS Proposed Action; however, Alternative 3 modifies the USGS Proposed Action for the purpose of avoiding adverse effects on structures and areas within the Mount Rainier NHLD, with the exception of the proposed installation at the Gobblers Knob historic fire lookout tower, for which no alternative location exists. Under this alternative, alternate monitoring station locations are proposed for Fremont Lookout, Mount Wow, Shriner Peak, Tahoma Vista, and Tolmie Peak Lookout (see Figure 1). The lahar detection capabilities are essentially unchanged from Alternative 1. Table 3 on page 21 depicts the differences between the USGS Proposed Action (Alternative 1), Alternative 3, and Alternative 4 (described below).

In Alternative 3, the Fremont Lookout and Shriner Peak alternative sites would require a larger hut structure, such as the Pepro System design, as compared to the USGS Proposed Action. The

standard Pepro System design requires no foundation and no excavation (Figure 6). The design includes an enclosure containing the electronics and batteries measuring 6 feet long by 6 feet wide by 6 feet tall mounted on four concrete grounding pad "feet" with extended outrigger ballast baskets creating a footprint measuring 10 feet long by 10 feet wide. The ballast baskets filled with locally sourced rock would help weigh the structure down. Three solar panels would be mounted on the enclosure, creating a maximum station height of 12 feet above the ground surface. On one side of the structure, a 4-inch-diameter mast would extend up to 20 feet above the ground surface. On the mast, no more than four antennas with maximum dimensions of 1 foot long by 1 foot wide by 6 inches thick would be mounted near the top of the mast to stay clear of snow in the winter. A 5/8-inch-diameter copper grounding rod would be installed up to 8 feet deep adjacent to the hut using hand tools (or drilled if rock is encountered) to provide protection from static discharge. In addition, the Tolmie Peak, Tahoma Vista, and Mount Wow Talus alternative sites would all require hut-style enclosures. Under Alternative 3, the proposed alternate monitoring installations would be located outside of the Mount Rainier NHLD and within currently undeveloped areas within the Mount Rainier Wilderness.

Figure 6. Monitoring Station Similar to the Proposed Station at Fremont Lookout and Shriner Peak Alternative Sites (Alternative 3).

Helicopter use would be the same as described for Alternative 1, except that two additional sites, the Mount Wow Talus and Tahoma Vista Ridge alternative sites, would require use of helicopters for installation and maintenance. The number of helicopter flights required would increase compared to Alternative 1, as shown in Table 3 on page 21. In addition, the Fremont Lookout and Shriner Peak alternative sites would require use of a medium helicopter for installation instead of a light helicopter because the hut structure would be larger.

ALTERNATIVE 4 – REDUCED NUMBER OF MONITORING SITES (NPS PREFERRED ALTERNATIVE)

Alternative 4 is similar to Alternative 1 – USGS Proposed Action; however, Alternative 4 was developed to reduce the number of stations as originally proposed by the USGS to reduce adverse effects on historic structures and minimize the number of new installations within designated wilderness while providing for improved lahar detection as proposed by the USGS. Under Alternative 4, only 9 of the proposed 12 monitoring stations would be approved. As described in Appendix B, the Fremont Lookout, Shriner Peak, and Tolmie Peak stations would function primarily as telemetry nodes for future stations installed along the Carbon, White, Ohanapecosh/Cowlitz, and Mowich River drainages in the event of future volcanic unrest at Mount Rainier and would not repeat data from any current or proposed stations.

Under Alternative 4, the following monitoring stations would be installed to increase rapid detection along the west flank of Mount Rainier, which is the most vulnerable to a large lahar down the Puyallup River, Mowich River, and Tahoma Creek drainages (Finn et al. 2001; Reid et al. 2001):

- Ararat South
- Copper Mountain
- Emerald Ridge
- Gobblers Knob
- Mildred Point
- Mount Wow – roadside site
- Paradise Parking Lot Tower
- Tahoma Bridge
- Tahoma Vista – roadside site

Figure 7 illustrates the monitoring stations included under Alternative 4. The number of helicopter flights required would be reduced compared to Alternatives 1 and 3. Under the NPS Preferred Alternative, about 42 flights would be needed for installation. About 189 maintenance flights would be performed over a period of 30 years with about 95 to 189 hours of flight time for maintenance flights over a period of 30 years. Flights for tuning and emergency repairs are included in this total.

Table 2 provides a comparison of the elements of Alternatives 1, 3, and 4.

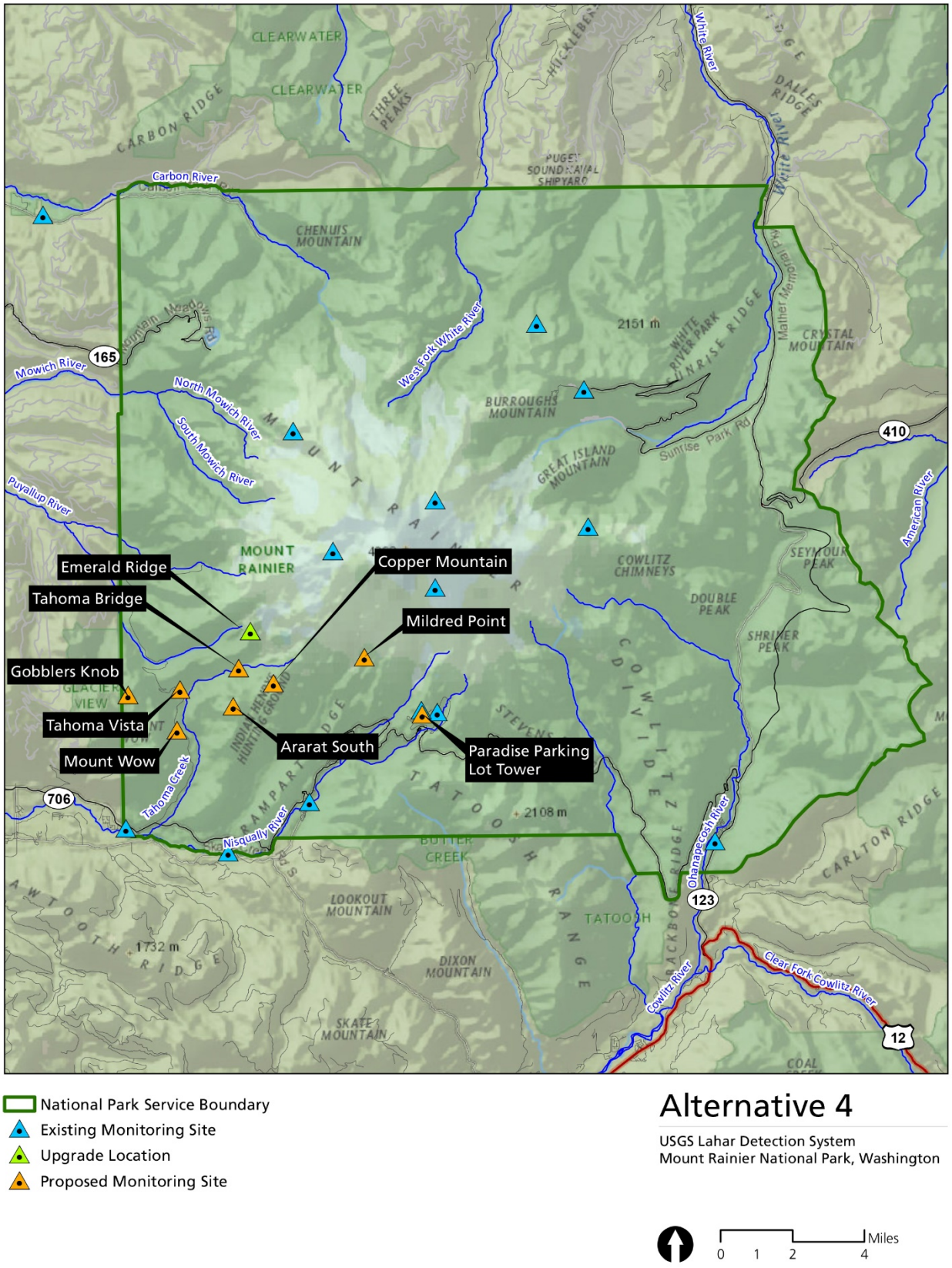

Figure 7. Alternative 4.

Table 2. Comparison of USGS Proposed Action and Alternative 3 Sites.

Site Name	Fremont Lookout (Alt 1)	Fremont Alt (Alt 3)	Mount Wow (Alt 1 & Alt 4)	Mount Wow Talus Alt (Alt 3)	Shriner Peak Lookout (Alt 1)	Shriner Peak Alt (Alt 3)	Tahoma Vista Overlook (Alt 1 & Alt 4)	Tahoma Vista Ridge Alt (Alt 3)	Tolmie Peak Lookout (Alt 1)	Tolmie Peak Alt (Alt 3)
Location										
In Wilderness?	X	X		X	X	X		X	X	X
In NHLD?	X		X	Highly visible from Westside Road	X		X		X	
On or Near Historic Structure?	X		X	Highly visible from Westside Road	X		X		X	
Structure Type										
Hut Enclosure (60"x60"x80", with solar panel(s); not to exceed 9' high)			X	X			X	X		X
Hut Enclosure (72"x72"x72")		X				X				
Roof Solar Panels (58"x26"x2" - requires rail mounts and roof holes)	X				X				X	
Solar Panel Conductor Wire to Existing Conductor Pole (with possible new hole entry; fire lookouts)	X				X				X	
GNSS Antenna (3"x3"x2.5" under eave)	X				X				X	
Solar Panels (installed on existing shutters in the winter)	X				X				X	
New Mast (less than 12' tall with radio antennas – 12"x12"x6")	X	X (<20' tall)	X	X	No – Installation of 3 antennas on existing telephone pole	X (<20' tall)	X		No - Installation of 2 antennas on existing mast	
Equipment to be Installed										
Seismometer			X	X	X	X	X	X	X	X
Infrasound Array						X	X	X		
Installation Tools										
Helicopter Size Required?	Light	Medium	None	Light	Light	Medium	None	Light	Light	Light
Battery (Lithium)-Powered Tools?	X	X	X	X	X	X	X	X	X	X
Rock Drill (Battery-Powered)?				X						
Other Mechanical Device?				Bolted Faraday cage						
Disturbance										
Vegetation Removal?		X	X	X	X	X	X	X	X	X
Soil Disturbance?		X	X	X	X	X	X	X	X	X
Near Wetlands or Other Water Bodies?			X (<330')	X (<660')			X (<1,200')	X (<3,000')		
Near or Within Sensitive Species Habitat[2]	X (WBP)		X (NSO, MM)	X (MM)			X (NSO)	X (NSO)		
Footprint Dimensions (Enclosure) (10'x10')		X	X	X		X	X	X		X
Footprint Dimensions (Hut) (four 2'-deep concrete footers; pad leveling)								X		X
Four 2'-Long x 1" Rebar to Anchor Hut			X	4x rock bolts			X			
Infrasound Footprint Dimensions (3-component infrasound array box, cable, and windscreen – 8"x8"x6" box dimensions; 45"x45"x24" windscreen; conduit trench 2' deep)						X	X	X		
Seismometer Footprint Dimensions (Seismometer and Cable Trench) (4' deep x 2' wide and 6" wide by 18"- to 24"-deep trench)			Contained in hut	X	X	X	X	X	X	X
Copper Ground Rod (up to 8' deep and 4" aboveground)		X	X			X	X	X		X

Note that Alternative 4 is shown in this table only for the sites that are included in Alternative 4.
Medium helicopters would be needed due to the use of larger monitoring stations at the Fremont Lookout and Shriner Peak alternative sites.
[1]All sites would require hand tools and power tools.
[2]MM = marbled murrelet, NSO = northern spotted owl, WBP = whitebark pine. All sites are within or near potential gray wolf habitat.

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ALTERNATIVES SUMMARY

Table 3 provides a summary of Alternatives 1 through 4, including the number of proposed and existing monitoring stations under all alternatives and number of proposed and existing monitoring stations in Mount Rainier Wilderness or NHLD.

Table 3. Summary of All Alternatives.

	Alternative 1 – USGS Proposed Action	Alternative 2 – No Action	Alternative 3 – Alternative Monitoring Sites	Alternative 4 – Reduced Number of Monitoring Sites (NPS Preferred Alternative)
Total of **new** monitoring stations proposed in MRNP	12	0	12	9
Total stations (**15 existing** stations plus new stations proposed in MRNP)	26	15	26	23
• **New sites** proposed in wilderness	9	0	11	6
• **Total sites** in wilderness (**5 existing plus new sites** proposed)	13	5	15	10
• **New sites** proposed in NHLD	6	0	1	3
○ Sites on/near MRNP historic structure	4	0	1	1
New sites requiring helicopter use	9	0	11	6
Helicopter flights for maintenance of existing sites over 30 years (~24 trips per site)[1]	144	144	144	144
Helicopter trips for installation of new sites (~7 trips per site, plus 1 trip per site for revegetation)	72	0	88	48
Additional helicopter trips for tuning and maintenance of new sites over 30 years (~27 trips per site)[2]	243	0	297	189

[1]Assumes up to four maintenance trips per site every 5 years for 30 years.
[2]Assumes three trips for fine-tuning after 2 to 3 years plus four trips every 5 years over 30 years for maintenance.

ALTERNATIVES CONSIDERED BUT DISMISSED

During the development of the proposed monitoring stations, alternatives were proposed that were dismissed due to resource impacts or because they did not meet the purpose and need for the project. These alternatives are described below.

Locate All New Long-Term Seismic/GPS Monitoring Stations Outside Wilderness

Because the intent of the proposed project is to more effectively detect lahars, identify affected drainages, and monitor the lahar hazards associated with the Mount Rainier volcano, placing the stations outside wilderness would mean locating them off the volcano. This would not meet the purpose and need for the project because locating stations off the volcano would not achieve the goal of rapidly detecting debris flows and lahars to provide authorities inside and outside the park with as much time as possible to notify and potentially evacuate residents, staff, and visitors. The short amount of time between the initiation of an event on the west side of the volcano and downstream impacts requires instrumentation within the potentially impacted drainages. Surrounding instrumentation is required (e.g., Mildred Point) to assess the extent of the hazard, such as if one or multiple drainages are being impacted. Infrasound, in particular, is most effective when placed near the impacted drainage as pressure waves in the atmosphere have been shown to be distorted or shadowed by local topography.

