Olympic National Park

ENVIRONMENTAL ASSESSMENT
UPPER ELWHA SNOW TELEMETRY PROJECT

SEPTEMBER 2007

Waterhole Snow Telemetry Site – Hurricane Ridge, Olympic National Park

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National Park Service and the Natural Resources Conservation Service
Washington

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Chapter 1: Purpose and Need for Action

Project Purpose and Need

The Natural Resources Conservation Service (NRCS), in conjunction with the National Park Service (NPS), is considering the installation of a snowpack telemetry site (SNOTEL) in the upper Elwha watershed of Olympic National Park.

The four primary objectives of this project are as follows:

1. Provide accurate snow and precipitation measurements from the upper Elwha watershed.
2. Improve daily runoff forecasts for the Elwha and Dungeness Rivers.
3. Provide emergency managers, meteorologists and avalanche forecasters with real-time climate data from the upper Elwha to better predict timing and extent of flood, winter storm and avalanche events.
4. Provide long-term climate data from a high elevation site in the park interior for the purpose of interpreting NPS long-term monitoring efforts, understanding the impacts of global warming on park resources, and improving knowledge for the purpose of understanding the health and improving the management of park wilderness.

The effort to provide accurate snow and precipitation measurements and improve daily runoff forecasts for the Elwha and Dungeness Rivers stems from a National Aeronautics and Space Administration (NASA)-funded proposal by the North Olympic Peninsula Resource Conservation & Development Council. This council is a private, non-profit group committed to natural resource conservation and comprised of water users on the North Olympic Peninsula. The council includes city and county governments, tribes, ports, conservation districts, public utility departments and economic development council members. SNOTEL data would be used to verify modeling efforts which use remote sensing techniques, such as satellite imagery to estimate daily snowpack and river runoff.

When Congress first established the mandate for the snow survey program, the primary purpose was for water management in areas that relied on mountain snowpack for agricultural and urban water sources. Placement of manual snow measurements and later SNOTELs was based on filling those specific needs. For this reason, snow courses and SNOTELs were never established in remote areas of the Olympic National Park interior or on the western flank of the Olympic Mountains.

In recent years, more emphasis has been placed on the importance of mountain snowpack in the northwest. In addition to providing agricultural and urban water sources, snowpack is one of the most important system drivers in mountain environments, affecting the timing and frequency of flood events, the vitality of many salmon, fish and wildlife species, and the composition and location of forests and meadowlands. Scientists predict that snowpack in the Olympic Mountains will decrease as temperatures warm in response

to global climate change. Predicted change, combined with the significance of the affected resources to the NPS, Olympic Peninsula tribes, and other government and private land managers, has created a need for mountain snowpack information from areas of the Olympic Peninsula where there was once little interest.

The Olympic mountain range acts as a major barrier to storms originating from the Pacific Ocean. The result is one of the steepest precipitation gradients in North America. Slopes on the west sides of the Olympic Mountains receive heavy precipitation, which in some places may exceed 200 inches annually, while locations on the northeast side of the range receive annual precipitation as low as 20 inches.

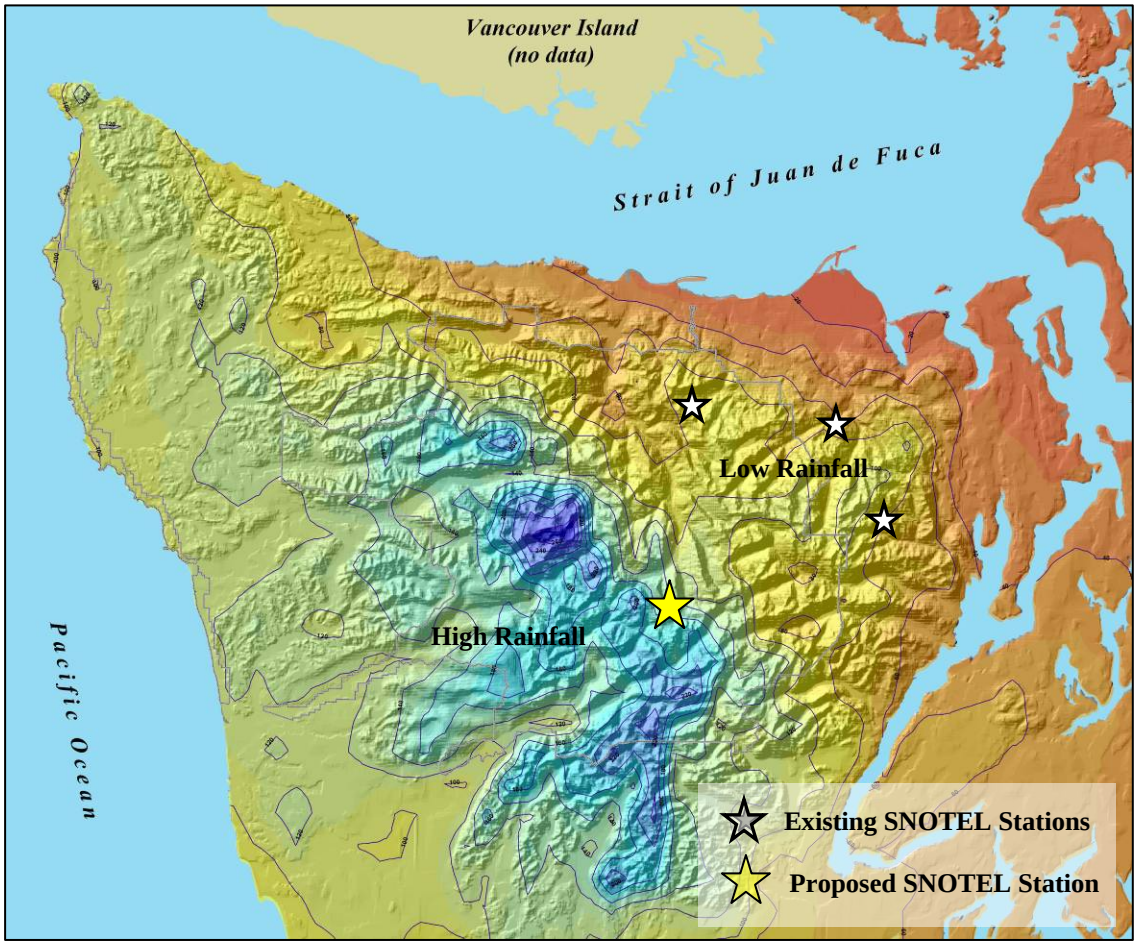

Figure 1. Location of existing and proposed SNOTEL sites. *Precipitation gradient of the Olympic Peninsula based on PRISM (**P**arameter-elevation **R**egressions on **I**ndependent **S**lopes **M**odel) model. Shades of green to blue indicate gradients of high rainfall – with dark blue indicating wettest areas. Shades of yellow to red indicate gradients of low precipitation – with red indicating driest areas.*

All existing Olympic snowpack data comes from a small cluster of existing SNOTEL sites located outside of park wilderness on the north and east sides of the park (Figure 1). Current estimates of precipitation and snowfall on the western and interior Olympics are based exclusively on computer models. Current models are fraught with inaccuracies, due primarily to the rugged, complex topography and steep precipitation gradient. The result

is that the usefulness of these models for understanding Olympic National Park's microclimates is extremely limited and snow conditions at high elevations on the west side and interior of the park are largely unknown.

