

FINAL MEMORANDUM OF AGREEMENT
AMONG THE NATIONAL PARK SERVICE, MOUNT RAINIER NATIONAL PARK
AND THE
WASHINGTON STATE DEPARTMENT OF ARCHAEOLOGY AND HISTORIC PRESERVATION
AND THE
UNITED STATES GEOLOGICAL SURVEY, CASCADES VOLCANO OBSERVATORY
REGARDING THE PROPOSED LAHAR DETECTION AND VOLCANO MONITORING SYSTEM EXPANSION AT
MOUNT RAINIER NATIONAL PARK PURSUANT TO THE NATIONAL HISTORIC PRESERVATION ACT

WHEREAS, the National Park Service (NPS), Mount Rainier National Park (MRNP) proposes to permit the United States Geological Survey (USGS), Cascades Volcano Observatory (CVO) to expand the lahar detection and volcano monitoring system at Mount Rainier National Park pursuant to Public Law 113-287 §100101 (a); and

WHEREAS, the John D. Dingell, Jr. Conservation, Management and Recreation Act of 2019 (Public Law 116-9, Title V, Section 5001), 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;” and includes the stated objective of, “upgrading existing networks on monitored volcanoes;” and

WHEREAS, the National Park Service is the lead agency for the purpose of fulfilling Section 106 of the National Historic Preservation Act (NHPA); and

WHEREAS, the proposed undertaking consists of installing monitoring equipment within the Mount Rainier National Historic Landmark District (NHLD); and

WHEREAS, the NPS has defined the proposed undertaking’s area of potential effects (APE) as the area of all ground disturbance associated with installation of monitoring equipment, and the area within Mount Rainier’s National Historic Landmark District (NHLD), where the installation of monitoring equipment is proposed on contributing historic structures or would be visible within the NHLD. Location Map and photos are shown in Attachment 1; and

WHEREAS, NPS has determined that approval of a permit authorizing the lahar detection and volcano monitoring system expansion would constitute an undertaking that would have an adverse effect on contributing elements of the Mount Rainier NHLD, which is listed in the National Register of Historic Places; and

WHEREAS the NPS has consulted with the Washington State Department of Archaeology and Historic Preservation (DAHP) pursuant to 36 CFR Part 800, the regulations implementing Section 106 of the National Historic Preservation Act (54 U.S.C. § 306108); and

WHEREAS, the NPS has invited consultation from the Indian tribes traditionally associated with lands now within Mount Rainier National Park, including the Muckleshoot Indian Tribe, the Puyallup Tribe of

Indians, the Nisqually Indian Tribe, the Cowlitz Indian Tribe, the Squaxin Island Tribe, and the Confederated Tribes and Bands of the Yakama Nation; the NPS invited consultation via letters sent on September 28, 2020, and December 14, 2020, and verbally during the annual Meeting with Traditionally Associated Tribes with Mount Rainier National Park on April 28, 2021, and received no comments or requests for further discussions; and

WHEREAS, in accordance with 36 CFR Section 800.6(a)(1), the NPS has notified the Advisory Council on Historic Preservation (ACHP) of its adverse effect determination with specified documentation, and the ACHP has chosen *not to* participate in the consultation pursuant to 36 CFR § 800.6(a)(1)(iii); and

WHEREAS, the NPS has provided an opportunity for public review in accordance with 36 CFR Section 106 §800.2(d) concurrent with public review of an environmental assessment prepared to comply with the National Environmental Policy Act (NEPA) from May 27 through July 9, 2021.

NOW, THEREFORE, the NPS, the Washington State DAHP, and the USGS agree that the proposed undertaking, if approved, shall be implemented in accordance with the following stipulations to take into account the effect of the undertaking on historic properties.

STIPULATIONS

- I. **The NPS and USGS** shall ensure that the following measures are carried out if the NPS proceeds with the issuance of a permit to authorize the expansion of the lahar detection and volcano monitoring system at Mount Rainier National Park:
 - A. Archeological monitoring will be completed by NPS archeological staff in coordination with USGS staff during the installation of monitoring equipment at the Copper Mountain, Mount Ararat, and Emerald Ridge monitoring sites, as the landforms have the potential to contain buried archaeological resources, consistent with the NPS-approved Inadvertent Discovery Plan (Attachment 2). That plan requires that work be halted in the event human remains or previously unidentified archeological resources are found. Tribes traditionally associated with lands now within Mount Rainier National Park will be notified in advance of archeological monitoring activities to provide an opportunity for participation.
 - B. The NPS and USGS shall identify locations for monitoring equipment so as to minimize visibility within or into the Mount Rainier NHL to the extent practicable while ensuring the operability of monitoring equipment.
 - C. To the extent practicable, the antenna on the volcanic monitoring stations will be installed in such a way as to not protrude beyond the silhouette/horizon of the ridge as viewed from the historic fire lookout towers or the historic route of the Wonderland Trail while ensuring the operability of monitoring equipment.
 - D. The USGS will paint antennas and equipment boxes with appropriate colors selected in consultation with the NPS historical landscape architect to blend into the monitoring locations, which include a variety of steep, rock, and alpine settings and would include matte grey, brown, or other NPS-approved color based on each monitoring location.
 - E. To increase public understanding and appreciation for the NHL, the proposed lahar detection system, and other related topics, the NPS shall develop interpretive material in consultation with the USGS, DAHP, and the Indian tribes traditionally associated with the lands now designated Mount Rainier National Park. Subjects may include but not be

limited to the Tahoma Vista Overlook, historic fire lookout towers, the lahar detection system, or any historical, cultural, or spiritual storylines relating to Mount Rainier and its preceding names since time immemorial. Interpretive material may consist of interpretive waysides, exhibits, printed brochures, or digital media.

- F. Web-based Interpretive materials may provide information regarding the broader context of the historic fire lookout towers in the region, including sites that are no longer extant within the park. This interpretive content would be developed for use on the park website and app and may be used to update interpretive materials provided at the park visitor centers and wilderness information center.

II. **The NPS** shall ensure that the following measures are carried out:

- A. A funding proposal to support the rehabilitation of the historic views and vistas, guardwalls, or other contributing landscape elements at the historic Tahoma Vista Overlook and Westside Road will be prepared and submitted through the NPS budget process to reflect existing park cultural resources management priorities.
- B. A funding proposal will be developed and submitted through the NPS budget process to prepare a Historic Structures Report (HSR) for the historic fire lookout towers within MRNP. The HSR will provide documentary, graphic, and/or physical information about the properties' history and existing condition. The HSR will also address management goals for the use or re-use of the properties. The report will serve as guide for all future changes proposed to the historic fire lookout towers during project-repair, rehabilitation, or restoration-and can also provide information for maintenance procedures. Finally, the HSR will record the findings of research and investigation, as well as the processes of physical work, for future researchers.
- C. An HSR for the historic fire lookout towers will be completed and provided to the WA DAHP for review prior to NPS authorization to further increase the size or physical extent of non-historic materials attached to these historic structures.
- D. Any subsequent proposals to add non-historic materials to the MRNP historic fire lookout towers would be evaluated for consistency with the recommendations included in the HSR to the greatest extent practicable.