Increase the Number of Stations Proposed by the USGS

Additional stations would need to be installed by the USGS inside the park to enable robust lahar detection capabilities in other parts of the park besides the Nisqually River drainage, including the Carbon, White (East and West Forks), Muddy Fork of the Cowlitz, and Ohanapecosh River drainages. To enable robust lahar detection capabilities for all of Mount Rainier, the USGS would need to install three to four stations inside the park along each of these drainages, as well as additional high-elevation sites to serve as telemetry repeaters. Most sites would need to be near rivers and would feature a seismometer, an infrasound sensor and/or infrasound array, and in some cases a 300-foot- to 500-foot-long tripwire array. In addition, to bring the Mount Rainier volcano monitoring network up to the USGS's Level 4 standard for Very High Threat volcanoes (Ewert et al. 2005; Moran et al. 2008), at least six additional GPS stations would need to be installed inside the park. In most cases, these GPS stations would not be co-located with the lahar detection sites as GPS stations need a clear sky view, which means the stations would need to be installed on ridgetops or other locations with few or no trees. This would translate to roughly 25 new lahar detection sites inside the park (i.e., 13 sites in addition to the 12 sites proposed in Alternative 1, the USGS Proposed Action).

However, additional sites were not considered for this proposal because (a) current scientific understanding is that these other drainages are not as vulnerable to spontaneous noneruptive landslide-caused lahars; (b) the primary purpose of this project is to improve lahar detection capabilities, not volcano monitoring capabilities; and (c) the impact on wilderness would be far greater under this alternative. As described in Appendix B, the primary risk scenario that has influenced the design of the proposed lahar detection system is a spontaneous (i.e., not

associated with eruptive activity) collapse of a part of the west flank (Sunset Amphitheater), which has been shown by several studies to be the weakest flank of Mount Rainier and most susceptible to a spontaneous collapse.

ISSUES IDENTIFIED FOR AND DISMISSED FROM FURTHER ANALYSIS

The following issues were identified for detailed analysis in this EA:

- Special Status Species (northern spotted owl and marbled murrelet)
- National Historic Landmark District and Associated Historic Properties and Cultural Landscapes
- Public Health and Safety
- Wilderness Character

The rationale for carrying these topics forward for detailed analysis, along with issues dismissed from further analysis, is presented in Appendix C.

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the current and expected future conditions of the resources, including environmental trends (existing setting or baseline conditions), and analyzes the environmental consequences (impacts or effects) that would occur as a result of implementing the alternatives.

The preamble to the Council on Environmental Quality (CEQ) Regulations Implementing the Procedural Provisions of NEPA states that an agency "may contrast the impacts of the proposed action and alternatives with the current and expected future conditions of the affected environment in the absence of the action, which constitutes consideration of a no-action alternative" (85 Federal Register 43304, at 43323). Under the No Action Alternative, the new seismic and volcanic monitoring stations would not be placed in the park. The current conditions and trends of the resources described in *Affected Environment* would continue into the future. Because the information in *Affected Environment* fully captures the impacts that would occur under the No Action Alternative (i.e., "in the absence of the action"), to avoid restating the same information, the impact analysis of the No Action Alternative points the reader back to the discussion of resources and trends in *Affected Environment*. This constitutes consideration of the impacts of the No Action Alternative, in accordance with CEQ direction.

SPECIAL STATUS SPECIES – NORTHERN SPOTTED OWL AND MARBLED MURRELET

Affected Environment

For the purposes of this analysis, threatened and endangered wildlife species potentially impacted by the project include northern spotted owl and marbled murrelet. The analysis area includes project locations within the elevation range for habitat for these species (below 4,800 feet for northern spotted owl and below 3,800 feet for marbled murrelet) and the flight paths for project helicopters.

Northern Spotted Owl

The northern spotted owl (spotted owl) is strongly associated with structurally complex old growth forests. Suitable habitat has multiple canopy layers and contains trees of a variety of species, sizes, and ages, including standing and downed dead trees. Spotted owls require large amounts of suitable habitat, with median home ranges typically about 3,000 to 5,000 acres per pair of owls. Spotted owls nest in cavities or platforms in trees, and pairs are typically spaced about 1 to 2 miles apart. Northern spotted owls are long-lived territorial birds and often spend their entire adult life in the same territory.

The northern spotted owl nesting and fledging season is from March 15 through September 30. The breeding season is divided into an early season of March 15 to July 31 and a late season of August 1 to September 30. In late March or early April, the female will lay one to three eggs. Young are fed by both parents until August or September, although fledging may occur in May or June; by October the young disperse from the nest site. Nest trees include Douglas-fir, grand fir, Pacific silver fir, and other species. Nests are usually found in forests up to 4,800 feet in elevation.

The park contains approximately 80,000 acres of suitable spotted owl habitat (NPS 2020a). Spotted owl habitat extends up to an elevation of about 4,800 feet in the park (Figure 8). Surveys for spotted owls have been conducted annually in the park since 1997 as part of an ongoing spotted owl demography study (NPS 2020b). Critical habitat for spotted owls has been designated on national forest lands in Lewis and Pierce Counties, Washington, but no critical habitat has been formally designated in the park (U.S. Fish and Wildlife Service (USFWS) 2008). Recent studies found spotted owl occupancy declined by 50 percent in 20 years and provided evidence that spotted owls have declined in the park due to competition with barred owls (Mangan et al. 2019).

No spotted owl nesting attempts were documented at MRNP in 2020. This result is not unusual considering the biannual pattern of reproduction typically exhibited by Pacific Northwest spotted owl populations (NPS 2020a). Thirty-five spotted owl territories or sites were surveyed at MRNP in 2019 to determine occupancy and reproductive success, with five (14 percent) sites having at least one spotted owl present. One (3 percent) site had a male-female pair and four (11 percent) sites were occupied by single owls. These results are equivalent to observations from 2018 and represent the lowest level of occupancy, pairing, and number of individual owls since standardized monitoring began in 1997 (NPS 2019). In addition to ongoing threats from competition with barred owls, timber harvest and wildfires have resulted in habitat loss for northern spotted owls throughout their range. Existing impacts could include disturbance from recreational use or maintenance activities at the project locations within the elevation range for northern spotted owl or helicopter flights over suitable habitat. Although timber harvest does not occur at the park, habitat loss in the park due to wildfires may increase in the future due to climate change (Wan et al. 2019).

The USFWS uses a 0.7-mile radius (984 acres) from the spotted owl activity center to delineate the most heavily used area during the nesting season (USFWS 2006). Most of the proposed project locations are above 4,800 feet in elevation and not within suitable spotted owl habitat; and all but two sites (Tahoma Vista and the alternative site at Tahoma Vista Ridge) are beyond 0.7 mile of the activity centers of spotted owl territories. The project locations at Mount Wow, Tahoma Bridge, and Tahoma Vista, and the alternative site at Tahoma Vista Ridge are below 4,800 feet in elevation and are considered northern spotted owl dispersal habitat. Habitat at Mount Wow consists of talus and a disturbed roadside, with forest and Tahoma Creek nearby. The only active spotted owl territory in the park in 2020 was in the Tahoma Creek territory and none of the proposed sites are within 0.7 mile of this activity center. Forest habitat is present at the Tahoma Bridge and Tahoma Vista Ridge sites. The Tahoma Vista site is in a clearing surrounded by a road and forest. Spotted owls (juveniles or adults) may disperse beyond historic site centers in the autumn or if they are nonterritorial during the breeding season. They may also occasionally use these areas for foraging. In 2019, the NPS detected a banded adult female spotted owl that had not been observed for 10 years. The existing Kautz Helipad is also below 4,800 feet in elevation but is in a previously disturbed area without suitable spotted owl nesting habitat.

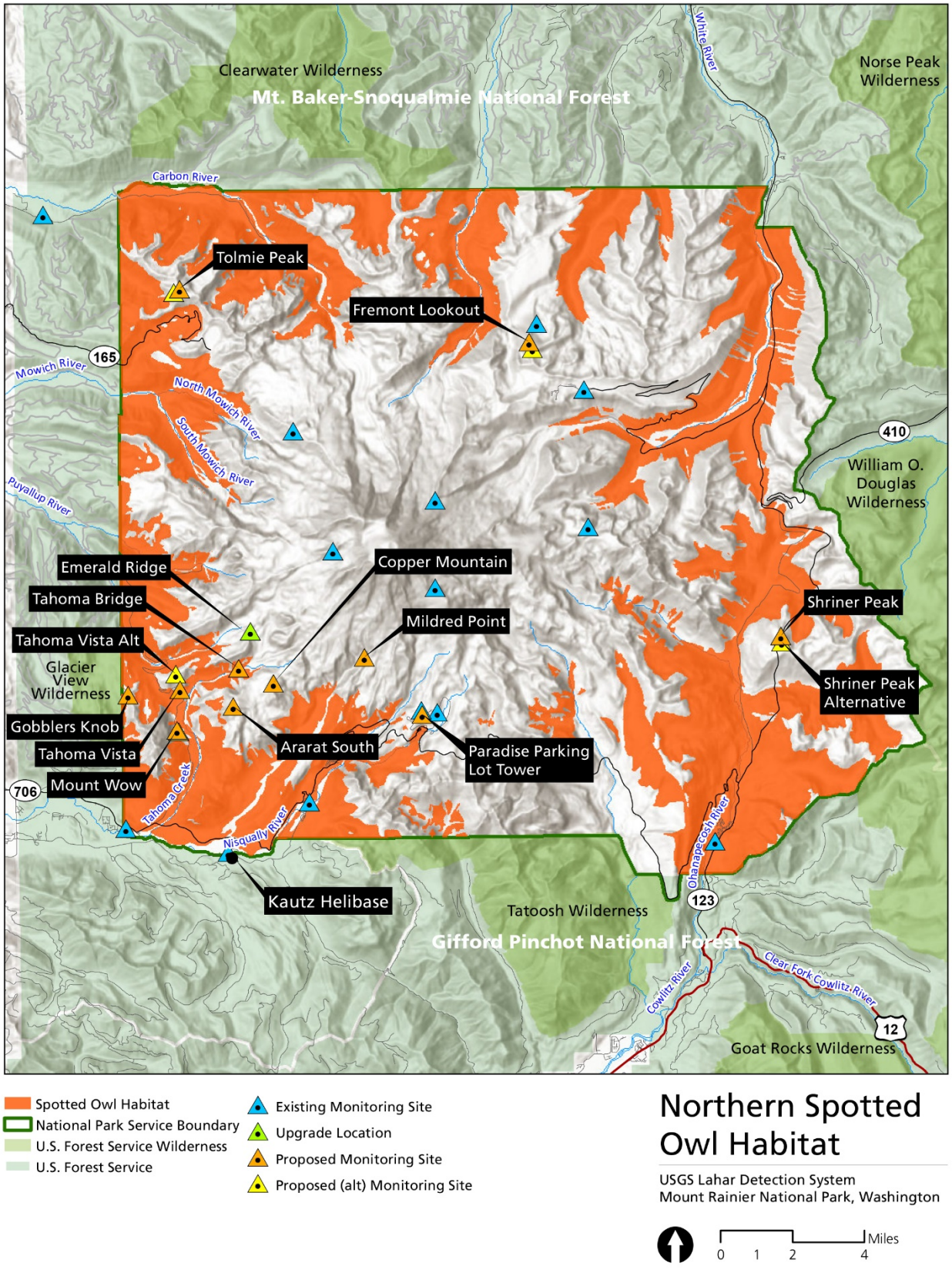

Figure 8. Northern Spotted Owl Habitat.

Marbled Murrelet

The marbled murrelet (murrelet) is a robin-sized seabird. Murrelets forage in sheltered near-shore waters and are year-round residents of coastal areas from northern California north to Alaska. Murrelets typically nest high in the canopy of old growth forests or stands of large trees infected with mistletoe and make daily inland-to-sea migrations. Approximately 26,500 acres of potential murrelet nesting habitat is in the park (Figure 9). Suitable habitat is typically below 3,800 feet in elevation. High-quality habitat is distributed along the western boundary of the park in valleys running east and west, separated by high-elevation ridges. Lower quality suitable habitat continues along the southern and southeastern areas of the park. Critical habitat for the species has been designated in Lewis and Pierce Counties, but the designation does not include the park.

A USFWS reassessment of available surveys and study findings indicate that murrelets in western Washington and the park actively nest from April 1 through September 23. In Washington, on average, incubation begins in April and extends through July. Both sexes incubate the egg for about 30 days. The average nesting period extends from late May through August, lasting about 30 days. Adults feed the chicks up to eight times per day, most often at dusk and dawn. Adults leave the chicks alone on the nest except during active feeding. A fledgling's first flight is presumed to be from the nest directly to the marine environment. The murrelet is thought to be most vulnerable to noise disturbance during the breeding season when adults are producing and incubating eggs.

Within the park, murrelets have been documented in four river corridors—Carbon, Mowich, Puyallup, and Nisqually. Audiovisual surveys have detected breeding behavior (subcanopy flights) in the Carbon, Mowich, and Puyallup Rivers. Thus, these drainages are considered "occupied" per USFWS guidelines. Repeated radar surveys along the Nisqually River at the Kautz Creek and Tahoma Creek confluences have detected very few (mean 4.7 per day, range 1 to 12) murrelet targets, suggesting the Nisqually River drainage, which includes Tahoma Creek, contains few murrelets (ABR, Inc. 2009). No active nests have been identified in the park; however, nest surveys have been few and limited to the Carbon River drainage. The park does not conduct regular monitoring activities for marbled murrelets. Existing impacts could include disturbance from recreational use or maintenance activities at the project locations within the elevation range for marbled murrelets or helicopter flights over suitable habitat. Future trends that could affect murrelets in the park and surrounding areas include habitat loss from logging or wildfires. Although timber harvest does not occur at the park, habitat in the park lost due to wildfires may increase in the future due to climate change.