In 2007, the North Olympic Peninsula Resource Conservation & Development Council received grant money to use remote sensing, real-time climate data and a predictive model, called the "hybrid model," to estimate snowpack and runoff in the Dungeness and Elwha Rivers. If successful, use of this model could then be applied to "non-instrumented" drainages throughout the western United States. A benefit of this project's success would be the ability to move away from the impacts of instrument placement in remote drainages and more reliance on models for streamflow prediction.

The placement of a SNOTEL in the upper Elwha is necessary because it will provide measured precipitation and snow water content in an area where estimating values using models is difficult (Christopher Daly, Oregon State University, Spatial Climate Analysis Group, pers. comm.). Measured snow and rainfall values are needed to verify the accuracy of the proposed hybrid model. The real-time climate and snow data will enhance the ability of model developers to "tune" model variables and interpret remote sensing data to better estimate precipitation and snow water content throughout high areas of the upper western slopes of the Olympics.

In addition to development of the model, the SNOTEL would provide real-time, measured data in an area where values were previously estimated. SNOTEL data is regularly accessed by the National Weather Service, emergency managers and the Northwest Avalanche Center to provide winter storm and flood warnings as well as avalanche forecasts. Measured data from the interior Olympics would allow for more accurate predictions of these events and increase public safety through more timely response.

Project Background

The NRCS installs, operates and maintains an extensive, automated system to collect snowpack and related climatic data in the western United States. This system, known as the SNOTEL (SNOwpack TELemetry) network, evolved from the NRCS's Congressional mandate in the mid-1930s "to measure snowpack in the mountains of the west and forecast the water supply." Evolving from manual snow surveys, the SNOTEL network has now grown to include over 700 sites in remote, mountainous areas throughout the western United States. It has proven to be extremely reliable for collecting and transmitting snow and climate data. The high-elevation watershed locations and the broad coverage of the SNOTEL network provide important data to meteorologists, climatologists, avalanche forecasters, water and natural resource managers, and emergency managers for natural disasters such as floods.

Snowpack data has been collected by federal scientists at Olympic National Park since 1949. Beginning that year, monthly winter snow surveys were conducted at two marked transects or "snow courses," one at Deer Park and the other west of Hurricane Ridge

adjacent to the Wolf Creek Road. The snow courses were established in open gaps in the forested landscape. Using a hand held instrument known as a "federal sampler," scientists took manual measurements of snow depth and snow water equivalent (the amount of equivalent rainfall captured in the snowpack) at the beginning of February, March, April and May because these months were considered most relevant to spring and summer stream flows. In 1968, an additional snow course was added to the Hurricane Ridge area in Cox Valley.

As more accurate and timely forecasting products were required by water users in western states, automated SNOTEL stations began replacing manual snow courses throughout the west. Rather than rely on a few (monthly) measurements, the SNOTEL instruments could effectively and reliably collect and transmit hourly snowpack and climate data. The finer scale of data allowed for better water supply forecasting and became an additional tool for short-term forecasting of events such as floods and avalanches.

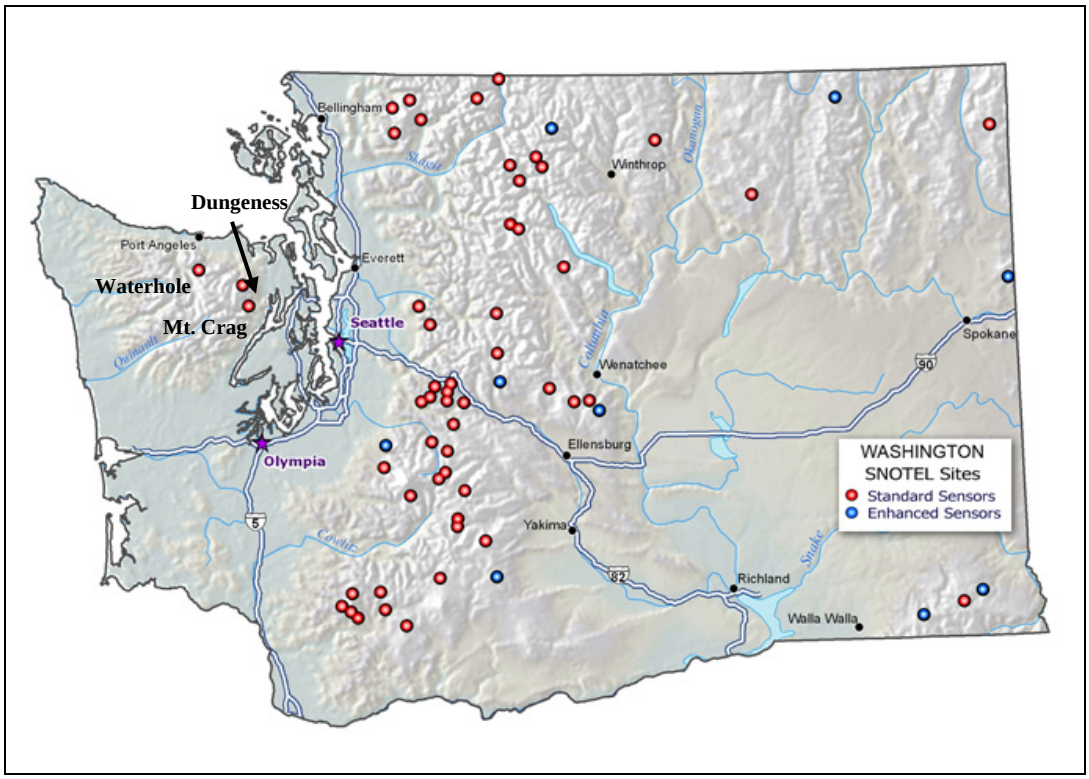

Figure 2. Washington State SNOTEL Sites

In 1989, the first SNOTEL was installed in the Olympic Mountains, near Mt. Crag on the northeast corner of the Olympic Peninsula. This installation served the Quilcene River watershed. Increasing development on the north peninsula and concerns about limited water supplies shared by agriculture, fisheries and residents prompted the addition of two new SNOTELs in 1999. The first was in the upper Dungeness River and the second was installed in the "Waterhole" area, just east of Hurricane Ridge. The Dungeness SNOTEL

services the Dungeness River, while the Waterhole site services both the Dungeness and Elwha watersheds.

On April 28 and 29, 2003, the National Park Services' North Coast and Cascades Network (NCCN) held a climate monitoring workshop. The workshop was attended by scientists and resource managers from multiple agencies and organizations. The primary goal of the workshop was to devise the best way to monitor climate within NCCN parks and use the data to interpret measured changes to park ecosystems. A secondary goal was to provide climate data for park managers and the broader climate community. A working group was assembled to consider Olympic National Park and make recommendations of the most important monitoring locations, type of equipment and appropriate models for extrapolation of climate data.