III. **The USGS** shall ensure that the following measures are carried out:

- A. A funding proposal will be developed and submitted through the USGS budget process to help the NPS prepare the HSR for the historic fire lookout towers within MRNP for funding at a level proportionate to the anticipated effect of non-historic equipment proposed by USGS on the historic fire lookout towers relative to other non-historic equipment already in place on the historic fire lookout towers.

IV. **DURATION**

This MOA becomes effective upon the date of its signature by all authorized signatory officials.
This MOA shall remain in force for a period of five (5) years from the date of its execution or

until mitigation measures are complete, unless terminated or amended prior to the date of expiration.

V. POST-REVIEW DISCOVERIES

If properties are discovered that may be historically significant or unanticipated effects on historic properties found, the NPS shall implement the inadvertent discovery plan included as attachment [Attachment 2] of this MOA.

VI. MONITORING AND REPORTING

Each year following the execution of this MOA until it expires or is terminated, the NPS shall provide all parties to the MOA a summary report detailing work undertaken pursuant to its terms. Such report shall include any scheduling changes proposed, any problems encountered, and any disputes and objections received in the agencies' efforts to carry out the terms of this MOA.

VII. ANTI-DEFICIENCY ACT

The NPS and USGS (agencies) obligations under this MOA are subject to the availability of appropriated funds, and the stipulations of this MOA are subject to the provisions of the Anti-Deficiency Act. The agencies shall make reasonable and good faith efforts to secure the necessary funds to implement this MOA in its entirety. If compliance with the Anti-Deficiency Act alters or impairs the agencies' abilities to implement the stipulations of this MOA, the agencies shall consult in accordance with the amendment and termination procedures found at Stipulations IX and X of this MOA.

VIII. DISPUTE RESOLUTION

Should any signatory to this MOA object at any time to any actions proposed or the way the terms of this MOA are implemented, the NPS shall consult with such party to resolve the objection. If the NPS determines that such objection cannot be resolved, the NPS will:

- A. Forward all documentation relevant to the dispute, including the NPS's proposed resolution, to the ACHP. The ACHP shall provide the NPS with its advice on the resolution of the objection within thirty (30) days of receiving adequate documentation. Prior to reaching a final decision on the dispute, the NPS shall prepare a written response that considers any timely advice or comments regarding the dispute from the ACHP and signatories and provide them with a copy of this written response. The NPS will then proceed according to its final decision.
- B. If the ACHP does not provide its advice regarding the dispute within the thirty (30) day time period, the NPS may make a final decision on the dispute and proceed accordingly. Prior to reaching a final decision, the NPS shall prepare a written response that considers any timely comments regarding the dispute from the signatories to the MOA and provide them and the ACHP with a copy of such written response.
- C. Should the USGS or DAHP disagree with resolution provided by NPS in Part B, the disagreeing agency or agencies will submit all relevant documents to the Director of the USGS or their designee, the Director of the National Park Service or their designee, and the Washington State Historic Preservation Officer or designee. The Directors and

Officer or their designees will then seek to resolve the dispute; if the dispute cannot be resolved, any signatory may terminate the MOA in accordance with Stipulation X.

- D. The Parties' responsibilities to carry out all other actions subject to the terms of this MOA that are not the subject of the dispute remain unchanged.

IX. AMENDMENTS

This MOA may be amended when such an amendment is agreed to in writing by all signatories. The amendment will be effective on the date all of the signatories have signed the amendment.

X. TERMINATION

If any signatory to this MOA determines that its terms will not or cannot be carried out, that party shall immediately consult with the other signatories to attempt to develop an amendment per Stipulation IX, above. If within thirty (30) days (or another time period agreed to by all signatories) an amendment cannot be reached, any signatory may terminate the MOA upon written notification to the other signatories.

Once the MOA is terminated, and prior to work continuing on the undertaking, the NPS must either (a) execute an MOA pursuant to 36 CFR § 800.6 or (b) request, take into account, and respond to the comments of the ACHP under 36 CFR § 800.7. The NPS shall notify the signatories as to the course of action it will pursue.

Execution of this MOA by the NPS, the USGS CVO and Washington State DAHP and implementation of its terms evidence that the NPS has taken into account the effects of this undertaking on historic properties and afforded the ACHP an opportunity to comment.

SIGNATORIES

National Park Service, Mount Rainier National Park

Greg Dudgeon, Superintendent

Date

Washington State Department of Archaeology and Historic Preservation

Allyson Brooks, Ph.D., State Historic Preservation Officer

Date

United States Geological Survey:

Christina Neal, USGS Volcano Science Center Director

Date

Attachment 1

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, Shriners 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.