Most of the project locations are above 3,800 feet in elevation and are not within suitable habitat for the murrelet. Project locations below 3,800 feet in elevation include both Mount Wow sites, Tahoma Vista, and the existing Kautz Helipad, which would be used for helicopter operations. These sites are previously disturbed and lack large old growth trees that could provide murrelet habitat.

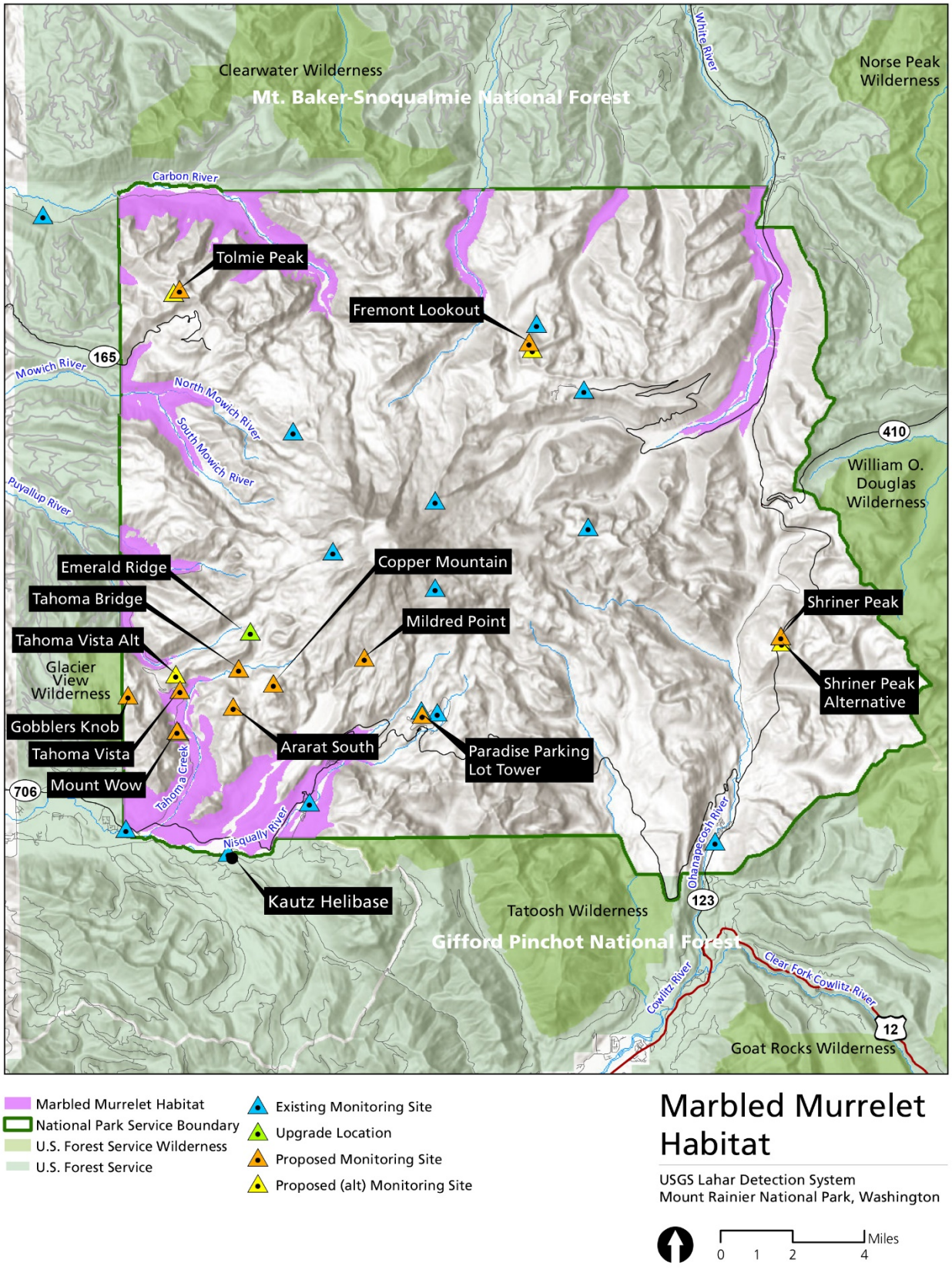

Figure 9. Marbled Murrelet Habitat.

Environmental Consequences

Alternative 1 – USGS Proposed Action

Northern Spotted Owl

Under the USGS Proposed Action, removal of vegetation would be minimal and would not degrade spotted owl habitat. The Tahoma Vista site is within 0.7 mile of the Lake George activity center. The Lake George activity center was last occupied by spotted owls in 2015, when a single female spotted owl was documented. The last nesting attempt at the Lake George activity center was in 2001 and was unsuccessful (NPS 2019). The Tahoma Vista monitoring station would be in a clearing encircled by a dirt road and surrounded by forest. Impacts at Tahoma Vista would include removal of about 100 square feet of previously disturbed grassy vegetation within the footprint of the newly installed hut and temporary disturbance of up to 500 square feet of vegetation from trenching to install conduit and by installing a seismometer.

Permanent impacts at Mount Wow would result from removal of about 100 square feet of grassy vegetation on the roadside within the hut footprint and would not degrade spotted owl habitat. About 100 square feet of mostly unvegetated area would be permanently affected at Tahoma Bridge within the hut footprint, and up to 500 square feet of temporary vegetation impacts would occur to install conduit and a seismometer. Although a seismometer would be installed in a forested area at Tahoma Bridge, no trees would be removed and trenching or digging near large tree roots would be avoided. These two sites are not within 0.7 mile of spotted owl activity centers; however, the Tahoma Bridge site is just outside the 0.7-mile buffer from the Tahoma Creek activity center, which was the only site occupied by spotted owls in 2020.

The total vegetation impacts at all sites below 4,800 feet in elevation would be 300 square feet of permanent impacts for hut installation and up to 1,500 square feet of temporary impacts for installation of conduit and seismometers. The remaining project locations are either above the 4,800-foot elevation limit for spotted owl habitat or unvegetated. At all sites, construction activities would be confined to the smallest area necessary to complete the work, and all areas of temporary vegetation disturbance would be restored with native vegetation following construction.

Increased noise and human presence from installation and maintenance of the lahar detection facilities could potentially result in disturbance to individual owls. Construction would use mostly nonmechanized and lithium battery-powered hand tools as summarized in Table 1 on page 12; therefore, noise disturbance from construction would be minimal. Installation would require up to seven round trips to each project location by a small helicopter carrying sling loads, as described above under *Helicopter Use*. Noise and activity from construction and helicopters during the breeding season has the potential to affect normal breeding and roosting behaviors of spotted owls. Spotted owl responses to noise disturbance range from no apparent reaction, to an alert response where the owls are attentive for the duration of the activity, to a flush response (Delaney et al. 1999). A negative effect on breeding occurs when noise or project activity causes a spotted owl to become so agitated that it flushes away from an active nest site or aborts a feeding attempt during incubation or brooding of nestlings. Such events are considered important because they have the potential to result in reduced hatching success, fitness, or survival of juveniles.

In previous consultations, the USFWS has determined that use of small helicopters greater than 110 yards and medium helicopters greater than 150 yards horizontally or vertically from a known occupied spotted owl nest tree or suitable nest trees in unsurveyed nesting habitat would not adversely affect spotted owls during the March 1 through July 15 early nesting season. During the late nesting season (July 16 through September 30), small and medium helicopters are not likely to adversely affect spotted owl nesting if they avoid hovering within 50 yards of a known occupied spotted owl nest tree or suitable habitat. USFWS guidance on disturbance, disruption, and physical injury distance thresholds for spotted owls is attached in Appendix D.

Most of the proposed helicopter flights would fly over potential northern spotted owl habitat; however, helicopters would stay at least 2,000 feet above the ground, except during takeoff, approach, and landing, to minimize impacts on spotted owls. Impacts would be further reduced by conducting installations and associated helicopter flights in September and October, avoiding most of the spotted owl nesting period. In addition, the sites below 4,800 feet (Mount Wow, Tahoma Bridge, and Tahoma Vista Overlook) would be installed in October as a mitigation measure to further reduce impacts on spotted owls. Helicopter flights within 110 yards of suitable habitat are only expected to occur at Tahoma Bridge. Flights at this site would occur after September 30, and landings would occur about 0.7 mile or greater from activity centers. Flight time at this site would be about 1 to 2 hours per day over a period of 2 days in October, and about 13.5 to 27 hours for tuning and maintenance flights over a period of 30 years. Work would also occur at Tahoma Vista Overlook and Mount Wow in October, but no helicopters would be needed because these sites are accessed by existing roads. Helicopter access to lahar detection sites during the nesting season for spotted owls would only occur if needed for emergency repairs. The frequency of possible flights for emergency repair is unknown but is estimated to be about two flights per year, based on USGS experience with other installations. As with other flights for installation, tuning, and regular maintenance, emergency flights would only encroach within 110 yards of suitable habitat at the Tahoma Bridge site and would not occur within 0.7 mile of an activity center. Although flights and work at the other lahar detection sites would occur in September or October and may overlap the last month of the nesting season, it would occur after birds have fledged and would not involve work or helicopter flights within 110 yards of spotted owl habitat.

Based on the distance from activity centers and implementation of mitigation measures, impacts on roosting or nesting spotted owls would be minimized to the extent that negative effects from helicopter overflights would be unlikely to occur. It is not expected that the local spotted owl population would be measurably affected, especially with implementation of mitigation measures, which greatly reduce the chances of any adverse impacts by minimizing helicopter operations within 110 yards of spotted owl habitat and within 0.7 mile of activity centers during the nesting season.

Marbled Murrelet

Project activities would not reduce available habitat for marbled murrelets because most work would occur in previously disturbed areas or would occur in nonhabitat areas above 3,800 feet in elevation. Where vegetation disturbance occurs below 3,800 feet (at Mount Wow and Tahoma Vista), it would not impact suitable marbled murrelet habitat. No trees that provide suitable nesting habitat for the marbled murrelet would be removed. Ground-disturbing activities would be confined to the smallest area necessary to complete the work, and all areas of temporary vegetation disturbance would be restored with native vegetation following construction.

Project work would occur in September and October and would overlap the murrelet nesting season (April 1 through September 23). There is limited information concerning murrelet vulnerability to disturbance effects. In general, responses to noise disturbance at nest sites have been modifications of posture and on-nest behaviors without flushing or abandoning the nest (Long and Ralph 1998; Hébert and Golightly 2006). Disturbance occurs when noise or project activity causes a murrelet to become so agitated that it flushes away from an active nest site or aborts a feeding attempt during incubation or brooding of nestlings. Such events have the potential to result in reduced hatching success, fitness, or survival of juveniles. Overall, it appears that murrelets are not easily disrupted from nesting attempts by human disturbance except when confronted at or very near the nest itself. The study completed by Hébert and Golightly (2006) monitored murrelet responses to disturbance events in a controlled manner. In this study, adult murrelets exposed to people operating chainsaws or groups of hikers passing nearby on park trails did not flush from the nest.

In previous consultations, the USFWS has determined that use of small helicopters greater than 110 yards and medium helicopters greater than 150 yards horizontally or vertically from a known occupied marbled murrelet nest tree or suitable nest trees in unsurveyed nesting habitat would not adversely affect marbled murrelets during the April 1 to September 23 nesting season. USFWS guidance on disturbance, disruption, and physical injury distance thresholds for marbled murrelets is attached in Appendix D.

Helicopter transport of equipment, materials and personnel (when necessary) to the sites would occur after Labor Day (near the September 23 end of the nesting season for marbled murrelets, after most of the young have fledged). Helicopter flights and installation work would occur over a two-day period at each site during installation, as described above for the spotted owl. As described above in the *Northern Spotted Owl* section, helicopters would stay at least 2,000 feet above the ground except during takeoff, approach, and landing. This would avoid most marbled murrelet habitat in the park, including the Carbon, Puyallup, and Mowich River valleys where most murrelets have been documented in the park. No helicopter landings would occur at the Mount Wow or Tahoma Vista Overlook sites, which are below 3,800 feet in elevation, because these sites are adjacent to existing roads.

As previously described, the Kautz Helipad site is not suitable murrelet nesting habitat; however, murrelets pass this site during their inbound and outbound daily movements along the Nisqually River. The Kautz Helipad would be used for most helicopter operations associated with the USGS Proposed Action, including during the murrelet nesting season, which ends on September 23. The area within 110 yards of the Kautz Helipad is not suitable nesting habitat for murrelets and, therefore, landing and takeoff from the Kautz Helipad would not affect nesting murrelets. The baseline level of noise at the Kautz Helipad would not increase because this location has operated as a helicopter base for many years. In addition, as described in Appendix A, helicopter flights from the Kautz Helipad would begin two hours after official sunrise and cease two hours before official sunset to avoid potential disruption to marbled murrelets during peak activity periods for feeding and incubation exchanges. As previously described, helicopter access to lahar detection sites during the nesting season for marbled murrelets would only occur if needed for emergency repairs. The frequency of possible flights for emergency repair is unknown but is estimated to be about two flights per year, based on USGS experience with other installations.

Based on the short duration of work, avoidance of murrelet habitat by flying helicopters at 2,000 feet, and implementation of timing restrictions as described in Appendix A, impacts on nesting

marbled murrelets would be minimized to the extent that negative effects from ground disturbance and helicopter noise are unlikely to occur. It is not expected that the murrelet population in the park would be measurably affected, especially with implementation of mitigation measures, which greatly reduce the chances of any adverse impacts.