The working group had two key recommendations:

1. The overall and clear consensus is that there is a major lack of precipitation and temperature data on the west side of the park at high elevations (3,500-5,500 ft.). The first climate priority should be placement of a SNOTEL or similar instrumentation on the west "wet" side of the park. Recommendation: Install a SNOTEL to measure snowpack, temperature and total precipitation in a site at high elevation (3,500-4,500 ft.) on the west or southwest face of the Olympic Range.

2. One of the greatest unknowns is the location and extent of the precipitation gradient in the interior Olympics. How fast does precipitation drop off on the lee side of Mt. Olympus and Mt. Anderson? This question would suggest placement of a high elevation weather station somewhere in the upper Elwha. Recommendation: Install a SNOTEL to measure snowpack, temperature and total precipitation in a site at high elevation (4,000-5000 ft.) on the interior of the Olympic Range, closer to the Mt. Anderson massif. The purpose would be to get greater geographic range and help determine the accuracy of current precipitation models.

Park Purpose and Significance

An essential part of the planning process is to understand the purpose and significance of the park for which this environmental assessment is being prepared.

Olympic National Park protects 922,651 acres of three distinctly different ecosystems — rugged glacier-capped mountains, more than 70 miles of wild Pacific coast, and magnificent stands of old-growth and temperate rain forest. Olympic National Park encompasses and protects one of the largest wilderness areas in the contiguous United States — 95% of the park (876,669 acres) is designated wilderness, offering visitors a chance to experience the park's amazing diversity in its natural and pristine state.

Park Purpose
Park purpose statements are based on national park legislation, legislative history and National Park Service policies. The statements reaffirm the reasons for which the national park was set aside as a unit of the national park system, and provide the foundation for national park management and use.

The purpose of Olympic National Park is described in the 1996 *Statement for Management* as follows:

> The purpose of Olympic National Park is to preserve for the benefit, use and enjoyment of the people, the finest sample of primeval forests of Sitka spruce, western hemlock, Douglas fir and western red cedar in the entire United States; to provide suitable winter range and permanent protection for the herds of native Roosevelt elk and other wildlife indigenous to the area; to conserve and render available to the people, for recreational use, this outstanding mountainous country, containing numerous glaciers and perpetual snow fields, and a portion of the surrounding verdant forests together with a narrow strip along the beautiful Washington coast.

Park Significance
Olympic National Park protects several distinct and relatively pristine ecosystems, including more than 70 miles of wild Pacific coast and islands, densely forested lowlands and the glacier-crowned Olympic Mountains.

The ecosystems protected within Olympic National Park contain a unique array of habitats and life forms, resulting from thousands of years of geographic isolation, and extreme gradients of elevation, temperature and precipitation. At least 16 kinds of animals and 8 kinds of plants on the Olympic Peninsula exist nowhere else in the world.

Olympic National Park protects the primeval character of one of the largest wilderness areas in the contiguous United States.

Olympic National Park protects some of the finest remaining stands of old-growth temperate rainforest in the United States. These forests of ancient and immense trees provide habitat for dozens of smaller plants and animals, including important habitat for a number of threatened species.

Olympic National Park protects more than 3,000 miles of rivers and streams within 11 watersheds and provides one of the largest remaining tracts of pristine fish spawning and rearing habitat in the lower 48 states. Nine species of salmon, trout, char and many other native fish inhabit these waters.

The Olympic rocky intertidal community is considered to be one of the most complex and diverse shoreline communities in the United States. Olympic National Park protects about 1,400 square miles of the intertidal, island and shoreline habitat. Altogether, Olympic National Park, the neighboring Olympic Coast National Marine Sanctuary and

U.S. Fish and Wildlife Service Washington Islands National Wildlife Refuge, protect a total of 3,600 square miles of intertidal, island and ocean habitats.

Olympic National Park protects the largest population of Roosevelt elk in its natural environment in the world. Decades of protection from human harvest and habitat manipulation have sustained not only high densities of elk, but have also preserved the natural composition, social structure and dynamics of this unique coastal form of elk as found nowhere else.

Legislation and Policy

The NPS Organic Act of 1916 **(16 USC 1, 2-4) and the** ***General Authorities Act*** **(16 USC 1a-8)**: These acts direct the NPS to "conserve the scenery, the natural and historic objects, and wildlife, and to provide for the enjoyment of those resources in such a manner as to leave them unimpaired for future generations."

The Redwood Act (March 27, 1978, 16 USC 1a-1): This act reaffirms the mandates of the *NPS Organic Act* and provides additional guidance on national park system management as follows:

> The authorization of activities shall be construed and the protection, management and administration of these areas shall be conducted in light of the high public value and integrity of the national park system and shall not be exercised in derogation of the values and purposes for which these various areas have been established.

The Wilderness Act of 1964 (September 3, 1964, 16 USC 1131-1136) establishes a national wilderness preservation system to be composed of federally owned areas designated by Congress as wilderness. By law these wilderness areas, ". . . shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness." (16 USC 1131)

Each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area and shall so administer such areas for such other purposes for which it may have been established as also to preserve its wilderness character.

Except as otherwise provided in this Act, wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation and historical use.

The Washington Park Wilderness Act of 1988: Wilderness was officially designated in Olympic National Park by Congress on November 16, 1988 (PL 100-668). A total of

876,669 acres, about 95% of the park, was designated as the Olympic Wilderness, and another 378 acres was designated as potential wilderness.

The National Parks Omnibus Management Act of 1998: This act provides national parks with clear guidance to use sound scientific methods to better achieve the park service mission.

Section 101 describes protection, interpretation and research in the national park system.

> Recognizing the ever increasing societal pressures being placed upon America's unique natural and cultural resources contained in the national park system, the Secretary shall continually improve the ability of the National Park Service to provide state-of-the-art management, protection, and interpretation of and research on the resources of the national park system.

Section 201 describes the purposes of a park inventory and monitoring program:

1. to more effectively achieve the mission of the National Park Service;
2. to enhance management and protection of national park resources by providing clear authority and direction for the conduct of scientific study in the national park system and to use the information gathered for management purposes;
3. to ensure appropriate documentation of resource conditions in the national park system;
4. to encourage others to use the national park system for study to the benefit of park management as well as broader scientific value, where such study is consistent with the Act of August 25, 1916 (*National Park Service Organic Act*; 16 USC 1 et seq.); and
5. to encourage the publication and dissemination of information derived from studies in the national park system.

Section 202 describes a research mandate for the National Park Service.

> The secretary is authorized and directed to assure that management of units of the national park system is enhanced by the availability and utilization of a broad program of the highest quality science and information.

Section 204 describes the creation of an inventory and monitoring program.

> The secretary shall undertake a program of inventory and monitoring of national park system resources to establish baseline information and to provide information on the long-term trends in the condition of national park system resources. The monitoring program shall be developed in cooperation with other federal monitoring and information collection efforts to ensure a cost-effective approach.

Section 205 describes the availability of national parks for scientific study.

> The secretary may solicit, receive and consider requests from federal or non-federal public or private agencies, organizations, individuals or other entities for the use of any unit of the national park system for purposes of scientific study.
>
> A request for use of a unit of the national park system may only be approved if the secretary determines that the proposed study:
>
> 1. is consistent with applicable laws and National Park Service management policies; and
> 2. will be conducted in a manner as to pose no threat to park resources or public enjoyment derived from those resources.