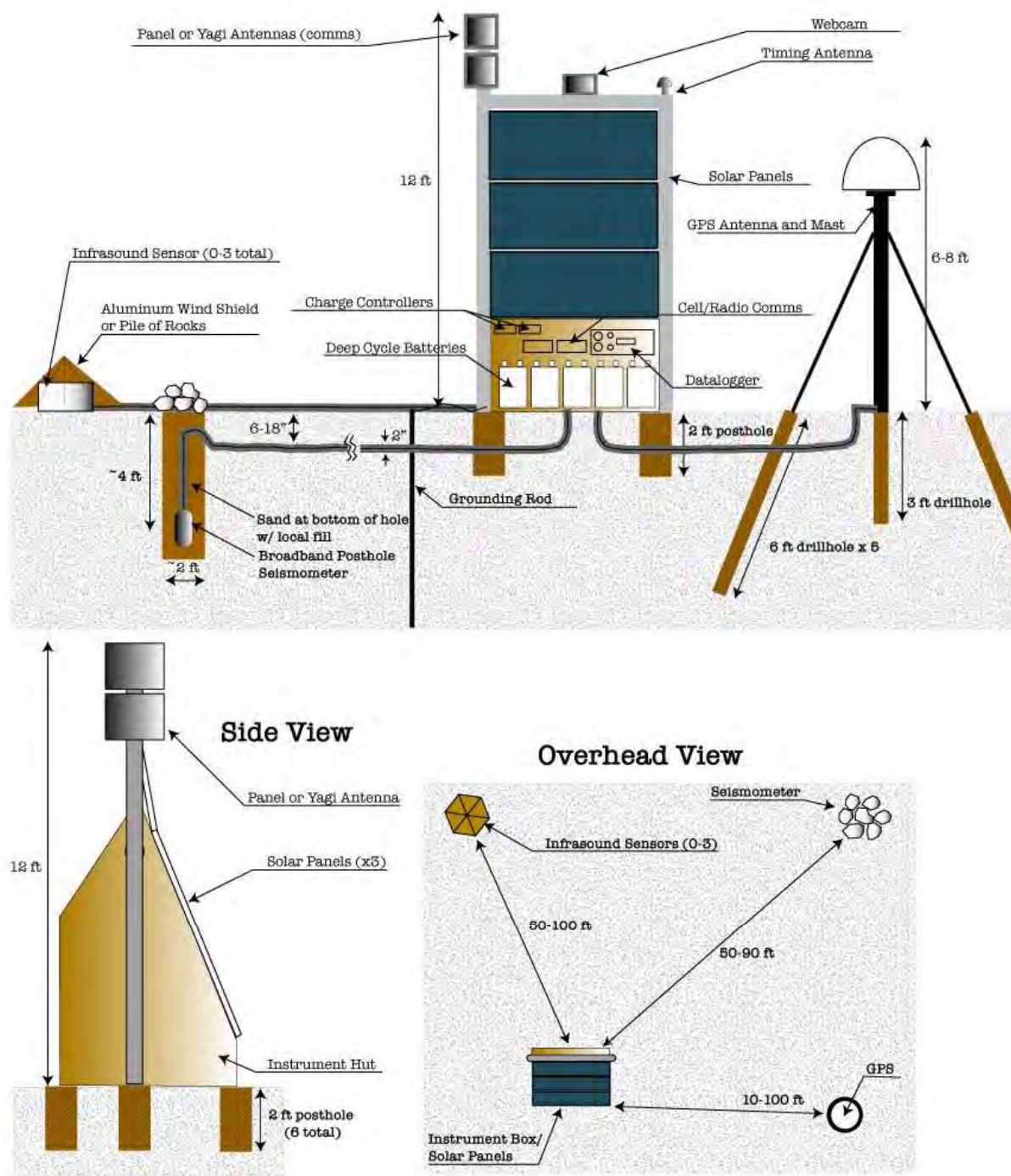


Figure 2. Representative Hut Enclosure.



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.

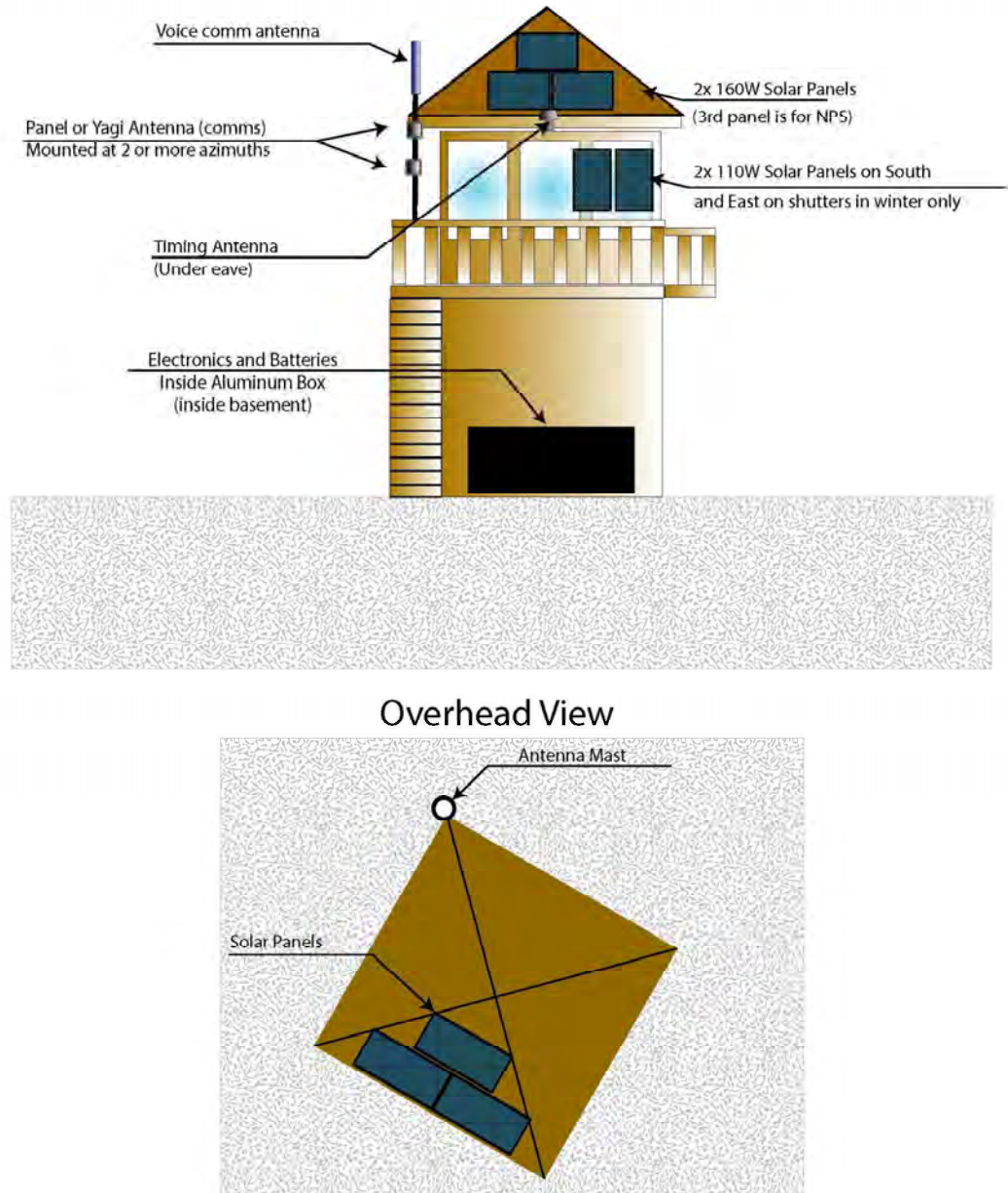


Figure 5. Representative Proposed Historic Fire Lookout, Monitoring Station Elements.

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).

Table 1. Summary of Proposed Monitoring Stations.

	Location	Ararat South	Copper Mountain	Emerald Ridge	Mildred Point	Mount Wow	Paradise Tower Parking Lot	Tahoma Bridge	Tahoma Vista Overlook	Historic Lookout Towers			
										Fremont Lookout	Gobblers Knob Lookout	Shriner Peak Lookout	Tolmie Peak Lookout
Historic Lookout Towers	In Wilderness?	X	X	X	X			X		X	X	X	X
	In NHL?					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				
	Roof Solar Panels (58"x26"x2" - requires rail mounts and roof holes)									X	X	X	X
	Solar Panel Conductor Wire to Existing Conductor Pole (with possible new hole entry)									X	X	X	X
	GNSS* Antenna (3"x3"x2.5" under eave)									X	X	X	X
	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 Mountain	Emerald Ridge	Mildred Point	Mount Wow	Paradise Tower Parking Lot	Tahoma Bridge	Tahoma Vista Overlook	Fremont Lookout	Historic Lookout Towers		
										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 Tower Parking Lot	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 gray wolf habitat.

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, Shriners 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 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.