Alternative 2 – No Action

Under the No Action Alternative, there would be no new impacts on northern spotted owls and marbled murrelets. Existing impacts on northern spotted owls and marbled murrelets would continue as described in the *Affected Environment* section. As previously described, the total number of flight hours in the park from 2015 to 2019 averaged 142 flight hours per year and the USGS estimates that about 3 to 4 maintenance trips per site would be needed every 5 years for the six existing monitoring sites that are helicopter dependent, for a total of about 144 helicopter flights over 30 years.

Alternative 3 – Alternative Monitoring Sites

Northern Spotted Owl

Impacts on vegetation at sites below 4,800 feet in elevation that could provide foraging habitat for spotted owls would be the same as described for the USGS Proposed Action, except that the Tahoma Vista location would instead be installed at Tahoma Vista Ridge and the Mount Wow site would be installed at the alternative site on the talus hillside instead of the roadside (Figure 8). Additional helicopter flights would be needed because neither of these sites can be directly accessed from existing roads. At the alternative site on Tahoma Vista Ridge, permanent impacts would occur on about 100 square feet of grasses and shrubby vegetation in an open area from installation of the hut, with an additional temporary disturbance of up to 500 square feet for installation of conduit. Infrasound devices would be placed in a forested area, but no trees would be removed. Impacts at Tahoma Vista Ridge would affect a similar size area as the Tahoma Vista site, but the existing vegetation at Tahoma Vista Ridge is undisturbed, in contrast to the Tahoma Vista site. The Tahoma Vista Ridge site is within 0.7 mile of the South Puyallup River activity center and is just outside the Lake George activity center. The South Puyallup River activity center was last occupied by a single male spotted owl in 2016 and was occupied by a nesting pair that produced one fledgling in 2013 (NPS 2019). The total vegetation impacts at sites below 4,800 feet in elevation would be 300 square feet of permanent impacts from hut installation and up to 1,500 square feet of temporary impacts from installation of conduit and seismometers.

Helicopter flights would be the same as described for the USGS Proposed Action, except that the total number of helicopter flights would increase to about 88 during installation over a 2-month period (September and October) each year for 2 years, and about 297 maintenance flights over a period of 30 years. The Shriner Peak and Fremont Lookout alternative sites would require use of medium helicopters instead of light helicopters. As previously described, most of the proposed helicopter flights would fly over spotted owl habitat; however, helicopters would stay at least 2,000 feet above the ground, except during takeoff, approach, and landing, to minimize impacts on spotted owls. Helicopters would deliver a sling load within 110 yards of spotted owl habitat at the Tahoma Bridge, Mount Wow Talus, and Tahoma Vista Ridge sites. Flights at these sites would occur after September 30, and landings would occur about 0.7 mile or greater from activity centers. Flight time at each of these sites would be about 1 to 2 hours per day over a period of 2 days in October, and about 13.5 to 27 hours for tuning and maintenance flights over a period of 30 years. Of the flights during installation, 24 of 88 would land in or near spotted owl habitat and 8 (at Tahoma Vista Ridge) would land within 0.7 mile of a spotted owl activity center. All other

flights for the remaining lahar detection sites would fly at least 2,000 feet above spotted owl habitat. Compared to the USGS Proposed Action, Alternative 3 would involve 16 additional flights during installation and an estimated 54 additional flights for maintenance over 30 years.

Although impacts would be greater than under the USGS Proposed Action because there would be more helicopter flights, both in total and within spotted owl habitat, implementation of mitigation measures would reduce the chances of adverse impacts by minimizing helicopter operations within 110 yards of spotted owl habitat and within 0.7 mile of activity centers during the nesting season.

Marbled Murrelet

Impacts on sites within marbled murrelet habitat (below 3,800 feet elevation) would be the same as the USGS Proposed Action except that the Mount Wow site would be installed in a different location on the talus slope. No impacts on murrelet habitat would occur.

The impacts from helicopter flights would be the same as described for the USGS Proposed Action, except that medium helicopters would be needed for the Shriner Peak and Fremont Lookout alternative sites and the total number of helicopter flights would increase from 72 to about 88 during installation and increase from about 243 to about 297 for maintenance over a period of 30 years, an increase of about 22 percent. Although impacts would be slightly greater than under the USGS Proposed Action because there would be about 22 percent more helicopter flights, it is not expected that the local marbled murrelet population would be measurably affected based on the short duration of work, avoidance of murrelet habitat by flying helicopters at 2,000 feet, and implementation of timing restrictions as described in Appendix A.

Alternative 4 – Reduced Number of Monitoring Sites (NPS Preferred Alternative)

Northern Spotted Owl

Impacts on vegetation at sites below 4,800 feet in elevation that could provide foraging habitat for spotted owls would be the same as described for the USGS Proposed Action. Eliminating the stations at Fremont, Tolmie, and Shriner Lookouts would not change the impacts on northern spotted owl because these sites are not within northern spotted owl habitat.

Helicopter flights would be the same as described for the USGS Proposed Action, except that the total number of helicopter flights would decrease to about 48 during installation over a 2-month period (September and October) each year for 2 years, and about 189 maintenance flights over a period of 30 years. As previously described, most of the proposed helicopter flights would fly over spotted owl habitat; however, helicopters would stay at least 2,000 feet above the ground, except during takeoff, approach, and landing, to minimize impacts on spotted owls. As described for the USGS Proposed Action, helicopter flights within 110 yards of suitable habitat would only occur at Tahoma Bridge. Flights at this site would occur after September 30, and landings would occur about 0.7 mile or greater from activity centers. Flight time at this site would be about 1 to 2 hours per day over a period of 2 days in October, and about 13.5 to 27 hours for tuning and maintenance flights over a period of 30 years. Work would also occur at Tahoma Vista Overlook and Mount Wow in October, but no helicopters would be needed because these sites are on existing roads.

Impacts would be the same as under the USGS Proposed Action because the number of helicopter flights within or near spotted owl habitat would be the same. As described for the

USGS Proposed Action, implementation of mitigation measures would reduce the chances of adverse impacts by minimizing helicopter operations within 110 yards of spotted owl habitat and within 0.7 mile of activity centers during the nesting season. Based on the distance from activity centers and implementation of mitigation measures, impacts on roosting or nesting spotted owls would be minimized to the extent that negative effects from helicopter overflights and sling-load deliveries would be unlikely. Project-related disturbance would be short in duration and would not result in harassment or harm to spotted owls. It is not expected that the local spotted owl population would be measurably affected, especially with implementation of mitigation measures, which greatly reduce the chances of any adverse impacts. The NPS submitted a biological assessment (BA) to the USFWS (NPS 2021) to document the potential impacts and proposed mitigation measures to protect northern spotted owls. The BA is expected to include a determination of "may affect, not likely to adversely affect" for northern spotted owl because impacts would be unlikely and therefore discountable.

Marbled Murrelet

The three sites eliminated under this alternative (Fremont, Tolmie, and Shriner Lookouts) are not within marbled murrelet habitat; therefore, impacts on sites within marbled murrelet habitat (below 3,800 feet in elevation) would be the same as the USGS Proposed Action, and no impacts on murrelet habitat would occur.

The impacts from helicopter flights would be the same as described for the USGS Proposed Action, except that the total number of helicopter flights would decrease from 72 to about 48 during installation and decrease from about 243 to about 189 for maintenance over a period of 30 years, a decrease of about 22 percent. As described for the USGS Proposed Action, it is not expected that the local marbled murrelet population would be measurably affected based on the short duration of work, avoidance of murrelet habitat by flying helicopters at 2,000 feet, and implementation of timing restrictions as described in Appendix A. As described above, the NPS submitted a BA to the USFWS (NPS 2021), with an expected determination of "may affect, not likely to adversely affect" for marbled murrelet because impacts would be unlikely and therefore discountable.

NATIONAL HISTORIC LANDMARK DISTRICT AND ASSOCIATED HISTORIC PROPERTIES AND CULTURAL LANDSCAPES

Affected Environment

The park has rich and diverse cultural resources, including prehistoric and historic archeological resources, historic structures, and cultural landscapes. The park is a designated National Historic Landmark District (NHLD) listed in the National Register of Historic Places (NRHP) in 1997 (Toothman et al. 2009) under Criterion A for its association with the American Park movement and Criterion C for landscape architecture, master planning, and transportation. The NHLD is discontiguous and consists of the built environment, including roads, trails, developed areas, and backcountry structures. The structures that make up the NHLD were first listed in the NRHP in 1991 under a multiple resource nomination (NPS 1991). Under the 1997 listing, 97 buildings, 60 structures, and 3 objects contribute to the NHLD. The NHLD is considered the most complete and best-preserved example of NPS master planning in the first half of the 20th century (NPS

2015) and is one of the fundamental resources and values of the park, as stated in the park's General Management Plan (GMP) (NPS 2001) and foundation document (NPS 2015).

Four proposed monitoring stations would involve mounting equipment on four fire lookouts, which are contributing structures to the NHLD: Fremont Lookout, Gobblers Knob, Shriner Peak, and Tolmie Peak (see Figure 5). These structures were built from 1932 to 1934 according to standardized design for NPS fire lookouts – two stories with a balcony around the second floor (Thompson n.d.). Each fire lookout is 14 feet by 14 feet, wood-framed, and two rooms with a wrap-around balcony on the second floor; the first floor is used for storage and is poured concrete and dirt floor. The second floor functioned as the fire lookout and living quarters with a suspended ceiling, tongue and groove walls, and oak floor. The standardized design was created by the Edward Nickel, Western Division (Harvey 1982). The four fire lookouts have had nonhistorical elements added in the past, including copper conductors, antenna masts at Tolmie Peak and Gobblers Knob, solar panels on the roof at Shriner Peak and Fremont Lookout, winter solar panels on shutters, and a telephone pole at Shriner Peak.

The first fire lookout in the park was built on Anvil Rock in 1920, with six fire lookouts eventually being built. Today, only the four fire lookouts included in this project remain. The fire lookouts have played a significant role for resource protection in the park and surrounding national forest lands, but today function primarily for interpretation and park operational support and less for fire protection.

The developed area around the Westside Road includes a parking area, comfort station, viewing platform, stone seating, rustic guardwalls, and water fountain, all of which contribute to the landscape. The first section of Westside Road was initiated in 1921 and it was not until 1930 that the first section was open to travelers. The Civilian Conservation Corps established a camp in 1933 and subsequently built several bridges. Westside Road is a significant example of a historic designed landscape (NPS 2006; Thompson n.d.). Along with Nisqually Road, Stevens Canyon Highway, East Side Highway, Mather Memorial Parkway, Yakima Park Highway, and the Mowich Entrance Road, Westside Road is part of a discontiguous loop-style circulation pattern that includes all of the aforementioned roads; however, each road, including Westside Road, was conceived as an independent system with its own design and construction period.

Environmental Consequences

Alternative 1 – USGS Proposed Action

Historic Fire Lookouts

The USGS Proposed Action includes the introduction of additional nonhistorical elements on the historic fire lookout structures that contribute to the NHLD. These lookouts include Fremont, Gobblers Knob, Shriner Peak, and Tolmie Peak. Nonhistorical elements common to each fire lookout (see Appendix B) include installation of two solar panels with a combined size of about 116 inches by 52 inches by 4 inches mounted on the south-facing portion of the roof; solar panel conductor wire would be routed from the roof and into the fire lookouts through a small hole that would need to be drilled unless existing ingress could be found. Two solar panels would be added to existing solar panels on the east-facing roof at Gobblers Knob (as well as the addition of new solar panels on the south-facing roof). Flexible solar panels would be installed on the existing shutters that are placed over the windows during the winter; a new 2-inch-

diameter antenna mast would be installed on one corner of the Gobblers Knob and Fremont Lookout structures and would be installed on existing structures at Shriner Peak (on an existing telephone pole) and Tolmie Peak (on an existing mast). Two antenna panels each 12 inches by 12 inches by 6 inches would be installed on top of each mast and telephone pole on Shriner Peak.

New antenna masts are proposed for Fremont Lookout and Gobblers Knob, and new antennas are proposed to be added to existing masts at Tolmie Peak and Gobblers Knob. Three antennas would be added to an existing telephone pole at Shriner Peak including a cable trench from the pole to the structure. A 3-inch by 3-inch by 2.5-inch GNSS timing antenna would be installed at Gobblers Knob, Shriner Peak, and Tolmie Peak under an eave, which would only be visible if standing directly underneath the eave. A buried seismometer and data cable trench are proposed for Gobblers Knob, Shriner Peak, and Tolmie Peak, which would require burying the seismometer about 30 feet from the structure and excavating a trench to extend the data cable to the structure and into the basement. All electronic equipment would be housed in the basement of the fire lookouts, which are not accessible to the public.

The installation of nonhistorical elements such as adding solar panels to the roofs and shutters, and adding new antenna masts on historic structures would affect the integrity of design and materials that comprise the structures, which would affect the visual setting and feeling of the structures. Nonhistorical elements have been added in the past to the historic structures, including antenna masts on the Tolmie Peak and Gobblers Knob fire lookouts and a detached telephone pole at Shriner Peak. Solar panels exist on the roofs of Shriner Peak and Fremont Lookout, and the park uses the existing winter shutters for solar panels. Copper conductors also exist at all four lookouts.

Tahoma Vista

The Tahoma Vista Overlook site was designed to serve as an overlook into the Tahoma Creek drainage when Westside Road was open to public vehicles. The area around the proposed site consists of short rock retaining walls and a small outbuilding. The installation would not alter those structures, but would be visible from Westside Road and from the clearing of the historic Tahoma Vista Overlook.

Nonhistorical elements proposed for the Tahoma Vista Overlook site include a fiberglass hut with solar panels attached to the outside. The hut would have a square base approximately 60 inches wide by 80 inches high. A solar panel would extend above the top of the hut, not to exceed 9 feet. A pole would be attached to the hut that extends 12 feet or less above the local ground surface with a flat panel antenna (approximately 1 foot by 1 foot) placed near the top. The hut and exposed equipment (except the solar panels and radio antenna) would be painted to minimize visibility. Other visibility mitigation measures may also be employed in places that do not cover the antennas or solar panels and would be designed in coordination with the park historic landscape architect and the USGS.