Acts Related to Cultural Resources Management: The National Historic Preservation Act of 1966 (1992, as amended) (NHPA), and other applicable laws and regulations including the *NPS Organic Act* (1916), the Antiquities Act of 1906, NEPA, the National Parks and Recreation Act of 1978, the Archeological Resources Protection Act of 1979, the Native American Graves Protection and Repatriation Act of 1990, and the Curation of Federally Owned and Administered Archeological Collections (1991), along with applicable agency policies provide direction for the protection, preservation and management of cultural resources on public lands. Further, these laws and policies establish what must be considered in general management planning and how cultural resources must be managed in future undertakings resulting from the approved plan, regardless of the final alternative chosen.

NPS *Management Policies 2006* are based on these and other legislation, and provide guidance for management of all national park units. Several management policies are directly relevant to the possible installation of a SNOTEL site in the upper Elwha River.

4.1.4 Partnerships: The Service will develop agreements with federal, tribal, state and local governments and organizations; foreign governments and organizations; and private landowners, when appropriate, to coordinate plant, animal, water and other natural resource management activities in ways that maintain and protect park resources and values. Such cooperation may include park restoration activities, research on park natural resources and the management of species harvested in parks.

4.2 Studies and Collections: The Service will encourage appropriately reviewed natural resource studies whenever such studies are consistent with applicable laws and policies. These studies support the NPS mission by providing the Service, the scientific community, and the public with an understanding of park resources, processes, values and uses that will be cumulative and constantly refined. This approach will provide a scientific and scholarly basis for park planning, development, operations, management, education and interpretive activities.

4.2.1 NPS-conducted or -sponsored Inventory, Monitoring and Research Studies:
The Service will:

- identify, acquire and interpret needed inventory, monitoring and research, including applicable traditional knowledge, to obtain information and data that will help park managers accomplish park management objectives provided for in law and planning documents;
- define, assemble and synthesize comprehensive baseline inventory data describing the natural resources under NPS stewardship, and identify the processes that influence those resources;
- use qualitative and quantitative techniques to monitor key aspects of resources and processes at regular intervals;
- analyze the resulting information to detect or predict changes (including interrelationships with visitor carrying capacities) that may require management intervention and provide reference points for comparison with other environments and time frames; and
- use the resulting information to maintain—and where necessary restore—the integrity of natural systems.

4.2.2 Independent Studies: Non-NPS studies conducted in parks are not required to address specifically identified NPS management issues or information needs. However, these studies, including data and specimen collection, require an NPS scientific research and collecting permit. The studies must conform to NPS policies and guidelines regarding the collection and publication of data, the conduct of studies, wilderness restrictions and park-specific requirements identified in the terms and conditions of the permit.

6.3.5 Minimum Requirement: All management decisions affecting wilderness must be consistent with the minimum requirement concept. This concept is a documented process used to determine if administrative actions, projects or programs undertaken by the Service or its agents and affecting wilderness character, resources or the visitor experience are necessary, and if so how to minimize impacts. The minimum requirement concept will be applied as a two-step process that determines:

1. whether the proposed management action is appropriate or necessary for administration of the area as wilderness and does not cause a significant impact to wilderness resources and character, in accordance with the Wilderness Act; and
2. the techniques and types of equipment needed to ensure that impacts on wilderness resources and character are minimized.

When determining minimum requirements, the potential disruption of wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience. If a compromise of wilderness resources or character is unavoidable, only those actions that preserve wilderness character and/or have localized, short-term adverse impacts will be acceptable.

Although park managers have flexibility in identifying the method used to determine minimum requirement, the method used must clearly weigh the benefits and impacts of

the proposal, document the decision-making process, and be supported by an appropriate environmental compliance document. The minimum requirement analysis is included as Appendix A.

Administrative use of motorized equipment or mechanical transport will be authorized only:

- 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.

Such management activities will also be conducted in accordance with all applicable regulations, policies, and guidelines and, where practicable, will be scheduled to avoid creating adverse resource impacts or conflicts with visitor use.

6.3.6 Scientific Activities in Wilderness: The statutory purposes of wilderness include scientific activities, and these activities are encouraged and permitted when consistent with the Service's responsibilities to preserve and manage wilderness.

6.3.6.1 General Policy: The National Park Service has a responsibility to support appropriate scientific activities in wilderness and to use science to improve wilderness management. The Service recognizes that wilderness can and should serve as an important resource for long-term research into and study and observation of ecological processes and the impact of humans on these ecosystems. The National Park Service further recognizes that appropriate scientific activities may be critical to the long-term preservation of wilderness.

Scientific activities are to be encouraged in wilderness. Even those scientific activities (including inventory, monitoring and research) that involve a potential impact to wilderness resources or values (including access, ground disturbance, use of equipment and animal welfare) should be allowed when the benefits of what can be learned outweigh the impacts on wilderness resources or values. However, all such activities must also be evaluated using the minimum requirement concept and include documented compliance that assesses impacts against benefits to wilderness. This process should ensure that the activity is appropriate and uses the minimum tool required to accomplish project objectives. Scientific activities involving prohibitions identified in section 4(c) of the Wilderness Act (16 USC 1133(c)) may be conducted within wilderness when the following occur:

- The desired information is essential for understanding the health, management, or administration of wilderness, and the project cannot be reasonably modified to eliminate or reduce the nonconforming wilderness use(s); or if it increases scientific knowledge, even when this serves no immediate wilderness management purposes, provided it does not compromise wilderness resources or character. The preservation of wilderness resources and character will be given significantly more weight than economic efficiency and/or convenience.

- Compliance with the National Environmental Policy Act (including completion of documented categorical exclusions, environmental assessments/findings of no significant impact, or environmental impact statements/records of decision) and other regulatory compliance (including compliance with section 106 of the National Historic Preservation Act (16 USC 470(f)) are accomplished and documented.
- All scientific activities will be accomplished in accordance with terms and conditions adopted at the time the research permit is approved. Later requests for exceptions to the Wilderness Act will require additional review and approval.
- The project will not significantly interfere with other wilderness purposes (recreational, scenic, educational, conservation or historical) over a broad area or for a long period of time.
- The minimum requirement concept is applied to implementation of the project.

Research and monitoring devices (e.g., video cameras, data loggers, 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.

Park managers will work with researchers to make NPS wilderness area research a model for the use of low-impact, less intrusive techniques. New technology and techniques will be encouraged if they are less intrusive and cause less impact. The goal will be for studies in NPS wilderness to lead the way in "light on the resource" techniques.

Devices located in wilderness will be removed when determined to be no longer essential. Permanent equipment caches are prohibited within wilderness. Temporary caches must be evaluated using the minimum requirement concept.

All scientific activities, including the installation, servicing, removal, and monitoring of research devices, will apply minimum requirement concepts and be accomplished in compliance with management policies, director's orders and procedures specified in the park's wilderness management plan.