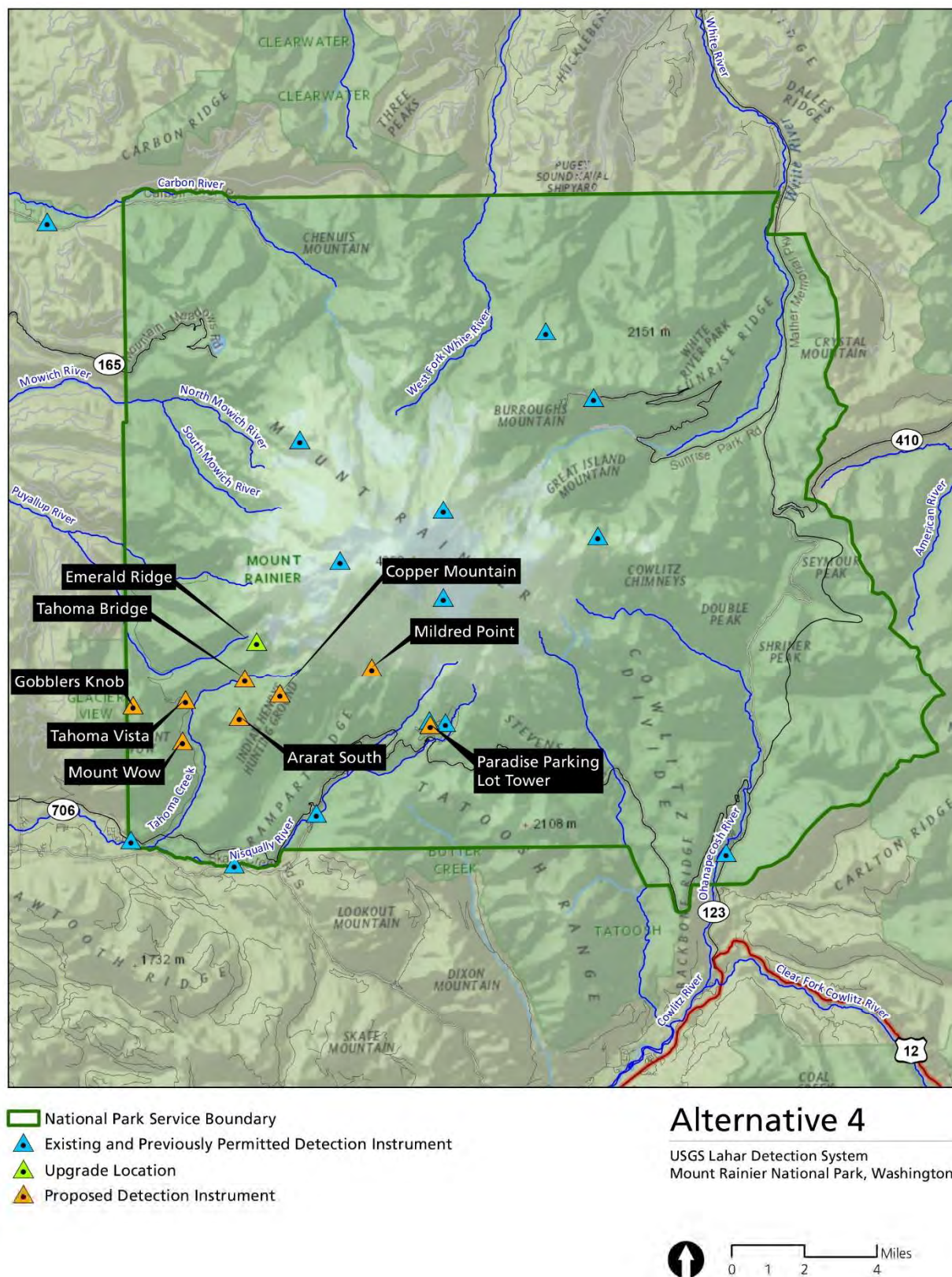


Figure 7. Alternative 4.

USGS Proposal for Gobblers Knob Lookout (46.79414 N, -121.91438 W)

The equipment requirements for the Gobblers Knob Site are:

- Southern exposure for solar panels.
- Robust structure that is resistant to heavy snow and high winds.
- Line-of-sight to Tahoma Bridge, Tahoma Vista, and Copper Mountain monitoring sites.
- Line-of-sight telemetry to existing repeater outside the Park (Puyallup Lookout or Tacoma Power Tower near Elbe).
- Seismometer for improved surface flow localization.

The Gobblers Knob site is considered the most important location within the proposed system because its primary role is to serve as a radio repeater for three other proposed sites on the Tahoma Creek drainage that are each critical for early detection of lahars and debris flows. In addition, a seismometer at the site will help localize surface flows down either the Tahoma Creek or Puyallup drainages.

Proposed nonhistorical elements are:

- 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. In addition, two solar panels would be added to existing solar panels on the east-facing roof at Gobblers Knob.
- 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 batteries, charge controllers and electronic equipment would be housed in the basement of the fire lookouts, which are not accessible to the public.

A mast for antennas would be installed on the Southeast corner of this lookout. The mast would be a pipe up to 2 inches in diameter secured to the floor of the deck with a flange and with bracing extending from the exterior roof rafters. This replicates park antenna installations at Gobblers Knob and other lookout sites.

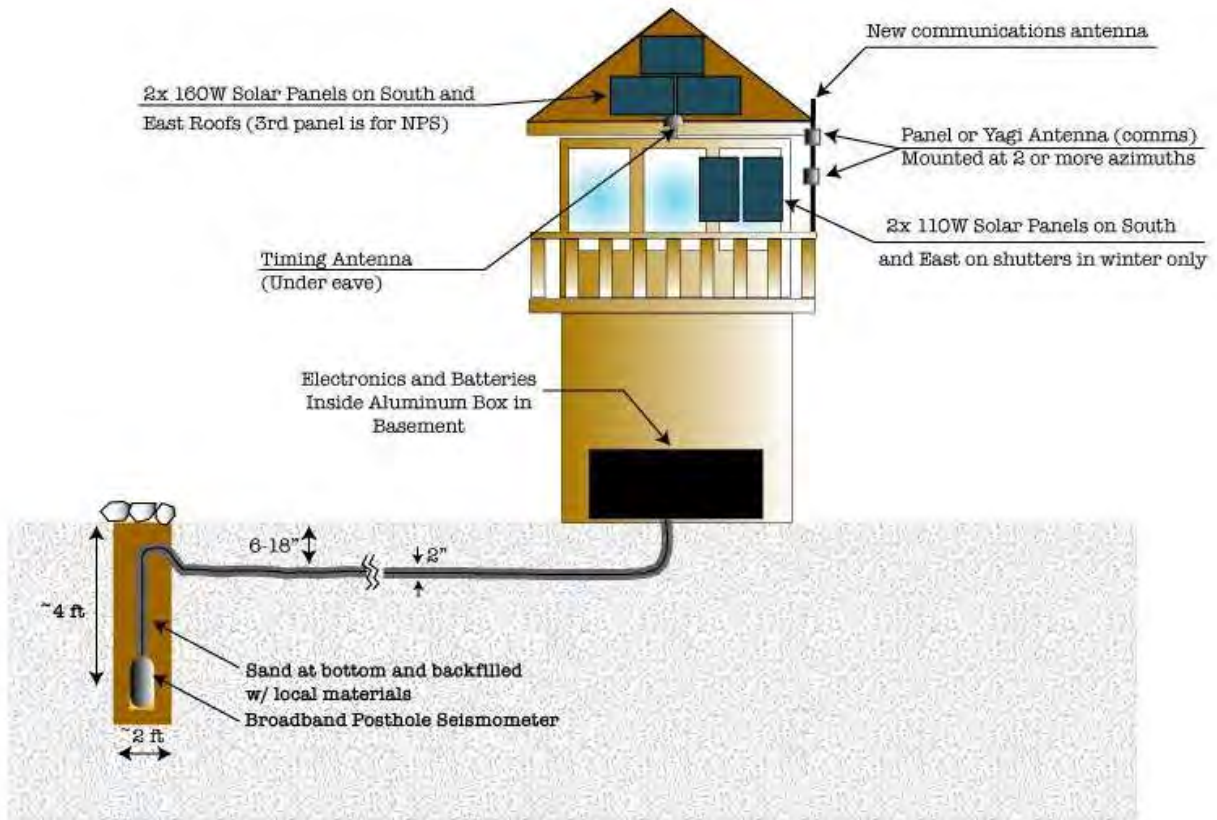
Mounting one-to-two 900MHz and/or cellular antennas on the pre-existing antenna mast on the North side of the lookout deck at the top of the stairs is proposed. Two to- three 900MHz antennas would be mounted to the newly installed mast in the Southeast corner. The maximum antenna dimensions will be approx. 12x12x6 inches (flat panel or Yagi.) No more than four antennas total would be mounted. Finding entry points for up to four LMR400 coaxial cables in the side of the structure. If there is not a pre-existing gap, a hole no larger than 1.25 inches will be drilled to allow cable entry/exit in a minimally visible location by the deck. Cables will be run beside or under the deck to remain invisible. Any holes or cracks will be filled from the interior with insulating foam.