A seismometer would be buried in the ground in a 4-foot-deep hole that is no more than 2 feet wide and would be located no more than 30 feet from the enclosure. The trench would be backfilled and revegetated using native species. An infrasound array housed in a small box would be placed on the ground and covered with a windscreen secured with rebar.

Installation of the monitoring station at Tahoma Vista would introduce a new visual element affecting the setting of the overlook, which contributes to the Westside Road cultural landscape

and NHLD. The visual effect of installing a hut and antenna could be mitigated by placing the equipment in an unobtrusive location within the overlook setting with additional screening measures.

Mount Wow

The Mount Wow proposed location would be situated directly adjacent to Westside Road and would add nonhistorical elements to the setting of the NHLD, including a fiberglass hut with a solar panel extending no more than 12 feet above the hut and an antenna mast and solar panel. Housing and equipment would be similar to Tahoma Vista except that the seismometer would be contained within the hut.

Tahoma Bridge

The Tahoma Bridge location would add nonhistorical elements to the setting of the NHLD and would be visible from the Wonderland Trail, which contributes to the NHLD. Housing and equipment would be similar to Tahoma Vista.

Alternative 2 – No Action

Under the No Action Alternative, there would be no new impacts on the NHLD, historic structures, or the cultural landscape. No equipment installation would take place that would affect the physical or visual setting of historic structures. Existing monitoring stations visible from the NHLD would continue to impact the setting and viewshed of the NHLD.

Alternative 3 – Alternative Monitoring Sites

Historic Fire Lookouts

Under Alternative 3, no new nonhistorical materials would be installed on Fremont Lookout, Shriner Peak, and Tolmie Peak historic structures. Rather, equipment would be housed in an enclosure containing the electronics and batteries measuring 6 feet long by 6 feet wide by 6 feet tall. The Fremont Lookout and Shriner Peak alternative sites would require a larger hut structure, such as the Pepro System design, as compared to the USGS Proposed Action. The standard Pepro System design requires no foundation and no excavation (Figure 6). The design includes an enclosure containing the electronics and batteries measuring 6 feet long by 6 feet wide by 6 feet tall mounted on four concrete grounding pad "feet" with extended outrigger ballast baskets creating a footprint measuring 10 feet long by 10 feet wide. with an overall footprint of 10 feet by 10 feet that would not be visible from the historic fire lookouts (although the top of the mast at the Fremont Lookout may be visible to the lookout). Other features include three solar panels mounted to the top of the enclosure, a mast extended up one side of the hut with up to four solar panels (each 1 foot by 1 foot by 6 inches) mounted on top. The enclosure would sit on four concrete pads. The Tolmie Peak alternative site would contain the detection equipment in a fiberglass hut 60 inches by 60 inches by 80 inches high. A solar panel would extend above the hut but would not exceed 9 feet, and a pole would extend above the hut not to exceed 12 feet and would have two antennas on top (each 1 foot by 1 foot by 6 inches). The hut would sit on four concrete pads.

Buried seismometers also would be installed at Gobblers Knob, Shriner Peak, and Tolmie Peak.

Tahoma Vista Ridge Alternative Site

Under the Tahoma Vista Ridge alternative site, proposed monitoring structures would not be installed in view of the Tahoma Vista developed area.

Mount Wow Talus Alternative Site

The Mount Wow Talus alternative site includes installation of a fiberglass hut and pole antenna on a rocky point above Westside Road and would be similar to the design at Tahoma Vista. However, the seismometer and infrasound sensor would be placed on the ground inside of the hut. Installation of equipment visible from Westside Road would introduce a nonhistorical element to the visual setting of the NHLD and Westside Road cultural landscape, although the location would be less visible than the USGS Proposed Action. Although the location would be visible from the road, screening could be implemented to minimize the visual effect. Under the Mount Wow Talus alternative site, impacts on the historic setting of the NHLD and contributing structure would be minimized by being located away from travelers' direct line of sight but would still have an effect on the setting of the NHLD.

Installation and maintenance involving battery swaps would likely require a helicopter.

The remaining antenna locations would not affect historic properties because they would be installed outside of the viewshed of the NHLD.

Alternative 4 – Reduced Number of Monitoring Sites (NPS Preferred Alternative)

Eliminating the stations at Fremont, Tolmie Peak, and Shriner Lookouts would avoid potential adverse effects on these lookouts by not installing additional nonhistorical elements on these historic structures. Effects on Gobblers Knob, Tahoma Vista, and Mount Wow would be the same as Alternative 1, the USGS Proposed Action.

PUBLIC HEALTH AND SAFETY

Affected Environment

Mount Rainier is an active volcano located in the park near the growing Seattle-Tacoma metropolitan area. The mountain poses significant volcanic, landslide, and flooding hazards to park visitors, NPS employees, and neighboring communities. Lahars, or volcanic mudflows, are the primary volcanic hazard with potential to impact people living, working, or recreating in or near the park. Mount Rainier has erupted more than 40 times over the last 10,000 years, including the most recent eruption about 1,000 years ago (Sisson and Vallance 2009). In addition, it has produced at least nine large lahars in the last 5,600 years that reached into the Puget Lowlands – most recently the Electron Mudflow in 1500 A.D.

Because of its hazards, the ongoing signs that it has potential to erupt again, and the large number of people exposed to its hazards, Ewert et al. (2005, 2018b) ranked Mount Rainier as one of 18 Very High Threat volcanoes (see the footnote on page 1, *Introduction*) in the United States. According to Diefenbach et al. (2015), more than 90,000 people live in areas vulnerable to lahars from Mount Rainier. The largest lahar of the last 5,600 years, known as the Osceola Mudflow, was caused by a large landslide that occurred during a Mount Rainier eruption that left a massive crater on the northeast flank. It flowed down the White River valley, eventually reaching the

ocean near the present-day ports of Seattle and Tacoma. The most recent large lahar, the Electron Mudflow from 1500 A.D., was caused by a large landslide from the present-day Sunset Amphitheater area on the west flank. It flowed down the Puyallup River valley, eventually reaching into areas that today have growing populations in the Puyallup River valley, including what is now the town of Orting, where 9 to 13 feet of mud and debris were deposited (Diefenbach et al. 2015).

Recent modeling studies (USGS unpublished data) indicate that a landslide that transitions into a lahar could flow down the Puyallup and/or Nisqually River valleys, reaching the park's Nisqually entrance in as little as 10 minutes, the town of Ashford in 20 minutes, and the city of Orting in 60 minutes. The actual arrival time of the flow and impacted drainages depend on the size and location of the failure and the mobility of the flow.

Although most large lahars have occurred in association with Mount Rainier eruptions (e.g., Sisson and Vallance 2009; Scott et al. 1995), recent scientific studies have shown that the west flank of Mount Rainier is potentially vulnerable to a large-scale collapse that could occur without eruption and that could produce a large lahar down the Puyallup River, Mowich River, or Tahoma Creek drainage (Finn et al. 2001; Reid et al. 2001), as apparently occurred with the 1500 A.D. Electron Mudflow (e.g., Sisson and Vallance 2009). For the Puyallup and Mowich Rivers, the USGS focused on installing new monitoring stations outside the park boundary because the warning capability required (40 to 60 minutes) can be addressed by the existing volcano monitoring network inside the park plus the new stations outside the park. However, in the Nisqually River drainage, in particular the Tahoma Creek drainage, the time to the nearest impact on population is estimated by recent modeling studies to be as little as 10 to 20 minutes (George et al. in review); thus, enhanced monitoring high in the drainage (and in the park) is required to mitigate the hazard. Most lahars at Mount Rainier and around the world are linked with eruptions at the volcano.

In a 2008 report, a panel of scientists issued a recommendation that Very High Threat volcanoes like Mount Rainier have 12 to 20 seismic and GPS stations within 20 kilometers to effectively monitor unrest at the volcano (Moran et al. 2008). Landslides and lahars were not explicitly mentioned in the report. As of September 2020, the Mount Rainier network consists of 18 seismic and 6 GPS stations located within 12 miles of the summit, of which 13 seismic and 6 GPS monitoring stations are within park boundaries (many seismic and GPS stations are collocated; therefore, 15 total monitoring sites are in the park). The short time between the start of a failure on the west side of the volcano and impacts in the Tahoma Creek drainage and communities downstream requires additional monitoring sites within and around the impacted drainage to help improve detection times. This information would then be provided to local emergency management agencies as well as to MRNP. A detection system has been in place since 1998 along the Puyallup and Carbon Rivers (all sites are outside the park), but the system has outdated equipment, has limited capabilities, and provides no coverage for the Nisqually River. Upgrades to this system, including new stations outside the park, are ongoing as part of the larger Mount Rainier lahar detection system project.

According to the USGS proposal (2019), the use of helicopters would be needed to install and maintain several of the proposed monitoring stations. According to the MRNP Aviation Briefing (2020), from 2015 through 2019, all aircraft use in the park, which is primarily helicopter flights, averaged 142 flight hours per year. Current use of aircraft in the park includes:

- Public health and safety
- Search and rescue
- Emergency medical evacuations
- Construction and maintenance of park facilities and volcano monitoring sites
- Stocking of backcountry camps and removal of human waste
- Research and natural resource management
- Wildland fire detection and suppression
- Law enforcement

Environmental Consequences

Alternative 1 – USGS Proposed Action

As discussed in *Affected Environment,* Mount Rainier shows ongoing signs that it has potential to erupt again, with many local communities, park staff, and visitors exposed to its hazards. Under the USGS Proposed Action, the addition of monitoring stations would greatly improve detection and the ability to notify the public of potential hazards. The proposed network would provide useful information for models of debris flow generation and movement. Such models would ultimately lead to an improved ability to detect and characterize debris flows on Mount Rainier, as well as other volcanoes around the world, and would enable the park to better inform visitors, including wilderness users, of local hazards and how the park itself handles such events.

The sites proposed in this EA would reduce the amount of time it takes for an alert to be sent out to potentially affected populations and communities after a lahar has been generated. The expansion would also increase the number of total drainage areas covered by the alert system to include the Tahoma Creek and Nisqually River drainages, which, along with the Puyallup River valley, are vulnerable to future spontaneous landslide-caused lahars from Mount Rainier. These sites would confirm the presence of a lahar coming down Mount Rainier and provide data on the velocity and size of the lahar, which would aid in estimating how far the lahar would travel and at what speed.

Although visitors to remote wilderness areas would likely not hear warning signals if a lahar is detected, early detection could help with quicker emergency response for wilderness users. In addition, visitors to lower reaches of wilderness areas could be within range of warning signals.

Installation and maintenance of the proposed monitoring stations would pose risks to staff working in these areas based on the inherent risks associated with these sites. Steep and rough terrain, high-altitude conditions, unpredictable weather events such as snow or lightning storms, and use of helicopters to access several of the sites increase risk to pilots and workers during site access (although staff would hike to installation sites whenever possible). Installation and maintenance protocols would be used to reduce these risks. Staff would be trained and experienced with wilderness and/or backcountry travel and working in these conditions. Weather would be tracked closely prior to any work being performed, and protocols would be in place if unanticipated inclement weather arose during work in backcountry areas.

Helicopter access is proposed for the following locations under the USGS Proposed Action: Emerald Ridge, Ararat South, Copper Mountain, Fremont Lookout, Gobblers Knob, Mildred Point, Shriner Peak, Tahoma Bridge, and Tolmie Peak. Helicopter use would follow current park

protocols, as specified in the Mount Rainier National Park Aviation Briefing (NPS 2020c). These protocols ensure all flights are reviewed and approved by designated authorities, risk assessments are completed prior to flights, wilderness concerns have been evaluated in a Minimum Requirements Decision Guide, and environmental concerns are mitigated to the extent possible (e.g., noise).

Additional BMPs and mitigations for work in wilderness and helicopter use are included in Appendix A.

Additional benefits are likely to result from installation of the system, including enhancing detection ability and understanding of rockfall, glacial dynamics, flooding, and other processes. The proposed stations would improve volcano monitoring capabilities, including the ability to detect anomalous small earthquakes that often precede eruptions, small-scale surface deformation that often precedes eruptions, and explosions that often accompany volcanic unrest and eruption.

The proposed network would also provide information useful for models of debris flow generation and movement. Such models would ultimately lead to an improved ability to detect and characterize debris flows on Mount Rainier as well as other volcanoes around the world and would enable the park to better inform visitors, including wilderness users, of local hazards, and also improve how the park itself is able to respond to such events. Smaller debris flows from Mount Rainier would also serve to calibrate and tune the proposed network, improving the ability of the USGS to detect and characterize smaller events with less risk of false alarms.

Alternative 2 – No Action

Under the No Action Alternative, there would be no change to public health and safety. Existing monitoring stations would continue to provide data for areas covered by these installations. Helicopter flights would continue to be needed to maintain existing aviation-dependent monitoring sites in addition to the current aviation use in the park. There would be no additional capability to provide reliable warning of a large lahar to residents downstream of Tahoma Creek, including park staff living in residences at the Nisqually entrance and citizens living in low-lying parts of Ashford near the Nisqually River. Information to advise park visitors regarding potential volcanic risks would remain at existing detection levels.

Alternative 3 – Alternative Monitoring Sites

The alternative monitoring sites proposed would provide the same degree of benefit to public health and safety as the USGS Proposed Action with regard to increased monitoring and the ability to notify the public of potential volcanic activity and lahars. Risks to public health and safety from installation and maintenance of monitoring stations would be similar to the USGS Proposed Action with regard to rough, steep terrain and unpredictable weather. Helicopter access would differ from the USGS Proposed Action for the Mount Wow Talus and the Tahoma Vista Ridge alternative sites. Under the USGS Proposed Action, helicopter access would not be needed at the Mount Wow and Tahoma Vista sites, whereas under the Mount Wow Talus and Tahoma Vista Ridge alternative sites, helicopter access would be needed, increasing pilot and worker safety risk during these flights (although staff would hike to installation sites whenever possible).