Director's Order #41 and Reference Manual #41, Wilderness Preservation and Management, NPS 1999: The purpose of this document is to provide accountability, consistency and continuity to the NPS wilderness management program and to guide NPS managers in meeting the letter and spirit of the Wilderness Act. It clarifies, where necessary, specific provisions of NPS *Management Policies*, and establishes specific instructions and requirements concerning the management of wilderness areas.

Director's Order #28 and Cultural Resources Guideline #28, NPS 1998: This guideline elaborates on cultural resource management policies and standards and offers guidance in applying them to establish, maintain and refine park cultural resource programs. It is intended to aid managers, planners, staff, and cultural resource specialists,

and places greater emphasis on the needs of park managers and staff and non-specialists. It outlines the basic principles and ingredients of a good park program.

Natural Resources Management Guideline, NPS-77, 1991: This document provides guidance to park managers for all planned and ongoing natural resource management activities. Managers must follow all federal laws, regulations and policies. This document provides the guidance for park management to design, implement and evaluate a comprehensive natural resource management program.

Directors Order #47 – Soundscape Preservation and Noise Management: The purpose of this Director's Order is to articulate National Park Service operational policies that will require, to the fullest extent practicable, the protection, maintenance or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources

Park Planning Documents

Several planning documents directly pertain to administrative activities within Olympic National Park.

1976 Olympic National Park Master Plan: The Master Plan outlines park purposes to preserve, protect and interpret, for the enjoyment and benefit of the American people. The Master Plan clearly specifies the need for research and states, "In order to facilitate effective management of the park's unique resources a number of research projects of varying scope and duration are needed."

It also specifies the need for climate monitoring: Collection of climatological information in the park is often haphazard, and most records are incomplete. Assuming that complete records of a few parameters are infinitely more useful than occasional measurements on many, consideration should be given to the installation of continuous monitoring or integrating instrumentation at selected locations, to document, at the least, variations in temperature means, temperature extremes and precipitation.

1980 Olympic National Park Backcountry Management Plan and 1992 Addendum: This plan was developed and updated to guide the park in managing its undeveloped backcountry areas. The plan was drafted and approved prior to the official designation of wilderness for most areas of Olympic National Park. Until final approval of an Olympic National Park Wilderness Plan, this document continues to guide wilderness use in the park. While the plan and addendum does not directly address research and monitoring activity in the park, it does specify the use of a "minimum tool." Service policy directs that "the minimum tool necessary to successfully, safely and economically accomplish its management objectives will be used in the wilderness."

Statement for Management, Olympic National Park – 1996: This document includes information regarding the park's purpose, the natural and cultural resources found in the park and their significance, the legislative history, and the jurisdiction over Olympic

National Park and the surrounding areas of the Olympic Peninsula. The document also includes the following management objectives:

1. Resource Stewardship and Protection: The primary responsibility of the NPS must be protection of resources.
2. Access and Enjoyment: Each park should provide the nation's diverse public access to park resources in a way that is compatible with the understanding and enjoyment of those resources and their preservation for future generations.
3. Education and Interpretation: The NPS shall enhance visitor and community understanding, appreciation and conservation of natural and cultural resources through education and interpretation.
4. Proactive Leadership: The NPS must be a leader in local, national and international park affairs, actively pursuing the mission of the national park system and assisting others in managing their resources.
5. Science and Research: The NPS must engage in a sustained and integrated program of natural, cultural, and social science research and resource management to acquire the information needed to manage and protect park resources.
6. Professionalism: The NPS must create and maintain a highly professional organization and workforce.

Olympic National Park Draft General Management Plan and Environmental Impact Statement: Olympic National Park is developing a general management plan (GMP). The draft GMP was released for public review from June 15 to September 30, 2006. The park anticipates completion of the GMP in late 2007. The GMP provides overall planning guidance for desired conditions and parkwide policies for resource protection, sets park access goals, and provides the direction for park management for the next 15 to 20 years. One strategy proposed in the draft GMP would be to develop and implement research programs related to the wilderness ecosystem and key natural resources and visitor experience. Another strategy identified in the draft GMP would be to participate in collaborative planning efforts with adjacent land managers and tribal governments to identify common goals, pursue solutions and build joint data sets through information sharing.

Scoping, Issues and Impact Topics

Scoping

Scoping is an effort to involve agencies and the general public in determining issues to be addressed in this environmental assessment. Internal scoping for this project began when the North Olympic Peninsula Resource Conservation & Development Council and NRCS submitted a proposal to the NPS to install a SNOTEL in the upper Elwha drainage. The proposal was presented to the park's interdisciplinary planning team. As part of this original proposal, a minimum requirement analysis was completed to determine if the proposed project would be appropriate or necessary for the administration of the area as wilderness and did not cause a significant impact to wilderness resources and character, in accordance with the Wilderness Act. Since the proposal was found to be appropriate, the wilderness minimum requirement analysis was completed to determine alternatives

and the type of equipment that could be used for minimizing the impact of the installation to wilderness.

A letter initiating public scoping and describing the project was issued on February 7, 2007 (Appendix B). The press release was sent to approximately 50 media outlets, interested groups, public officials, agencies, and individuals in the Puget Sound and Olympic Peninsula area. Comments were solicited during a public scoping period that ended March 9, 2007. Six responses were received. Comments received were generally in support of the project, although one organization expressed opposition and one individual expressed ambivalence, questioning the need for the project. Commenters expressed concern about the impacts a SNOTEL placement would have on park wilderness. There was interest in the park carefully choosing an appropriate site which would minimize the footprint on the land and would be hidden from public view. Individuals also desired direct benefits such as access to real-time data.

Issues and Impact Topics

Specific impact topics were developed for discussion and to allow comparison of the environmental consequences of each alternative. These impact topics were identified based on internal and external scoping, federal laws, regulations and executive orders; NPS *Management Policies 2006*; results of a site visit, and NPS knowledge of limited or easily impacted resources. A brief rationale for the selection of each impact topic is given below, as well as the rationale for dismissing specific topics from further consideration.

Impact Topics Selected for Detailed Analysis

Table 1. Impact Topics Retained for Further Evaluation and Relevant Laws, Regulations and Policies

Impact Topic	Reasons for Retaining Impact Topic	Relevant Laws, Regulations and Policies
Soil	The project would involve excavation and manipulation of small areas of soil for installation of the tower, instrument foundations and a snow pillow. Therefore, impacts to soil will be further evaluated in this environmental assessment.	NPS *Organic Act;* NPS *Management Policies; Resource Management Guidelines (NPS-77)*
Vegetation	The project would require the removal of small areas of vegetation for the installation of the tower, instrument foundations and a snow pillow. Therefore, impacts to vegetation will be further evaluated in this environmental assessment.	NPS *Organic Act;* NPS *Management Policies; Resource Management Guidelines (NPS-77)*
Wildlife	The project would have the potential to affect wildlife during construction activities and annual maintenance flights. Therefore, this topic will be further evaluated in this environmental assessment.	NPS *Organic Act;* NPS *Management Policies; Resource Management Guidelines (NPS-77)*
Wilderness Values	A SNOTEL installation could have an adverse effect on the Olympic National Park wilderness. In addition, the remote location and maintenance requirements of this installation would require annual access using a helicopter. The noise and visual presence of a helicopter could impact wilderness visitors. Therefore, wilderness values will be further evaluated in this environmental assessment.	NPS *Organic Act; Wilderness Act, 1964; The Washington Park Wilderness Act, 1988*