Attachment 4, Gobblers Knob Lookout

A buried seismometer and data cable trench are proposed for Gobblers Knob 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. The seismometer would be installed in the ground in a 4-foot-deep hole that is no more than 2-foot-wide and located no more than 30 feet from the structure, preferably to the east, to remain invisible to park visitors. The hole will be dug by hand using shovels and refilled with the dug material after installation. A seismic data cable in 2-inch aluminum conduit will extend from the lookout to the seismometer and will be placed in a hand-dug trench to a depth of up to 2 feet. If an existing hole is present to run the cable into the basement of the lookout, then it will be utilized, otherwise a 2-inch hole would be drilled as close to ground level as possible. The hole will be filled from the inside with insulating foam.



Figure 1: Location map with red shaded polygon showing the area that was physically searched for alternatives. A much larger search area was assessed using GIS before focusing on the red shaded polygon.



Overhead View

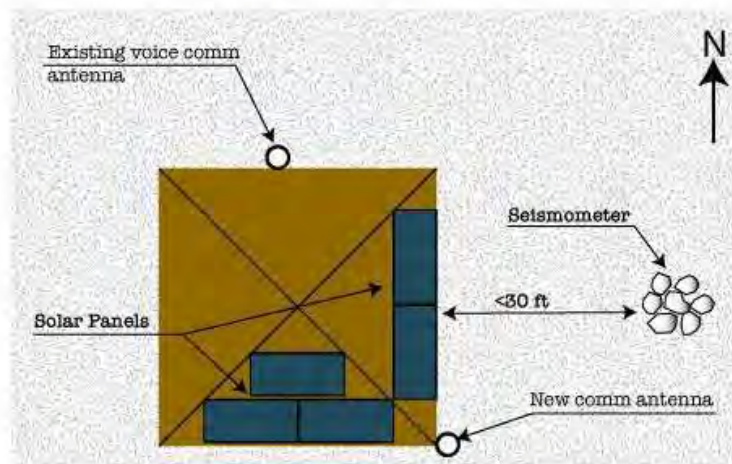


Figure 2: Schematic diagram of proposed installations on lookout.

Attachment 4, Gobblers Knob Lookout



Figure 3: Gobblers Knob lookout from the North. Note the existing antenna mast at the top of the stairs. The proposed seismometer location is to the left (east) among the trees in this picture.



Figure 4: The SE corner of the deck - proposed installation site for an additional antenna mast. Not all antennas can be mounted on the north side of the building because the structure blocks radio shots to remote sites.

Attachment 4 Gobblers Knob Lookout



Figure 5: View of Gobblers Knob lookout from trail approach to the south. The South and East roof faces (proposed locations of solar panel installations) are not clearly visible from any vantage point on the approach trail.

USGS Proposal for Tahoma Vista Overlook Monitoring Site (46.7958N, -121.8842W)

The requirements for the Tahoma Vista Overlook Site are:

- Southern exposure for solar panels
- Line-of-sight telemetry to repeater (Gobblers Knob)
- Seismometer/infrasound near bend in Tahoma Creek

The Tahoma Vista Overlook site is an important location in the detection network because of its position at a bend in the Tahoma Creek from Northeast-Southwest to North-South. This bend will allow for an estimate of velocity of the flow, which in preliminary studies, is related to the volume of the flow. With an estimate of volume, the extent of downstream inundation can be inferred, which is important for decision making by emergency managers. The seismometer at this site, along with other seismometers in the detection system will provide early detection and localization of a failure on the edifice of the volcano and corroborating information on the leading edge of a debris flow or lahar.

Data collected using this station, and others in the proposed network, will also 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 over 33 debris flows since 1967, making it both a high-input management area due to the Westside Road, and an excellent natural laboratory to further scientific understanding of debris flows. In addition to the less-frequent large lahars, detection of the more-frequent smaller debris flows is of importance to the NPS for hazard mitigation and situational awareness.

Installation would include a fiberglass hut containing most of the electronics and all the batteries and with solar panels attached to the outside. The huts have a square base approximately 60 inches wide, and 80 inches high.

Attached to the hut will be a pipe (2.375-inch outer diameter) that extends 12 feet or less above the local ground surface that will have a flat panel antenna (~1'x1') placed near the top. Within the hut, solar controllers and lead acid batteries will power the equipment on site. The hut will be secured by driving 1-inch rebar through the flanges of the hut into the road, one on each corner. The goal is to drive the rebar to a depth of 2 feet. An 8-foot-long 5/8 inch-diameter copper ground rod will be driven adjacent to the hut to provide protection from static discharge. Four 7/8" diameter 1-foot long pieces of rebar or bolts will be driven into the road to secure a pipe flange to stabilize the antenna pipe. The hut and exposed equipment (except the solar panels and radio antenna) will be painted brown to minimize visibility. Other visibility mitigation measures, such as ghillie netting will also be employed in places that do not cover the antennas or solar panels at the direction of Mount Rainier National Park.

A seismometer will be buried in the ground in a 4-foot-deep hole that is no more than 2-foot-wide and will be located no more than 30 feet from the enclosure (Figure 2). The hole will be dug by hand using shovels and filled back in with the materials removed from the hole after the seismometer is placed in the hole. A seismic data cable in 2-inch aluminum conduit will extend from the enclosure to the seismometer and will be placed in a hand dug trench to a depth of up to 2 feet.