Overall, impacts on public health and safety under Alternative 3 would be similar to the USGS Proposed Action, with the exception of the increased risks from helicopter use for the Mount Wow Talus and Tahoma Vista Ridge alternative sites.

Alternative 4 – Reduced Number of Monitoring Sites (NPS Preferred Alternative)

Under Alternative 4, the following three stations under the USGS Proposed Action would not be installed: Fremont Lookout, Shriner Peak, and Tolmie Peak; the remaining nine stations would be installed. As described under the USGS Proposed Action and Appendix B, the three stations would function primarily as telemetry nodes for future stations installed along the following drainages, in the event of future volcanic unrest at Mount Rainier: White, Ohanapecosh/Cowlitz, Carbon, and Mowich Rivers. The Shriner Peak and Tolmie Peak stations proposed in Alternatives 1 and 3 would also have seismometers, providing improved seismic monitoring capabilities particularly on the east/southeast side of MRNP where there are presently only three seismometers. Under Alternative 4, if Mount Rainier were to start exhibiting signs of volcanic unrest, these three stations would not be in place for rapid installation of new real-time monitoring stations to help mitigate lahar hazards along these other drainages. Modeling and geologic studies (see Appendix B) show that the drainages most vulnerable to lahars created by a west-flank landslide are Tahoma Creek and the Puyallup River valley; and the nine sites proposed under Alternative 4 would address the area with the highest known lahar risk to public health and safety. Alternative 4 would not address the elements included in Alternatives 1 and 3 that are intended to support future data communication from within steep, confined river valleys closer to the volcano in other areas of the park. This would require additional mobilization efforts should increased volcanic activity in these areas of the park be detected that require deployment of additional monitoring and telemetry equipment.

WILDERNESS CHARACTER

Affected Environment

The Mount Rainier Wilderness currently encompasses 228,400 acres, approximately 97 percent of the park (Figure 10). Located on the western slope of the Cascade Range, the wilderness includes Mount Rainier, which is the most prominent peak in the Cascade Range and is 65 miles southeast of the Seattle-Tacoma metropolitan area. The Mount Rainier Wilderness was designated by Congress on November 16, 1988, by Title III of the Washington Park Wilderness Act, which required that the land be protected and managed in accordance with the Wilderness Act of 1964. Wilderness character is one of the fundamental resources and values of the park, as stated in the park's GMP (NPS 2001) and foundation document (NPS 2015).

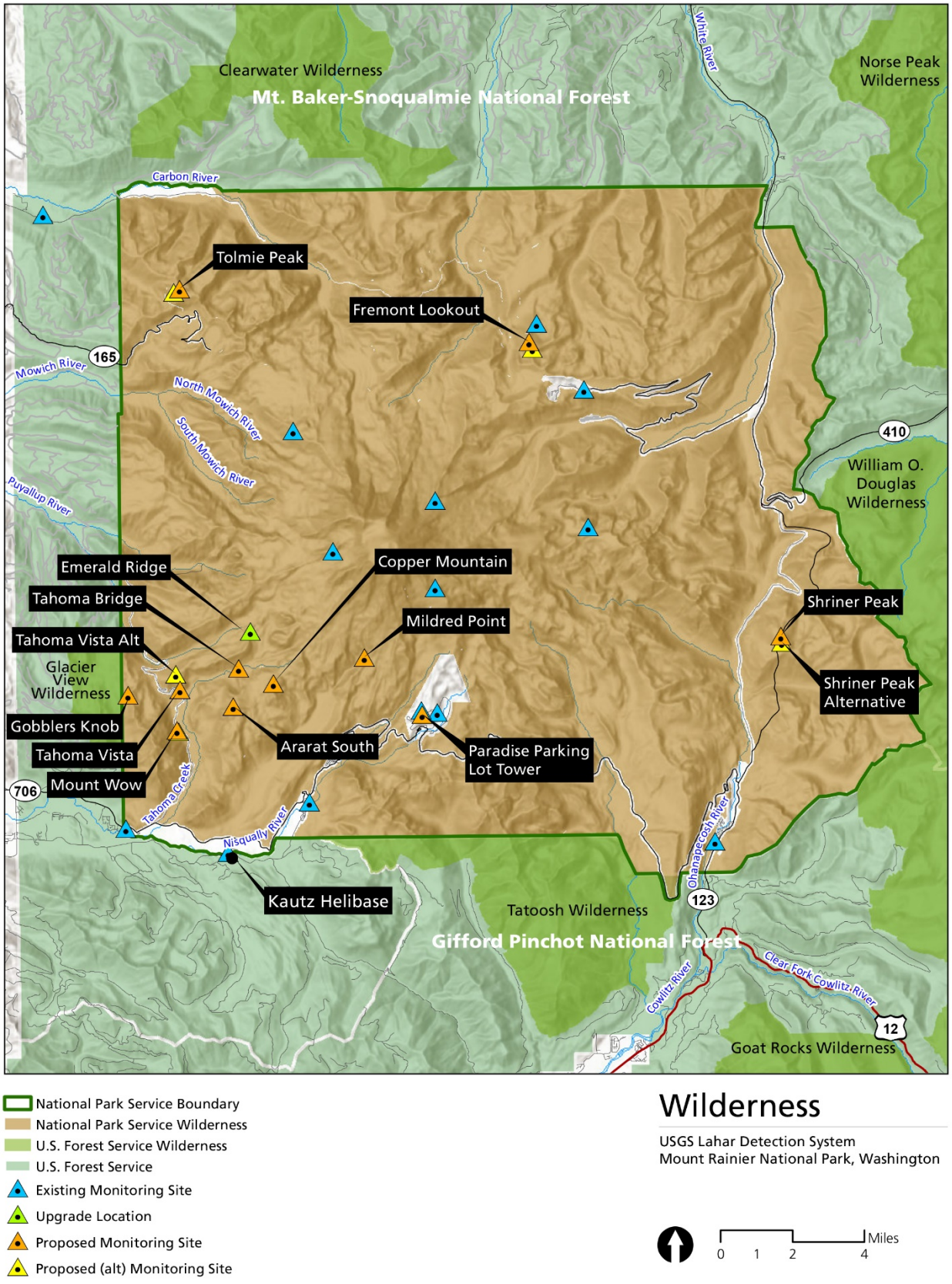

Figure 10. Mount Rainier National Park and Surrounding Wilderness Areas.

The Wilderness Act provides a legal mandate to preserve wilderness character. Wilderness character comprises tangible and intangible qualities of landscapes unmodified by modern human activity; personal experiences free from societal constraints; and symbolic meanings of humility, restraint, and interdependence (NPS 2014). The five tangible qualities of wilderness character that stem from the Wilderness Act of 1964 are natural, undeveloped, untrammeled, outstanding opportunities for solitude or primitive and unconfined recreation, and other features of value. These qualities in the park are described below.

Natural

A natural wilderness is one where ecological systems are substantially free from the effects of modern civilization.

The natural quality is preserved when only indigenous species and natural ecological conditions and processes exist, and may be improved by controlling or removing nonindigenous species or by restoring ecological conditions. The natural quality is degraded by human-caused change to the natural environment (i.e., human-caused effects on plants, animals, air, water, and ecological processes).

The Mount Rainier Wilderness contains some of the nation's cleanest air and water and is home to diverse plants, animals, and ecological processes, which is especially important given the park's location near heavily logged and developed lands. Ongoing and potential future degradations to the natural quality of wilderness in the park include the extirpation of native species, introduction of nonnative species, acceleration of disturbance regimes, and presence of pollutants. Anthropogenic climate change also poses a continual threat as warming temperatures irreversibly alter ecological communities and processes.

Undeveloped

An undeveloped wilderness is one without permanent improvements or the sights and sounds of modern human occupation.

The undeveloped quality is preserved or sustained when modern structures, installations, habitations, motor vehicles, motorized equipment, or other mechanical transport is not used in wilderness. This quality is improved when these prohibited uses are removed or reduced.

Nearly all structures, signs, roads, and other developments in the park are concentrated in the 3 percent of the park outside of designated wilderness. The undeveloped quality is degraded, however, by administrative and research infrastructure, as well as necessary mechanical operations, and it is continually threatened by increasing demands on wilderness and deteriorating infrastructure. Examples of existing or potential future degradations to the undeveloped quality include the presence of backcountry cabins, fire lookouts, service roads, radio repeaters, weather telemetry stations, and administrative use of motorized transport such as helicopters.

Untrammeled

An untrammeled wilderness is one that is unhindered and free from the intentional actions of modern human control or manipulation.

The untrammeled quality is preserved or sustained when actions to intentionally control or manipulate the components or processes of ecological systems inside wilderness (e.g.,

suppressing fire, stocking lakes with fish, installing water catchments, and removing predators) are not taken. The untrammeled quality is further degraded by actions that intentionally manipulate the biophysical environment (e.g., removing nonnative species, collaring and tagging animals, intervening in the behavior or lives of native plants and animals, conducting projects to restore the natural conditions of wilderness, and interfering in natural processes and energy flows).

The Mount Rainier Wilderness is fundamentally untrammeled and shaped by the forces of nature, including powerful meteorological and geological forces. However, despite park management's commitment to maintain the untrammeled quality of the wilderness, future authorized and unauthorized actions may degrade the untrammeled quality. These activities including fire suppression, soil and vegetation restoration projects, herbicide use on nonnative plant species, trail rerouting projects, projects involving the capture and release of wildlife, and restoration or repair of infrastructure such as bridges and trails. Unauthorized degradation of the untrammeled quality has also occurred from unauthorized stocking of nonnative fish in alpine lakes.

Solitude or Primitive and Unconfined Recreation

Wilderness provides outstanding opportunities for recreation in an environment that is relatively free from the encumbrances of modern society, and provides the benefits and inspiration derived from self-reliance, self-discovery, physical and mental challenge, and freedom from societal obligations.

The solitude or primitive and unconfined recreation quality is preserved or improved by management activities that reduce visitor encounters, reduce signs of modern civilization inside wilderness, remove agency-provided recreation facilities, and reduce management restrictions on visitor behavior. The solitude or primitive and unconfined recreation quality is degraded by sights and sounds of human activity (solitude), and by facilities that decrease self-reliant recreation and management restrictions on human behavior (primitive and unconfined).

The park's expansive wilderness provides outstanding opportunities for experiencing solitude in remote areas of the park. These unspoiled reaches of wilderness provide an arena where those visiting the wilderness may find tranquility and escape reminders of mechanized society, and where individuals can be truly alone in the enormity of the natural world. However, because of the park's proximity to heavily populated metropolitan areas, heavy visitation by day hikers and overnight users degrades this quality. In the future, increasing visitation pressures, improving technologies, and growing concerns for visitor and resource safety may threaten this quality.

Other Features of Value

This quality captures important elements or "features" of a particular wilderness that are not covered by the other four qualities, and are truly unique and essential to the character of that wilderness.

The Wilderness Act states that wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." Typically, other features of value occur in a specific wilderness location, such as archeological, historical, or paleontological features; some, however, may occur over a broad area such as an extensive geological or paleontological area, or a cultural landscape. This quality is preserved when these "other features

of value" are preserved. The other features of value quality are degraded by deterioration or loss of integral site-specific features of value.

Other features of value in the park's wilderness include traditional and cultural properties associated with six Native American tribes, archeological sites, and portions of the park's NHLD, including historic patrol cabins and fire lookouts that also contribute to the "other features of value" quality of wilderness character. The park's wilderness also has substantial scientific and educational, geologic, and scenic value. The wilderness offers educational and scientific opportunities for geologists, ecologists, and biologists. For example, the Mount Rainier Wilderness provides unparalleled opportunities to study geological and volcanic processes, and the results of these studies are applicable not just at Mount Rainier but at other volcanos around the world. The scientific and educational, geologic, scenic, and experiential values of the Mount Rainier Wilderness are, however, degraded by multiple factors, such as climate change, glacial recession, air pollution, and deteriorating infrastructure.

Environmental Consequences

The analysis area for wilderness character includes the monitoring sites within wilderness, the viewsheds from which the sites could be visible to visitors within wilderness, and flight paths for project helicopters.

Alternative 1 – USGS Proposed Action

Under the USGS Proposed Action, structures or installations would be constructed or modified within designated wilderness at Ararat South, Copper Mountain, Emerald Ridge, Fremont Lookout, Gobblers Knob, Mildred Point, Shriner Peak, Tahoma Bridge, and Tolmie Peak. Of the 9 installations in wilderness, 4 would be collocated with existing developments in wilderness; 4 would be new developments in wilderness in previously undisturbed locations; 1 (Emerald Ridge) is an upgrade but is being relocated and increased in size; and 3 (Mount Wow, Tahoma Vista Overlook, and Paradise Parking Lot Tower) would be in non-wilderness sites. Impacts on wilderness character are described below.

Natural

The natural quality of the Mount Rainier Wilderness would be affected by small scale, localized, and temporary impacts on the natural environment. The USGS Proposed Action would alter less than 0.1 acre of vegetation within the 228,400-acre wilderness and impacts are expected to partially recover to a natural state over time. Due to the small scale and widely separated nature of the proposed sites, and the implementation of mitigation measures to reduce impacts, the USGS Proposed Action would have only minimal adverse effects on plants, animals, air, water, and ecological processes. Some site-specific negative impacts on natural resources (soils, vegetation, and soundscape) would occur during installation, and potentially maintenance, of structures in currently undeveloped wilderness. It is also possible that foot traffic from maintenance visits or curious visitors could cause the development of visitor-created trail impacts where they do not currently exist. Noise and activity from construction and helicopters have the potential to affect breeding and roosting behaviors of spotted owls and marbled murrelets; however, with implementation of mitigation measures, the project is not expected to adversely affect these species, as described in the *Special Status Species* section.