Impact Topic	Reasons for Retaining Impact Topic	Relevant Laws, Regulations and Policies
Cultural Resources	This project would involve ground disturbance of small areas of soil for the installation of the tower, instrument foundations and a snow pillow. Since archeological resources are abundant in high country areas throughout the park, cultural resources are an impact topic that will be addressed in this document.	Chapter 5 of *Management Policies 2006,* and *Director's Order # 28: Cultural Resource Management,* as well as other related policy directives such as the NPS *Museum Handbook* and the NPS *Manual for Museums.*
Visual Resources	Visual resources would be affected by the project by the placement of the SNOTEL site. Therefore, this topic will be addressed in this document.	NPS *Management Policies*
Soundscape	Noise associated with the use of helicopters for annual maintenance flights would have an effect on park visitors in the overflight path. Therefore, soundscapes have been included as an impact topic in this environmental assessment.	NPS *Management Policies; Sound Preservation and Noise Management (DO-47)*
Visitor Experience	Placement of a SNOTEL may affect the visitor enjoyment in Olympic National Park. Therefore, visitor experience will be addressed as an impact topic in this environmental assessment.	NPS *Organic Act;* NPS *Management Policies; NPS-77; The Redwood Act, 1978*
Park Safety & Operations	Park operations associated with restoration of the Elwha River and a variety of park natural resource management objectives would benefit from the data provided from a SNOTEL installation. Likewise, the safety of park visitors, employees and downstream communities could be affected by this project. Therefore, safety and park operations will be addressed as an impact topic in this environmental assessment.	NPS *Management Policies*

Impact topics dismissed from further analysis

The following topics were eliminated from detailed study because there would be no potential impacts or only negligible impacts expected.

Air Quality

The 1963 Clean Air Act, as amended (42 USC 7401 et seq.), requires land managers to protect air quality. Section 118 of the Clean Air Act requires parks to meet all federal, state and local pollution standards. *Management Policies 2006* address the need to analyze potential impacts to air quality during park planning. Under the Clean Air Act, Olympic National Park is designated as a Class I area, which implies the strictest requirements for protection of air quality (NPS 1990). The use of a helicopter could add some fumes to the air but this would be temporary, slight and negligible. None of the other activities associated with this project would affect air quality, therefore this topic will not be evaluated within this document.

Threatened and Endangered Species and Species of Special Concern

The Endangered Species Act (1973), as amended, requires an examination of impacts on all federally listed threatened or endangered species. NPS policy also requires examination of the impacts on federal candidate species, as well as state-listed threatened, endangered, candidate, rare, declining and sensitive species.

The project area is at an elevation well above potential breeding habitat for marbled murrelets and northern spotted owls. All flights would originate from Obstruction Point (elevation 6,000 ft.) and terminate at the SNOTEL location (elevation 5,000 ft.). The proposed use of helicopters for installation and maintenance would not affect these species. Maintenance would generally occur between fall and winter months, outside of the breeding periods of these species. No other listed threatened or endangered species exist in the project area. The only sensitive species that could occur in the project area is the Mazama pocket gopher (federal candidate, state threatened). However, the project area was surveyed and determined to be absent of burrows or other evidence of pocket gophers, and the area is not typical of pocket gopher habitat. Therefore, threatened, endangered and special-status species will not be addressed in this environmental assessment.

Fish and Fish Habitat
The perennial stream in the immediate project area does not support fish species. Distance to the nearest fish bearing waters (the Elwha River) from the project site is more than 5 miles. Therefore, this topic will not be evaluated.

Socioeconomic Environment
No alternatives associated with this project have the potential to directly affect economic activities outside the park. While the ability to better predict flood events and seasonal stream flow would have a positive impact on local government planning and emergency response, direct economic benefits would be difficult to quantify and would likely be negligible. Therefore, socioeconomics will be not be addressed in this environmental assessment.

Geology and Geologic Hazards
There would be no impacts to geologic features. Although ground-disturbing activities would be anticipated within two of the alternatives, the area of impact would be small and only within shallow soil horizons. Geologic features or hazards (e.g., landslides) would not be affected. Therefore, geology and geologic hazards have been dismissed as an impact topic in this environmental assessment.

Wetlands and Floodplains
Executive Order 11988 (Floodplain Management), Executive Order 11990 (Protection of Wetlands), and NPS policies require an examination of impacts to floodplains and wetlands. The project site would not be within the floodplain of the Elwha River or its tributaries. There would be no jurisdictional or NPS-defined wetlands within the project area. SNOTEL equipment requires well drained, level benches and therefore would not be placed within wetland areas. Wetlands and floodplains have been dismissed as an impact topic in this environmental assessment.

Designated Critical Habitat, Ecologically Critical Areas, Wild and Scenic Rivers, Other Unique Natural Areas
The project area is not located in an ecologically critical area, designated critical habitat, nor is it along any existing or potential wild and scenic rivers. Olympic National Park is

an important natural area, but the project would not threaten the associated qualities and resources that make the park unique. Therefore, designated critical habitat, ecologically critical areas, wild and scenic rivers, and other unique natural areas have been dismissed as impact topics in this environmental assessment.

Water Quality and Water Resources
The 1972 Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977, is a national policy to restore and maintain the chemical, physical and biological integrity of the nation's waters; to enhance the quality of water resources; and to prevent, control and abate water pollution. *Management Policies 2006* provide direction for the preservation, use and quality of water in national park units. While project installation would result in some minor soil disturbance, the project would not create run off or impact the intermittent stream near the project site and there would be no impact to water quality and water resources. Therefore this topic will not be further analyzed in this document.

Indian Trust Resources
Secretarial Order 3175 requires that any anticipated impacts to Indian trust resources from a proposed project or action by Department of Interior agencies be explicitly addressed in environmental documents. The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources and treaty rights, and it represents a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. The lands comprising Olympic National Park are not held in trust by the Secretary of the Interior for the benefit of Indians due to their status as Indians. Therefore, Indian trust resources have been dismissed as an impact topic in this environmental assessment.

Environmental Justice
Executive Order 12898 (General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations), requires all agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations or communities. No alternative under consideration would have health or environmental effects on minorities or low-income populations or communities as defined in the Environmental Protection Agency's Draft Environmental Justice Guidance (July 1996). Therefore, environmental justice has been dismissed as an impact topic in this environmental assessment.

Prime Farmland and other Downstream Water Users
In 1980, the Council on Environmental Quality directed federal agencies to assess the effects of their actions on farmland soils classified as prime or unique by the United States Department of Agriculture, Natural Resources Conservation Service. Prime farmland soil produces general crops such as common foods, forage, fiber and oil seed; unique farmland produces specialty crops such as fruits, vegetables and nuts.

There are no prime or unique farmlands within the project area. However, the proposed SNOTEL installation would provide improved seasonal runoff forecasts and could benefit agricultural users throughout the Olympic Peninsula. However, because it would be a negligible beneficial effect, this topic is dismissed from further analysis.