Additionally, the station will consist of a 3-component infrasound array. The infrasound units are placed in a small watertight plastic box that is 8x8x6 inches in area and placed directly on the ground and covered with an aluminum windscreen that is secured to the ground with 12-18 inch pieces of 1 inch diameter rebar. Rebar will be pounded into the ground to be flush with the local ground surface. The windscreen is

Attachment 5, Tahoma Vista Overlook

approximately 45 inches across, approximately 24 inches high, and is painted brown. Typically, the sensors and windscreen are placed near or under vegetation.

The proposal is to strive to keep the sensors and windscreens out of the open to reduce visibility if possible. The infrasound data cables will be placed in ½ in aluminum or plastic conduit and will run from the USGS enclosure and plug in to the infrasound boxes. The conduit will be buried in the ground up to 2 feet deep. One infrasound unit and windscreen will be placed on the ground near the enclosure, the other two units and windscreens will extend out no more than 100 feet away from the enclosure.

The conduit and seismometer will be buried in the ground, but if it is deemed less impactful, the conduit could lay on top of the ground and the seismometer could be installed at the ground surface, constructing a rock pile above it for protection and thermal isolation.

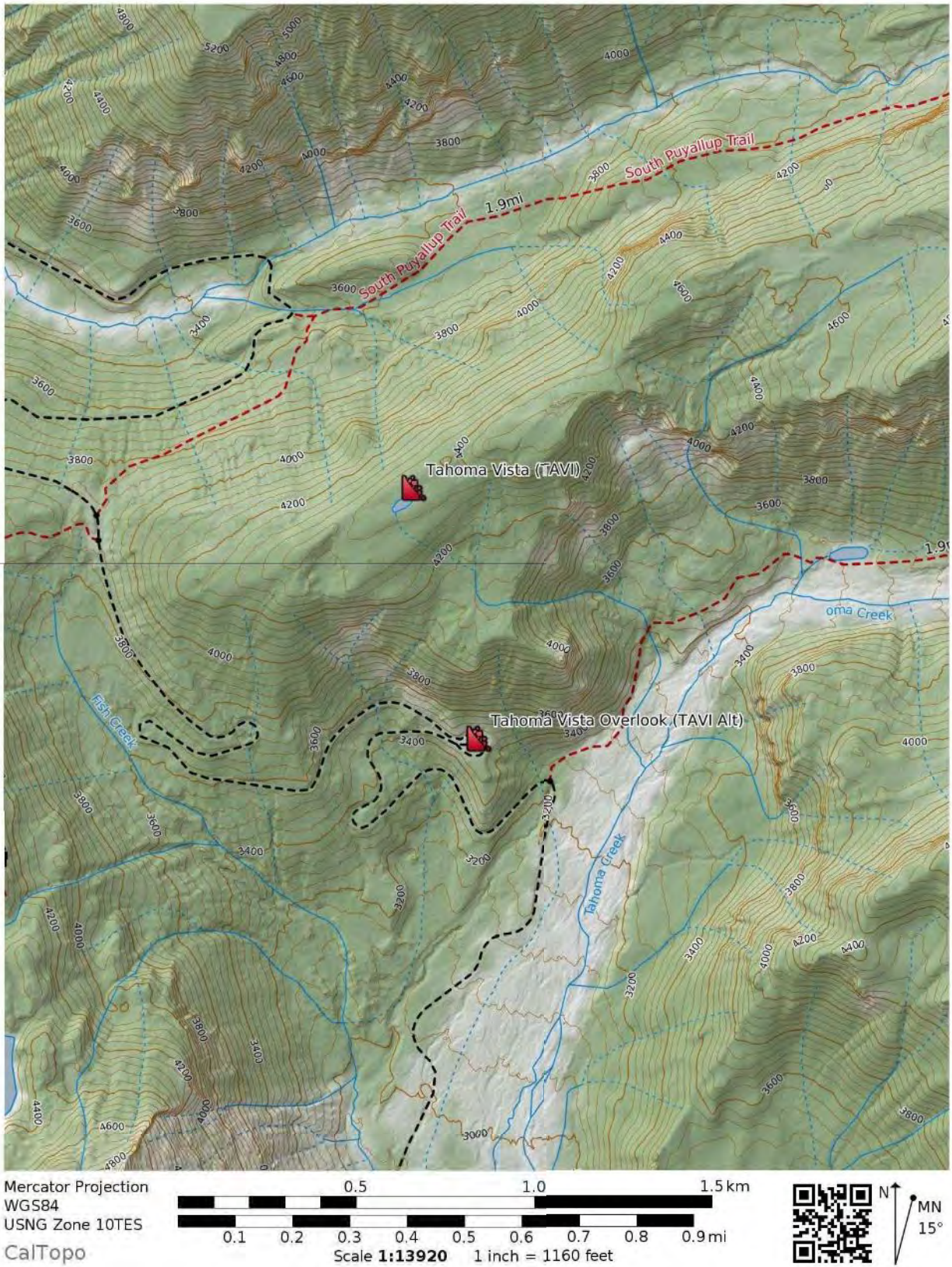


Figure 1: Location map.

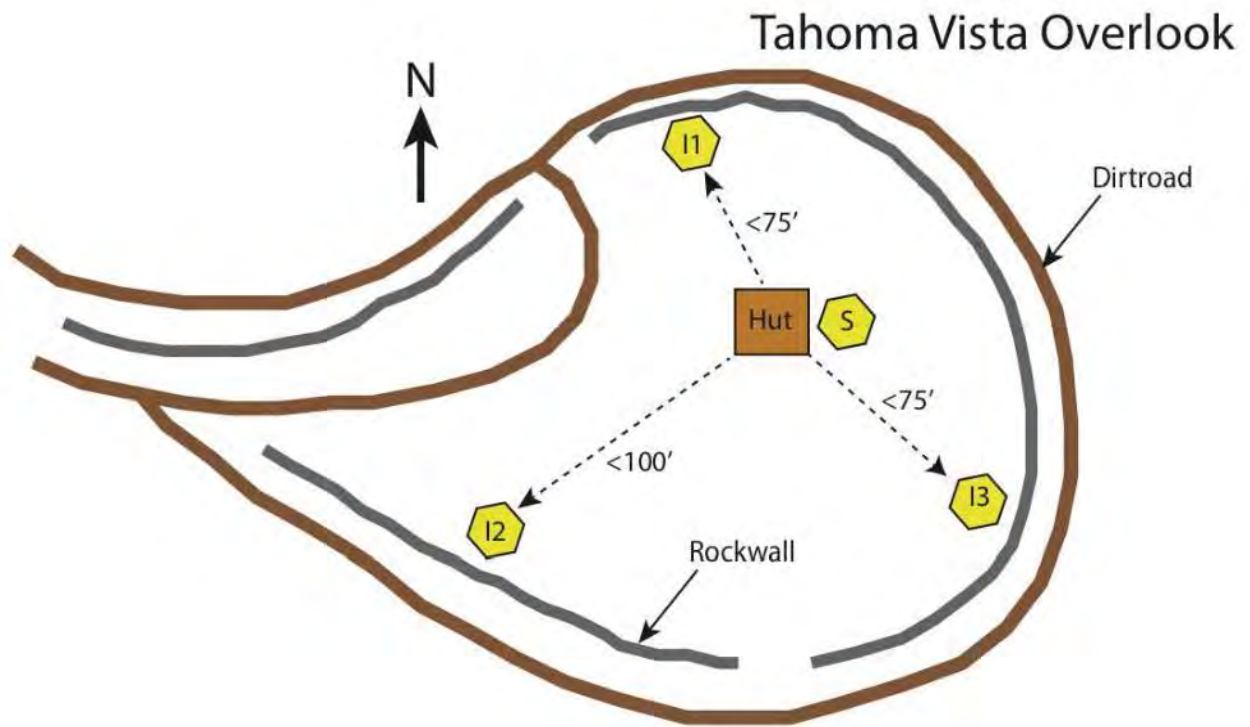


Figure 2: Schematic layout of site with respect to other landmarks. S refers to the seismometer. I1, I2 and I3 refer to the infrasound instruments. Dotted lines show approximate areas where conduit will be trenched in. Brown lines show the Westside Road and the Tahoma Vista Overlook Loop. Gray lines show rock walls.