Undeveloped

The USGS Proposed Action would have both permanent and temporary effects on the undeveloped quality of the Mount Rainier Wilderness. Construction activities would introduce noise and sights of additional human occupation, which would adversely affect the undeveloped quality of the wilderness. Use of mechanized equipment, such as power tools, and use of a helicopter for material delivery would introduce unnatural sounds during installation and maintenance work. Impacts on the undeveloped quality during construction would generally be low, and disturbance would be mostly contained to a brief construction period at each site. Elevated noise levels from the use of mechanized equipment would occur during construction for a period lasting two to three days at each site. Use of a helicopter to transport material would result in a temporary increase in noise that would affect the undeveloped quality of wilderness for about one to two hours per day over a period of about two days at each site. The total number of helicopter flights would be about 72 during installation over a 2-month period (which would occur September and October 2021 and possibly extend into September or October 2022 depending on weather conditions and other factors) and about 243 maintenance flights over a period of 30 years. This would represent an increase of about 25 to 50 percent in flight time during the 1- to 2-year installation period and an increase of about 3 to 6 percent in flight time compared to the existing number of flights over the 30-year maintenance period. Helicopters would deliver materials to the project sites via sling loads during installation. Maintenance flights would also involve sling loads to deliver and remove heavy equipment. Crews would hike to the sites to reduce the number of flights for both installation and maintenance. Maintenance flights could also involve landings in the wilderness if critical outages occur when sites are not accessible by foot.

Following installation, the presence of new structures and installations at Ararat South, Copper Mountain, Emerald Ridge, Mildred Point, and Tahoma Bridge would degrade the undeveloped wilderness quality by introducing visible signs of human occupation. Under the USGS Proposed Action, the number of standalone seismic installations in wilderness would increase from five to nine. The other installations would be collocated with existing developments and installations. The number of stations in wilderness dependent on aircraft would increase from 5 to 13. As previously described, the physical footprint of all installations in wilderness would be less than 0.1 acre in the 228,400-acre Mount Rainier Wilderness. The installation locations were designed to minimize visibility to the greatest extent practicable by using screening from vegetation and topography. Stations would be painted to reduce their visibility and placed strategically to minimize detection by the casual visitor; however, several of the sites would be potentially visible to the public from nearby as well as from a distance, including popular peaks and viewpoints. Installation of the sites at Ararat South, Copper Mountain, Emerald Ridge, and Mildred Point would affect relatively unimpacted sites with large viewsheds in designated wilderness, mostly in the upper Tahoma Creek watershed. These sites would be situated so they would be hard to see from established trails; however, visitors traveling off trail could come across these facilities or see them from a distance. Wilderness users encountering these facilities could feel that their wilderness experience has been degraded by the presence of these signs of human occupation.

The installation on Ararat South would be encountered by some hikers climbing to the summit and would tend to dominate the experience of the highest point on the summit; however, the summit is broad and visitors exploring the summit area could find places where the installation is not visible. The installation at Mildred Point would be out of sight of the majority of hikers who do not venture past the end of the maintained trail; however, for some hikers continuing up the ridge to experience the area without the aid of recreation developments, the installation would be

encountered and dominate the experience of the area within several hundred feet. The Mildred Point site would also be visible from a distance from many of the higher elevations of Van Trump Park.

The Copper Mountain site would be partially visible to climbers attempting the summit, but would not dominate the experience of the undeveloped summit or interfere with views of Mount Rainier or the surrounding landscape. The installation at Emerald Ridge would not be visible to the majority of on-trail hikers, but would be encountered by visitors exploring the area without the aid of recreation developments and would tend to dominate the experience at the location within 100 to 200 feet or greater. These impacts would persist for as long as the lahar detection sites are present in the wilderness, potentially indefinitely. The Tahoma Bridge site would be mostly screened from view by vegetation and would not likely be seen by visitors, but would completely dominate the experience of a visitor who ventured a short distance off trail to the outcrop, which currently provides an elevated view of the Tahoma Creek drainage out of sight of the more highly visited Wonderland Trail and suspension bridge.

The Fremont Lookout, Gobblers Knob, Shriner Peak, and Tolmie Lookout sites would be collocated with existing lookout structures, thus reducing the impacts on the undeveloped wilderness quality. The fire lookouts have been evaluated for necessity through the park's Wilderness Management Plan (NPS 1992, as amended), and satisfy the minimum requirement as historic features, but also for their necessity for administration of the wilderness through the provision of communication infrastructure and other administrative uses. The additional impact of adding solar panels or buried seismometers at these sites would be consistent with those administrative uses.

Untrammeled

The USGS Proposed Action would not adversely affect the untrammeled quality of the Mount Rainier Wilderness. The lahar detection stations would not increase human manipulation or control of the components or processes of ecological systems inside wilderness; therefore, the untrammeled quality of wilderness would be preserved.

Solitude or Primitive and Unconfined Recreation

To help distinguish effects on solitude from effects on the undeveloped quality, solitude is defined by policy as the state of being alone or remote from habitations or the sights and sounds of other people – the experience of being in an unfrequented or secluded place. Installation and maintenance of the structures would have an adverse effect on solitude or primitive and unconfined recreation during installation. Helicopter trips to install monitoring stations would affect solitude when aircraft are flying over or landing in wilderness. Impacts would affect individuals encountering aircraft as well as those who could hear the aircraft from distant locations. These effects would vary among individuals, depending on where visitors encountered the helicopter use, and would be temporary, limited to about 63 trips during installation of nine sites over a 2-month period (September and October) in 2021 (possibly extending into September or October 2022 if weather or other conditions do not allow for completion of installations in 2021) and about 243 maintenance flights over a period of 30 years.

After installation, the structures would have small effects on solitude or primitive and unconfined recreation. The presence of the monitoring stations would negatively affect the primitive nature of wilderness. Individuals who came across a site could have their wilderness experience negatively affected by the feeling of being monitored and by the feeling that modern humans have

occupied, and will return to, the sites. The presence of the stations might serve as curiosities that attract more users to the sites, but would not reduce opportunities for solitude or primitive and unconfined recreation overall. As described under the undeveloped quality, stations would be painted to reduce their visibility and placed to minimize being detected by the casual visitor. However, the greatest impact would be experienced by the visitor who expends the greatest effort to pursue the opportunity for solitude and, therefore, has a higher expectation of solitude. The opportunity for solitude in an unmodified setting, without the aid of recreation developments, is uniquely protected by the wilderness designation, when compared to other public lands.

Other Features of Value

The four proposed monitoring stations on the Fremont, Gobblers Knob, Shriner Peak, and Tolmie Peak fire lookouts would affect contributing features to the NHLD. Impacts on these features are described in detail in the *National Historic Landmark District and Associated Historic Properties and Cultural Landscapes* section. This quality would be degraded by a shift in visitor perception of the structures as historic features toward modern administrative facilities. As previously described, stations would be painted to reduce their visibility and placed strategically to minimize detection by the casual visitor; however, several of the sites would be potentially visible to the public.

The scientific and educational values of the Mount Rainier Wilderness would not be affected by the collection of seismic data from the USGS Proposed Action. However, study of these other features of value satisfies one of the public purposes of wilderness, "scientific use" as defined in Section 4b of the Wilderness Act. Data collected using stations in the proposed network would be useful in detecting smaller debris flows and outburst floods in Tahoma Creek and elsewhere in the park. The Tahoma Creek drainage itself has experienced more than 33 debris flows since 1967, making it both a high-input management area due to Westside Road and an excellent natural laboratory to further scientific understanding of debris flows.

Data collected using the detection sites would also be useful to the park for hazard mitigation and situational awareness for wilderness users. The data collected could ultimately lead to an improved ability to detect and characterize debris flows on Mount Rainier as well as other volcanoes around the world, and would enable the park to better inform visitors, including wilderness users, of local hazards. Data collected would benefit the broader scientific community, including enhancing detection ability and understanding of rockfall, glacial dynamics, flooding, and other processes. Finally, the proposed stations would also improve volcano monitoring capabilities, including the ability to detect anomalous small earthquakes and small amounts of surface deformation that often precede eruptions, and also to detect explosions that often accompany volcanic unrest and eruption.

Wilderness Act Consistency

The Wilderness Act specifically prohibits structures, installations, motorized equipment, and landing of aircraft in wilderness except as necessary to meet minimum requirements for the administration of the area (16 United States Code (USC) § 1133(c)). The NPS must administer wilderness to preserve the wilderness character of the area (16 USC § 1133(b)). Wilderness areas are managed for the public purposes of recreational, scenic, scientific, educational, conservation, and historical use (16 USC § 1133(b)). The statutory purposes of wilderness include scientific activities, and these activities are encouraged and permitted when consistent with the NPS's responsibilities to preserve and manage wilderness (NPS 2006). According to Section 6.3.6.1 of

NPS Management Policies 2006, even those scientific activities (including inventory, monitoring, and research) that involve a potential impact on wilderness resources or values should be allowed when the benefits of what can be learned outweigh the impacts on wilderness resources or values (NPS 2006).

Research and monitoring devices (e.g., video cameras, data loggers, and meteorological stations) may be installed and operated in wilderness if (1) the desired information is essential for the administration and preservation of wilderness and cannot be obtained from a location outside wilderness without significant loss of precision and applicability; and (2) the proposed device is the minimum requirement necessary to accomplish the research objective safely.

When considering whether to allow prohibited uses in the wilderness, a determination is needed on if the purpose of the proposed scientific activity is necessary to preserve wilderness character. This determination may often require subjective judgment that balances the impacts of the activity with its benefits (Landres 2010). Although the USGS Proposed Action would permanently degrade the undeveloped quality of the wilderness and the quality of solitude or primitive and unconfined recreation, the USGS Proposed Action would benefit wilderness users by informing managers of local hazards from debris flows and lahars with improved ability to inform visitors to the Mount Rainier Wilderness of potential volcanic risks or activity. The USGS Proposed Action would also contribute to the body of scientific knowledge of volcanic and seismic processes in the park.

Wilderness visitors and local communities are at risk from volcanic hazards such as lahars. Monitoring for these volcanic hazards cannot be adequately accomplished without the use of installations, motorized equipment for installing the installations, mechanical transport of materials, and landing of aircraft for installation and maintenance in wilderness (see *Purpose and Need*). NPS policy allows authorization of motorized equipment or mechanical transport "if determined by the superintendent to be the minimum requirement needed by management to achieve the purposes of the area, including the preservation of wilderness character and values, in accordance with the Wilderness Act" or "in emergency situations (for example, search and rescue, homeland security, law enforcement) involving the health or safety of persons actually within the area" (NPS 2006).

The localized nature of the data collected requires that stations be located on the slopes of Mount Rainier. Stations designed to monitor the Tahoma Creek and Nisqually River drainages, which are vulnerable to future lahars initiated by edifice collapse on Mount Rainier, must be located near those drainages. For these reasons, the proposed lahar detection system is wilderness dependent and could not be constructed outside of wilderness. The monitoring stations are too heavy to carry to the site via nonmotorized means. Additional information on the minimum requirements analysis is available in the Wilderness Minimum Requirements Worksheet (Appendix E).

Alternative 2 – No Action

Under the No Action Alternative, the lahar detection network in the park would not be expanded and no new disturbance would occur in designated wilderness. No new data would be collected using the new detection sites because the new sites would not be installed. Existing management activities in the park would continue, including operation and maintenance of the existing seismic monitoring sites in the Mount Rainier Wilderness. No new prohibited uses under the Wilderness Act would be proposed under the No Action Alternative and no new impacts on

wilderness qualities would occur, although aviation-dependent sites would continue to require use of helicopters for an estimated 144 maintenance flights over 30 years, as described under the description of the *No Action Alternative* above and in the Wilderness Minimum Requirements Worksheet (Appendix E).

Alternative 3 – Alternative Monitoring Sites

Instead of collocating new installations with existing developments and structures, sites would be selected to minimize impacts on cultural resources. One installation would be on an existing fire lookout and ten would be new installations in previously undisturbed locations in wilderness.

Natural

The natural quality of the Mount Rainier Wilderness would be affected by small-scale, localized, and temporary impacts on the natural environment. Alternative 3 would alter less than **0.1** acre of vegetation within the 228,400-acre wilderness and impacts are expected to recover to a natural state over time. Due to the small scale and widely separated nature of the proposed sites, and the implementation of mitigation measures to reduce impacts, Alternative 3 would have minimal adverse effects on plants, animals, air, water, or ecological processes. However, this alternative would have greater impacts (approximately double) compared to the USGS Proposed Action, but would still be less than 0.1 acre of total disturbance. Impacts at the Fremont, Shriner, and Tolmie Lookout alternative sites would result in greater local vegetation and soil disturbance compared to the already disturbed areas adjacent to the lookouts. As described for the USGS Proposed Action, noise and activity from construction and helicopters has the potential to affect behaviors of spotted owls and marbled murrelets; however, as described in the *Special Status Species* section, the project is not expected to adversely affect these species with implementation of mitigation measures.

Undeveloped

Like the USGS Proposed Action, the alternative station sites would have both permanent and temporary effects on the undeveloped quality of wilderness. Use of mechanized equipment, such as power tools, and use of helicopters for material delivery would introduce unnatural sounds during installation and maintenance work. Under Alternative 3, both Mount Wow Talus and Tahoma Vista Ridge alternative stations would be installed and maintained by aircraft. This increases the number of aircraft-dependent sites in wilderness from 5 to 15.

As described for the USGS Proposed Action, impacts on the undeveloped quality during construction would generally be low, and elevated noise levels from the use of mechanized equipment would occur during construction over a two-week period each year over two years while use of a helicopter to transport material would result in a temporary increase in noise that would affect the undeveloped quality of wilderness for about one to two hours per day over a period of about two days at each site. The total number of helicopter flights would be greater than under the USGS Proposed Action, with about 88 trips (16 more than the USGS Proposed Action) during installation over a 2-month period (September and October) and about 297 maintenance flights over a period of 30 years (54 more than the USGS Proposed Action). This would represent an increase of about 31 to 62 percent in flight time during the 2-year installation period and an increase of about 4 to 7 percent in flight time compared to the existing number of flights over the 30-year maintenance period.