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Chapter 2: Alternatives

Introduction

This chapter describes the alternatives that were considered for the installation of a SNOTEL site within Olympic National Park. During the scoping process, a full range of alternatives for meeting the project purpose and need were developed.

Criteria were formulated by park staff and NRCS to develop the action alternatives. To be considered, the alternative must meet the purposes and objectives of the project as described in Chapter 1. In addition, alternatives must:

- Provide accurate snow and precipitation data to verify modeling efforts by the North Olympic Peninsula Resource Conservation & Development Council.
- Improve daily runoff forecasts for the Elwha River.
- Provide long-term climate data from a high elevation site in the park interior for the purpose of interpreting NPS long-term monitoring efforts and understanding the impacts of global warming on park resources.
- Ensure that park designated wilderness and visitor wilderness experience is not significantly impacted.
- Protect the park's natural and cultural resources and scenic values.

Several sites were evaluated during the development of the alternatives. Determining an appropriate location for a SNOTEL involved consideration of many factors. The following are the installation requirements that were considered for site selection, understanding that all goals could not be met or certain goals contradicted others and required prioritization:

- The site must be above 4,000 ft. elevation where snow currently dominates winter precipitation.
- To meet the purposes of the North Olympic Peninsula Resource Conservation & Development Council's grant and Elwha River restoration activities, the site must be within or representative of the Elwha basin.
- The site should be placed in a "wet" area of the drainage (precipitation >100 inches/year) where models predict high precipitation amounts. "Dry" areas are currently well represented by existing SNOTEL and climate stations (Figure 1).
- The site must be well positioned for accurate capture of precipitation. A preferred site should be a small, tree sheltered opening that is away from ridge tops, major divides or other areas subject to wind or unusual snow loading.
- A preferred site should be out of park wilderness.
- To minimize impacts to visitors, a preferred site should be hidden from and situated well away from hiking trails, wilderness campsites, climbing destinations and popular cross-country routes.
- Site characteristics should allow for a minimum amount of disturbance to soils and vegetation (i.e., level, well drained, minimal vegetation).

- The site should be easily accessible for annual maintenance.
- The site would not be placed in cultural landscapes or areas likely to have extensive archeological resources.

Park and NRCS scientists studied climate records, modeling results, topographic maps, aerial photographs and remote sensing images to identify potential areas. These sites were then ranked, using the aforementioned goals. Finally, a reconnaissance flight and site visit was conducted to evaluate actual snow conditions and snow characteristics of considered sites. During this process, several promising areas were considered and then dismissed (Table 2).

Table 2. Locations Considered and Dismissed

Considered Location	Primary Reason for Dismissal
Bailey Range – Mt. Carrie, Stephen Basin or Mt. Barnes areas	Cross-country lake basin along the popular Bailey Range traverse. Known as one of the most scenic and remote wilderness destinations in Olympic NP. Likely to impact high quality wilderness experience.
Scott/Ludden Saddle	Alternative route into Bailey Range and along Bailey traverse. Likely to impact wilderness experience.
NW Mt. Wilder	No areas found with appropriate site characteristics.
Low Divide/Elwha Basin	High visibility due to location along major trail corridor or cross-country routes. Avalanche and snow loading conditions.
Rustler Creek Godkin Saddle	Possible snow loading conditions. Located along occasionally used high country traverse. High likelihood of archeological resources.
Hayden Pass	Drier site characteristics. Suitable sites close to trails and cross-country routes.
Crystal Peak	No areas found with appropriate site characteristics.

All areas within the "wet zone" above 4,000 ft. in the Elwha Valley occur within wilderness boundaries. Therefore, the SNOTEL site location would not meet the goal of locating the site outside of wilderness.

The goal of accessibility directly contradicts the goals of low visibility and low impact to wilderness users and requires prioritization. Few areas meeting even the limited site requirements have been found along accessible trail corridors. These locations occur along popular hiking and climbing destinations where installations would have a direct impact on wilderness users. For this reason, remote access sites were prioritized over the easily accessible sites where a permanent installation would have frequent and long-term effects on park wilderness users. After this analysis, it was determined that the site that best met the criteria for the proposed SNOTEL was located at Buckinghorse Ridge in the upper Elwha drainage. This site is the only one considered in the action alternatives. This site is considered inaccessible due to the high risk involved to hike or use stock to access the area over loose scree and unstable slopes. In addition, maintenance includes the transportation of up to 100 gallons of waste glycol from the tower each year (see alternatives B and C). For these reasons, the use of a helicopter is considered the minimum tool.

Alternative A: No Action

The no-action alternative describes the action of continuing the present management operation and condition; it does not imply or direct discontinuing the present action or removing existing uses, developments or facilities. The no-action alternative provides a basis for comparing the management direction and environmental consequences of the action alternatives.

Under the no-action alternative, no SNOTEL instruments would be placed within the Upper Elwha Valley or elsewhere in the park. Seasonal runoff on the Elwha and Dungeness rivers would continue to rely on existing data from outside of park wilderness. Annual climate summaries and changes in climate due to global warming would continue to be inferred from existing models or indirect methods such as downstream gauges and glacier mass balance despite the errors associated with these models and methods. Forecasting of floods, avalanches and winter storm events would rely on existing climate stations on the park periphery and use assumptions based on current models.

Alternative B: Full SNOTEL Installation (Management Preferred Alternative)

Under this alternative, a full SNOTEL installation would be placed on Buckinghorse Ridge in the upper Elwha drainage (Figure 3). A full SNOTEL installation would require the following infrastructure: a pressure sensing snow pillow, a storage precipitation gauge, an instrument tower, soil moisture and soil temperature sensors and a communication shed (Figure 4 and photos 1 and 2).

The pressure sensing snow pillow would consist of a 10-foot diameter “Hypelon” pillow that would be placed on a level or leveled area of ground. The pillow would be covered with a flexible mesh blanket to protect it from wildlife. The total area, including around this pillow, would be approximately 16 feet in diameter. This area is required to be perfectly level. The proposed area of installation is slightly sloped so some bank cutting would occur with subsequent material moved downhill as fill. The pillow would be filled with a non-toxic glycol (anti-freeze) solution. A set of tubes would connect the pillow to instruments in the communications shed. As snowpack accumulates on top of the pillow, pressure forces glycol through the tubes where the change in head would be measured by pressure transducers. This change in height would be translated to a snow water equivalent measurement.