Figure 3: View from proposed enclosure toward Gobblers Knob across the hairpin turn in the Westside Road. The infrasound I1 is to be placed inside the rockwall on the right side of the photo.



Figure 4: Proposed site for infrasound site I2 as seen from the enclosure. Infrasound is proposed to be placed near the rock wall in the middle of the picture.



Figure 5: Proposed site for infrasound (I3) looking from the proposed enclosure site. Infrasound will be placed just inside the rock wall.

USGS Proposal for Mount Wow Monitoring Station (Road) (46.77971N, -121.88484W)

The requirements for the Mount Wow Site are:

- Southern exposure for solar panels
- Line-of-sight telemetry to repeater (Mount Ararat)
- Seismometer along North-South reach of Tahoma Creek

The Mount Wow site is important to be able to track the progress of a lahar advancing down the Tahoma Creek drainage. This site will provide the last observation of the flow front before it begins to impact infrastructure and populations downstream. Having a site at or near this location will help USGS to refine arrival times downstream and provide relevant information to emergency managers for the purposes of evacuations. Without this site, estimates of arrival times of the flow to the Gateway Entrance Station and Ashford would be less accurate. Data collected using this station, and others in the proposed network, will also be useful in detecting smaller debris flows and outburst floods in Tahoma Creek and elsewhere in the park.

Installation will include a fiberglass hut containing most of the electronics and all the batteries, and with solar panels attached to the outside. The huts have a square base approximately 60 inches wide, and 80 inches high. Attached to the hut will be a pipe (2.375-inch outer diameter) that extends 12 feet or less above the local ground surface that will have a flat panel antenna (~1'x1') placed near the top. Within the hut, solar controllers and lead acid batteries will power the equipment on site. The hut will be secured by driving 1-inch rebar through the flanges of the hut into the road, one on each corner. The goal is to drive the rebar to a depth of 2 feet. An 8-foot-long 5/8-inch diameter copper ground rod will be driven adjacent to the hut to provide protection from static discharge. Four 7/8" diameter 1-foot long pieces of rebar or bolts will be driven into the road to secure a pipe flange to stabilize the antenna pipe. The hut and exposed equipment (except the solar panels and radio antenna) will be painted brown to minimize visibility. Other visibility mitigation measures, such as ghillie netting will also be employed in places that do not cover the antennas or solar panels at the direction of the National Park Service.

The seismometer will be placed on the ground inside the hut for security purposes. A single infrasound sensor will be placed inside the enclosure with air ports to the outside. The infrasound will not change the footprint of the station nor require any additional digging.

The proposed site is on the Westside Road and thus in the NHL. It would be highly visible for all visitors using the Westside Road to recreate. The high visibility gives us an opportunity to educate visitors on the hazards in the area they are about to enter.

Attachment 6, Mount Wow

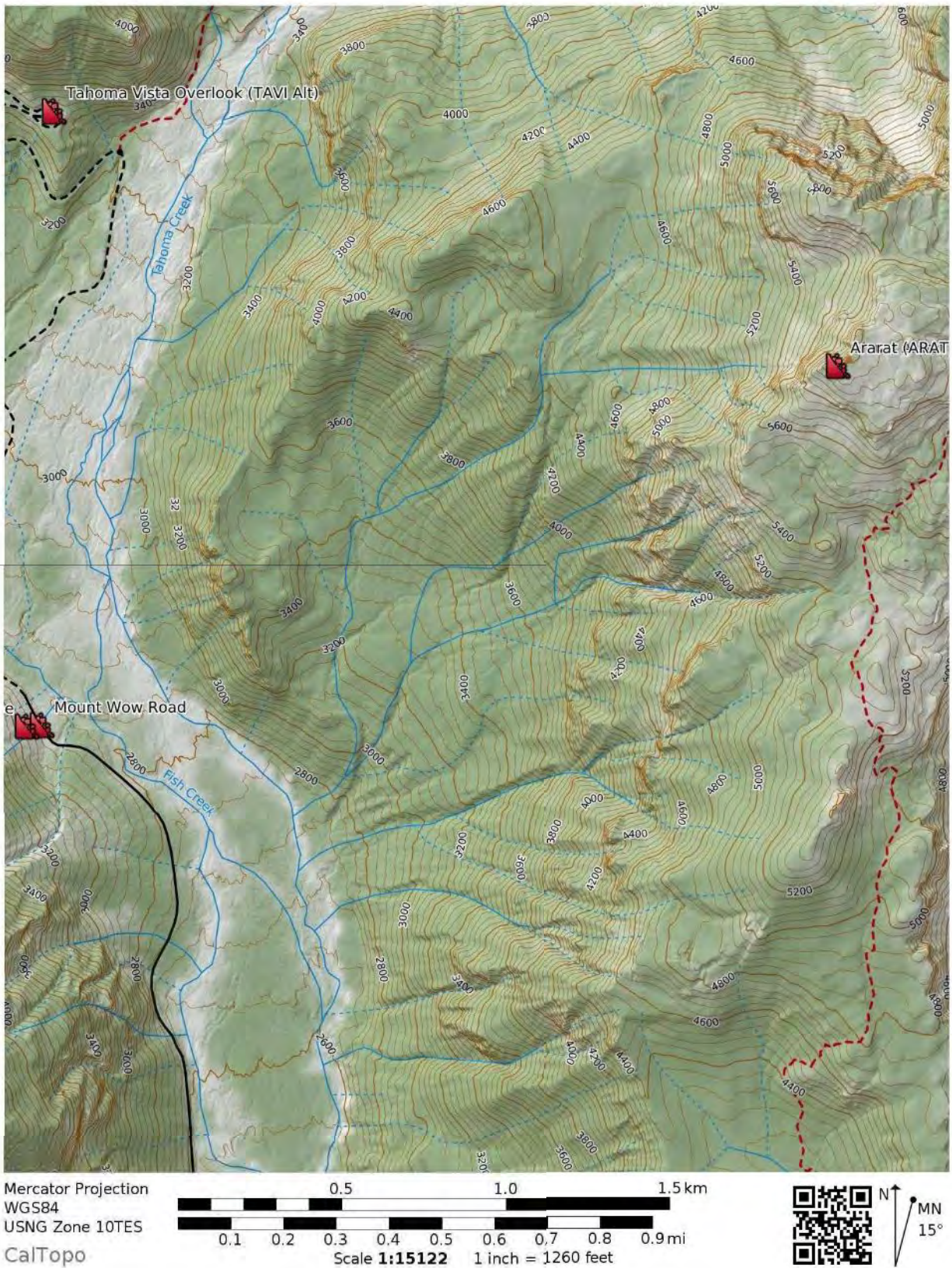


Figure 1: Location map showing the Ararat repeater to the east.