All five of the alternative sites at Fremont Lookout, Mount Wow Talus, Shriner Peak, Tahoma Vista Ridge, and Tolmie Peak would introduce visible signs of human disturbance to the wilderness. The Fremont Peak alternative station would not be visible from the Fremont Lookout, but would be visible in the distance from the Wonderland Trail, and would be highly visible to anyone venturing beyond the end of the maintained Mount Fremont Trail. The Mount Wow Talus alternative station would be highly visible from Westside Road. The Shriner Peak alternative site would be screened from view from the lookout tower by vegetation, but would have the potential to dominate the experience of a visitor venturing beyond the end of the maintained trail or navigating to the summit before the trail is melted out. The Tahoma Vista Ridge site would be in a location that is rarely visited and is not accessed by any routes or way trails. The Tolmie Peak alternative site would not be visible from the Tolmie Lookout; however, it would have a large viewshed into the upper Carbon and upper Mowich River drainages and would be located on a visitor-created trail accessed from the main trail leading to the lookout, with a high likelihood of being encountered by visitors (several hundred per day during peak periods).

The total footprint of the installations in wilderness would be greater than under the USGS Proposed Action but would still be less than 0.1 acre. Under this alternative, the number of standalone installations in currently undeveloped wilderness would increase from 5 to 15, twice as many new standalone installations as the USGS Proposed Action. The alternative installation locations were designed to minimize visibility to the greatest extent practicable by using screening from vegetation and topography. The Tahoma Vista Ridge site would be unlikely to be encountered by visitors due to its remote location away from any way trails, named peaks, or travel routes. Wilderness users encountering the Fremont Peak, Mount Wow Talus, Shriner Peak, or Tolmie Peak alternative sites could feel that their wilderness experience has been degraded by the presence of these signs of human occupation. These impacts would persist for as long as the lahar detection sites are present in the wilderness, potentially indefinitely.

Untrammeled

Alternative 3 would not adversely affect the untrammeled quality of the Mount Rainier Wilderness. The lahar detection stations would not increase human manipulation or control of the components or processes of ecological systems in wilderness; therefore, the untrammeled quality of wilderness would be preserved.

Solitude or Primitive and Unconfined Recreation

Installation and maintenance of the alternative sites would have an adverse effect on solitude and unconfined recreation during installation. Helicopter trips to install monitoring stations would affect solitude when aircraft are flying over or landing in wilderness. As described for the USGS Proposed Action, helicopter use would be temporary. Helicopter use would be greater under Alternative 3 than under the USGS Proposed Action, increasing to 88 trips during installation and about 297 maintenance flights over a period of 30 years.

After installation, the structures would have greater effects on solitude or unconfined recreation relative to the USGS Proposed Action. The presence of the monitoring stations would negatively affect the primitive nature of the wilderness. Individuals who came across a site could have their wilderness experience negatively affected by the feeling of being monitored and by the feeling that modern humans have occupied, and will return to, the sites. The presence of the stations might serve as curiosities that attract more users to the sites. Sites would be located close to popular destinations and would therefore be more likely to be encountered by the casual visitor.

However, the greatest impact would be experienced by the visitor who expends the greatest effort to pursue the opportunity for solitude and, therefore, has a higher expectation of solitude. The opportunity for solitude in an unmodified setting, without the aid of recreation developments, is uniquely protected by the wilderness designation, when compared to other public lands. In this alternative, the difficulty of finding a pristine site to experience solitude away from the frequently visited lookout structures would be increased, and opportunities for solitude would be reduced relative to the USGS Proposed Action.

Other Features of Value

The alternative sites would not affect historic structures and would not be within the NHLD. The proposed monitoring station on Gobblers Knob would affect a contributing feature to the NHLD. Impacts on this feature are described in detail in the *National Historic Landmark District and Associated Historic Properties and Cultural Landscapes* section. This historical structure predates the wilderness designation and contributes to wilderness character to the extent that it tells the story of historical use of the wilderness area. Modern installations and modifications contribute to a shift in visitor perception of the structure as a historic feature toward a perception as a modern administrative facility. As described above under the undeveloped quality, stations could potentially have adverse effects on scenic quality, especially the Mount Wow Talus and Tolmie Peak alternative sites, which would be highly visible. As previously described, stations would be painted to reduce their visibility and placed strategically to minimize detection by the casual visitor; however, several of the sites would be potentially visible to the public.

As previously described, the scientific and educational values of the Mount Rainier Wilderness would not be affected by the collection of seismic data. However, study of these other features of value satisfies one of the public purposes of wilderness, "scientific use" as defined in Section 4b of the Wilderness Act. Data collected using the detection sites would also be useful to the park for hazard mitigation and situational awareness for wilderness users. These benefits would be the same as described for the USGS Proposed Action.

Wilderness Act Consistency

The Wilderness Act specifically prohibits structures, installations, and landing of aircraft in wilderness (16 § USC 1133(c)). However, the statutory purposes of wilderness include scientific activities, and these activities are encouraged and permitted when consistent with the NPS's responsibilities to preserve and manage wilderness (NPS 2006). Even those scientific activities (including inventory, monitoring, and research) that involve a potential impact on wilderness resources or values should be allowed when the benefits of what can be learned outweigh the impacts on wilderness resources or values.

Research and monitoring devices (e.g., video cameras, data loggers, and meteorological stations) may be installed and operated in wilderness if (1) the desired information is essential for the administration and preservation of wilderness and cannot be obtained from a location outside wilderness without significant loss of precision and applicability; and (2) the proposed device is the minimum requirement necessary to accomplish the research objective safely.

Under Alternative 3, the minimum requirement would include double the number of prohibited uses (new installations) and a 22 percent increase in aircraft landings (a prohibited use), relative to the USGS Proposed Action, as well as increased impacts on the natural, undeveloped, and opportunities for solitude qualities, balanced against a reduced impact on features of historic value.

Alternative 4 – Reduced Number of Monitoring Sites (NPS Preferred Alternative)

Alternative 4 would reduce the number of installations in wilderness by eliminating the Tolmie Peak, Fremont Lookout, and Shriner Peak monitoring sites from the proposal.

Natural

As described for the USGS Proposed Action, the natural quality of the Mount Rainier Wilderness would be affected by small-scale, localized, and temporary impacts on the natural environment. Alternative 4 would alter less than 0.1 acre of vegetation within the 228,400-acre wilderness. Due to the small scale and widely separated nature of the proposed sites, and the implementation of mitigation measures to reduce impacts, Alternative 4 would have only minimal adverse effects on plants, animals, air, water, and ecological processes. With the elimination of the Tolmie Peak, Fremont Lookout, and Shriner Peak sites, impacts on vegetation and soils would be less than either the USGS Proposed Action or Alternative 3. As described for the other action alternatives, there is a possibility that foot traffic from maintenance visits or curious visitors could cause the development of visitor-created trail impacts where they do not currently exist. As previously described in the *Special Status Species* section, noise and activity from construction and helicopters has the potential to affect behaviors of spotted owls and marbled murrelets; however, with implementation of mitigation measures, the project is not expected to adversely affect these species.

Undeveloped

Alternative 4 would have both permanent and temporary effects on the undeveloped quality of wilderness. With the elimination of three of the proposed sites in wilderness, the total footprint of the installations in wilderness would be slightly less than under the USGS Proposed Action.

Use of mechanized equipment, such as power tools, and use of helicopters for material delivery would introduce unnatural sounds during installation and maintenance work. As described for the USGS Proposed Action, impacts on the undeveloped quality during construction would generally be low, and elevated noise levels from the use of mechanized equipment would occur during construction over a two-week period each year over two years while use of a helicopter to transport material would result in a temporary increase in noise that would affect the undeveloped quality of wilderness for about one to two hours per day over a period of about two days at each site. The total number of helicopter flights would be less than under the USGS Proposed Action, with about 48 trips (24 fewer than the USGS Proposed Action) during installation over a 2-month period (September and October) and about 189 maintenance flights over a period of 30 years (54 fewer than the USGS Proposed Action). This would represent an increase of about 17 to 34 percent in flight time during the 2-year installation period and an increase of about 3 to 6 percent in flight time compared to the existing number of flights over the 30-year maintenance period.

As described for the USGS Proposed Action, the presence of new structures and installations at Ararat South, Copper Mountain, Emerald Ridge, Mildred Point, and Tahoma Bridge would degrade the undeveloped wilderness quality by introducing visible signs of human occupation. Under Alternative 4, the number of standalone seismic installations in wilderness would increase from 5 to 9. The other installations would be collocated with existing developments and installations. The number of stations dependent on aircraft would increase from 5 to 10. Installation of the sites at Ararat South, Copper Mountain, Emerald Ridge, and Mildred Point would affect relatively unimpacted sites with large viewsheds in designated wilderness, mostly in

the upper Tahoma Creek watershed. These sites would be situated so they would be hard to see from established trails; however, visitors traveling off trail could come across these facilities or see them from a distance. Wilderness users encountering these facilities could feel that their wilderness experience has been degraded by the presence of these signs of human occupation.

As previously described, the installation on Ararat South would be encountered by some hikers climbing to the summit and would tend to dominate the experience of the highest point on the summit; however, the summit is broad and visitors exploring the summit area could find places where the installation is not visible. The Gobblers Knob Lookout site would be collocated with an existing lookout structure, thus reducing the number of installations and visual impacts on the undeveloped wilderness quality. The installation at Mildred Point would be out of sight of most hikers who do not venture past the end of the maintained trail; however, for some hikers continuing up the ridge to experience the area without the aid of recreation developments, the installation would be encountered and dominate the experience of the area within several hundred feet. The Mildred Point site would also be visible from a distance from many of the higher elevations of Van Trump Park. These impacts would persist for as long as the lahar detection sites are present in the wilderness, potentially indefinitely.

Untrammeled

Alternative 4 would not adversely affect the untrammeled quality. The lahar detection stations would not increase human manipulation or control of the components or processes of ecological systems in wilderness; therefore, the untrammeled quality of wilderness would be preserved.

Solitude or Primitive and Unconfined Recreation

As described for the other action alternatives, installation and maintenance of the structures would have an adverse effect on solitude or primitive and unconfined recreation during installation. Helicopter trips to install monitoring stations would affect solitude when aircraft are flying over or landing in wilderness. Impacts would affect individuals encountering aircraft as well as those who could hear the aircraft from distant locations. These effects would vary among individuals, depending on where visitors encountered the helicopter use, and would be temporary, limited to about 48 trips during installation over a 2-month period (September and October) each year for 2 years (including up to 6 flights for revegetation), and about 189 maintenance flights over a period of 30 years.

After installation, the structures would have small effects on solitude or primitive and unconfined recreation. The presence of the monitoring stations would negatively affect the primitive nature of the wilderness. These effects would be the same as previously described for the USGS Proposed Action.

Other Features of Value

As previously described, the proposed monitoring station on the Gobblers Knob fire lookout would affect contributing features to the NHLD. Impacts on these features are described in detail in the *National Historic Landmark District and Associated Historic Properties and Cultural Landscapes* section. This quality would be degraded by a potential shift in visitor perception of the structures as historic features toward modern administrative facilities. As described above under the undeveloped quality, the stations could potentially have adverse effects on scenic value. As previously described, equipment would be painted to reduce their visibility and placed

strategically to minimize detection by the casual visitor; however, several of the sites would be potentially visible to the public.

As previously described, the scientific and educational values of the Mount Rainier Wilderness would not be affected by the collection of seismic data. However, study of these other features of value satisfies one of the public purposes of wilderness, "scientific use" as defined in Section 4b of the Wilderness Act. Data collected using the detection sites would also be useful to the park for hazard mitigation and situational awareness for wilderness users. Elimination of the Tolmie Peak and Shriner Peak sites would eliminate the addition of seismometers that would otherwise improve the accuracy of earthquake locations at Mount Rainier and the ability to detect smaller lahars and debris flows down the Ohanapecosh River. Other than the elimination of data from these two sites, the data collected under Alternative 4 would be the same as the USGS Proposed Action.

Wilderness Act Consistency

As previously described, the Wilderness Act specifically prohibits structures, installations, and landing of aircraft in wilderness (16 § USC 1133(c)). Alternative 4 would reduce the number of prohibited uses because it would include three fewer new installations in wilderness and a 33 percent decrease in aircraft use relative to the USGS Proposed Action. This alternative would also result in decreased impacts on the natural, undeveloped, and opportunities for solitude qualities and a reduced impact on features of historic value compared to the USGS Proposed Action.

CONSULTATION AND COORDINATION

The park is conducting civic engagement activities to ensure the public has opportunities to provide input on the project. Civic engagement that has occurred for this project to date includes letters sent to the park's affiliated tribes, a press release, and a virtual public scoping meeting. The activities that have occurred thus far are summarized below.

CIVIC ENGAGEMENT SUMMARY

The park sought tribal input to help inform the analysis of the USGS Proposed Action and the alternatives. Affiliated tribes who were sent letters regarding the project include the following:

- Cowlitz Indian Tribe
- Muckleshoot Indian Tribe
- Nisqually Indian Tribe
- Puyallup Tribe of Indians
- Squaxin Island Tribe
- Confederated Tribes and Bands of the Yakama Nation

The park hosted a table at a Pierce County Lahar Siren Open House at Fire Station 87 in Ashford, Washington on Saturday, September 26, 2020. Information about the USGS proposal was given to approximately 20 community members.

The park initiated public scoping on October 5, 2020 in accordance with NPS guidance under NEPA, and the public comment period ran through October 30. Public notices were distributed through the following sources:

- A press release posted on the park website
- A news release sent electronically (via email) to various stakeholders, agencies, and media groups

The park also conducted a virtual public meeting on Wednesday, October 21, 2020 where park staff provided a project overview and answered questions about the project. The park received 49 correspondences during scoping, and the comments were considered during the development of this EA. Following public scoping, a report was prepared to summarize public notices, the virtual public meeting, and comments from the public.

During scoping, the park initiated more robust consultation with affiliated tribes. The park also has initiated Section 7 consultation with the USFWS and Section 106 consultation with the State Historic Preservation Office.

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APPENDICES

(Appendices A through E are available through the park website at the same link as this EA)

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