Figure 2: Location map showing the Mount Wow Road site (proposed here) and the Mount Wow Talus Slope site (proposed as an alternative).



Figure 3: Image of proposed site just in front of model. The seismometer will be placed on the road surface inside the footprint of the hut. An infrasound sensor would also be placed inside the footprint of the hut. Note gate in distant background.

Attachment 2

Archaeological Monitoring Plan for Mount Rainier National Park

The archaeological monitor for this undertaking will observe construction activities during project implementation in order to ensure that 1) known archaeological sites adjacent to, or within the Area of Potential Effect (APE) are avoided; 2) unanticipated discoveries of archaeological material are assessed for significance by the park archaeologist in an expeditious manner; 3) the park's Inadvertent Discovery Plan guidelines are followed.

Archaeological Monitoring Protocols:

- 1) A park archaeologist or technician will be on-site during project implementation.
- 2) Work monitored will be documented with photographs, stratigraphy documented when present, UTM coordinates collected with a survey grade GPS unit where possible, and location plotted in the park GIS.
- 3) Artifacts observed will be recorded in field notebooks and collected in plastic bags.
- 4) All significant artifacts recovered from the site will be curated at Mount Rainier National Park's curation facility.
- 5) If the number of artifacts found in any intact strata of the monitoring area is considered significant, excavation will cease until archaeological significance could be assessed by the park archaeologist.
- 6) If a feature is found in any intact strata, excavation will cease until archaeological significance could be assessed by the park archaeologist.
- 7) If the archaeological resource is determined significant and avoidance is not possible, the Washington Department of Archaeology and Historic Preservation (DAHP) and interested parties will be notified of the discovery and arrangements will be made to initiate a mitigation plan as noted in the included Inadvertent Discovery Plan.
- 8) If any human remains, funerary objects, sacred sites or objects of cultural patrimony are found, excavation will cease immediately, and the park archaeologist and park management will follow the Inadvertent Discovery Plan included with this Monitoring Plan.

Archaeological Inadvertent Discoveries Plan for Mount Rainier National Park

In a situation where intact deposits of artifacts determined to be of a historical or pre-contact nature (and in numbers deemed significant by the archaeological monitor) are inadvertently encountered during the construction work, all excavation in the area will cease immediately. Artifacts observed will be recorded in field notebooks and collected in plastic bags. If the number of artifacts found in any intact strata of the monitoring area is considered significant, recommendations for avoidance, data recovery, further monitoring or other mitigation will be made. If an archaeological deposit is determined by the park archaeologist to be of high enough significance to warrant further archaeological recovery efforts before the project may resume, all traditionally associated Tribes, Washington Department of Archaeology and Historic Preservation, and interested parties will be notified of the discovery within a 48-hour period, and arrangements will be made to initiate a mitigation plan.

In a situation where human skeletal remains, funerary objects, sacred sites or objects of cultural patrimony are encountered during the course of this construction work, all activity in the area will cease that may cause further disturbance to those remains. The area of the find will be secured and protected from further disturbance. The finding of human skeletal remains will be reported to park service law enforcement and the county medical examiner/coroner in the most expeditious manner possible. The remains will not be touched, moved, or further disturbed. The county medical examiner/coroner will make a determination of whether those remains are forensic or non-forensic. The county medical examiner/coroner may assume jurisdiction over the remains at that time in order to make the determination. If the county medical examiner/coroner determines the remains are non-forensic, then the park will assume jurisdiction over the remains and report that finding to the Department of Archaeology and Historic Preservation and notify any appropriate cemeteries and all affected tribes of the find within 24 hours of the determination. A qualified physical anthropologist will make a determination of whether the remains are Indian or Non-Indian and report that finding to any appropriate cemeteries and the affected tribes.

If the remains are determined Indian, the Park will handle all consultation with the affected parties. Excavations in the area would be terminated, all human remains, artifact discoveries from the strata associated with the remains, including any associated funerary objects, will be placed in the base of the excavation. The area will be backfilled with its original sediment and secured from further disturbance. All consulting tribes, Department of Archaeology and Historic Preservation, Advisory Council on Historic Preservation, and interested parties will be notified of the discovery, and a negotiation process will initiate to determine necessary mitigations.

Tribal Contacts for Inadvertent Discovery Notification Mount Rainier National Park

Tribe	Contact	Telephone	E-mail
Tribes and Bands of the Yakama Nation	Casey Barney Interim Program Manager Cultural Resource Program	(509)-865- 5121 x4378	casey_barney@yakama.com
	Jessica Lally Archaeologist Cultural Resource Program	509-865- 5121 x4766	jessica_lally@yakama.com
Cowlitz Indian Tribe	Dave Barnett Tribal Chair	(306)577- 8140	dbarnett@cowlitz.org
	Seth Russell Tribal Historic Preservation Officer	(306)577- 8140	srussell@cowlitz.org
Muckleshoot Indian Tribe	Jaison Elkins Tribal Chair	(253)939- 3311	Jaison.elkins@muckleshoot.nsn.us
	Melissa Calvert Director, Preservation Department	(253)939- 3311	melissa.calvert@muckleshoot.nsn.us
Nisqually Indian Tribe	Willie Frank III Tribal Chair	(360)456- 5221	frank.willie@nisqually-nsn.gov
	Annette Bullchild Tribal Historic Preservation Officer	(360)456- 5221	Bullchild.annette@nisqually-nsn.gov
Puyallup Tribe of Indians	Bill Sterud Tribal Chair	(253)573- 7800	bill.sterud@puyalluptribe-nsn.gov
	Brandon Reynon Regulatory Specialist/Tribal Archaeologist	(253)573- 7986	brandon.reynon@puyalluptribe-nsn.gov
Squaxin Island Tribe	Kristopher Peters Tribal Chair	(360)426- 9781	kpeters@squaxin.us
	Rhonda Foster Tribal Historic Preservation Office	(360)426- 9781 ext. 3504	rfoster@squaxin.us

Washington State Physical Anthropologist

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telephone: (360) 586-3534

Juliette Vogel,

Asst. State Physical Anthropologist

e-mail: juliette.vogel@dahp.wa.gov

telephone: (360) 586-3075

Lewis County Coroner

Warren McLeod 585

NW Center St.

Chehalis, WA 98532

Telephone: (360)740-1376

Pierce County Medical Examiner

Karen Cline-Parhamovich, DO

Medical Examiner's Ofc

3619 Pacific Avenue

Tacoma, WA 98418

Telephone: (253)798-6494