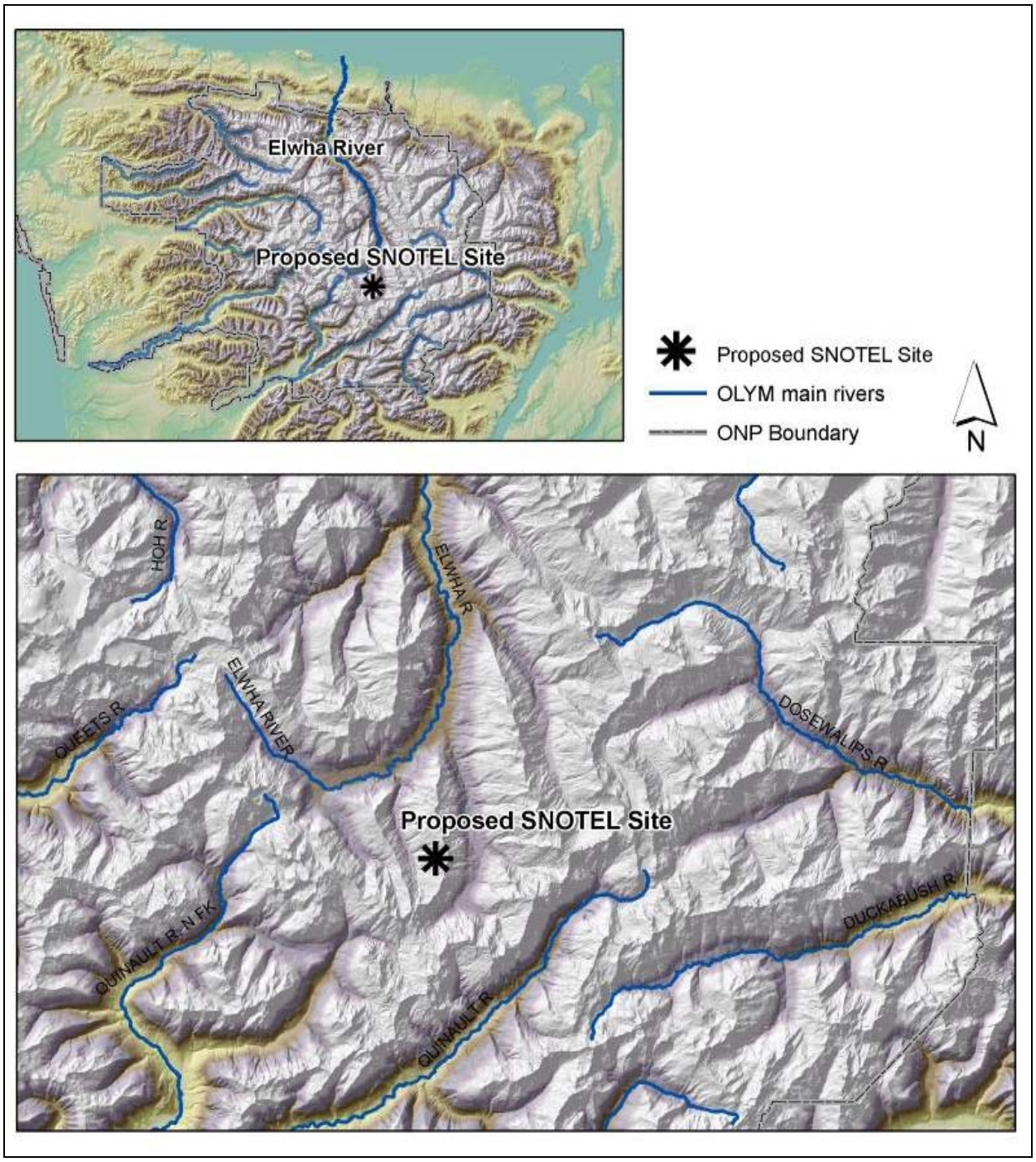


Figure 3. Location of proposed SNOTEL site in the Elwha Valley of Olympic National Park and Proposed SNOTEL site on Buckinghorse Ridge

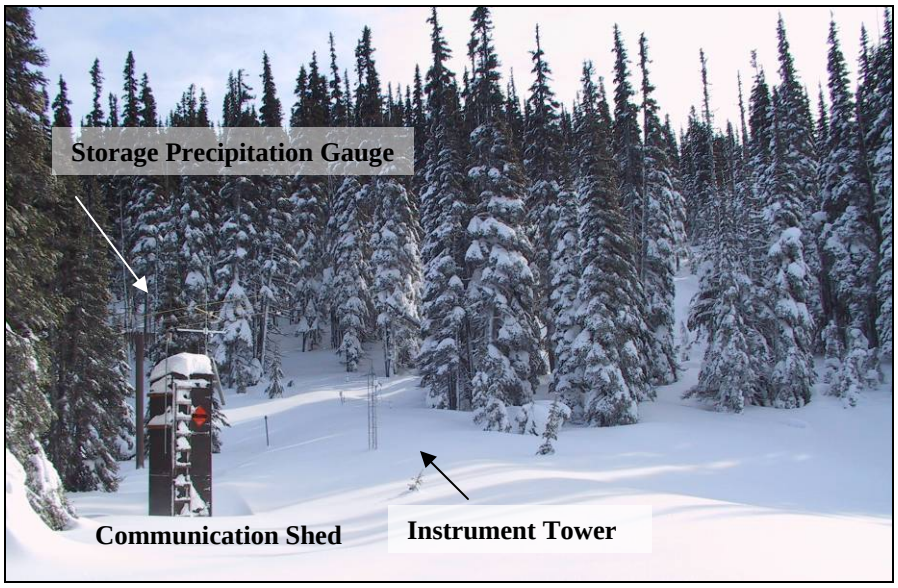


Photo 1. Typical SNOTEL site in winter

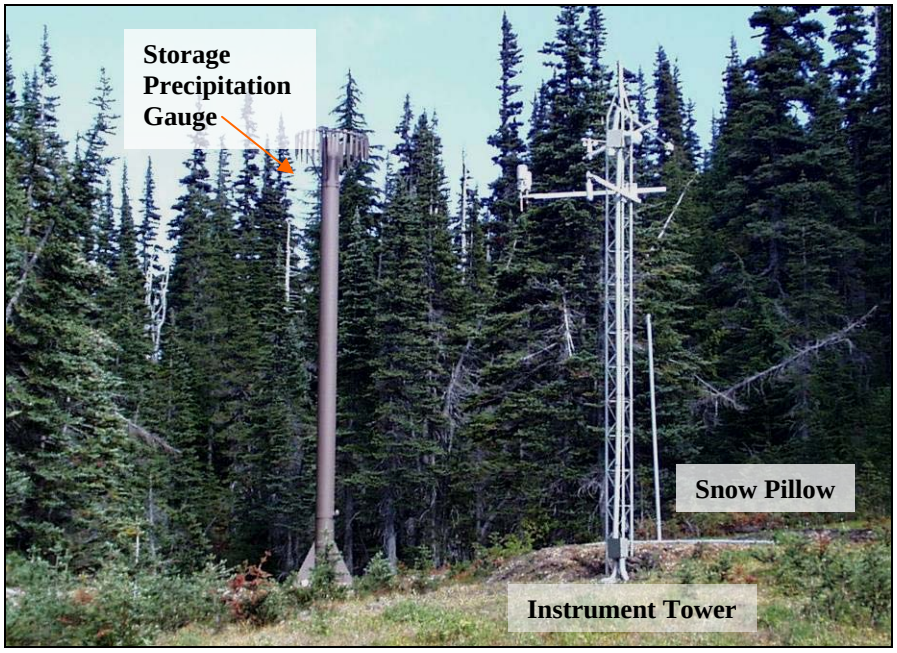
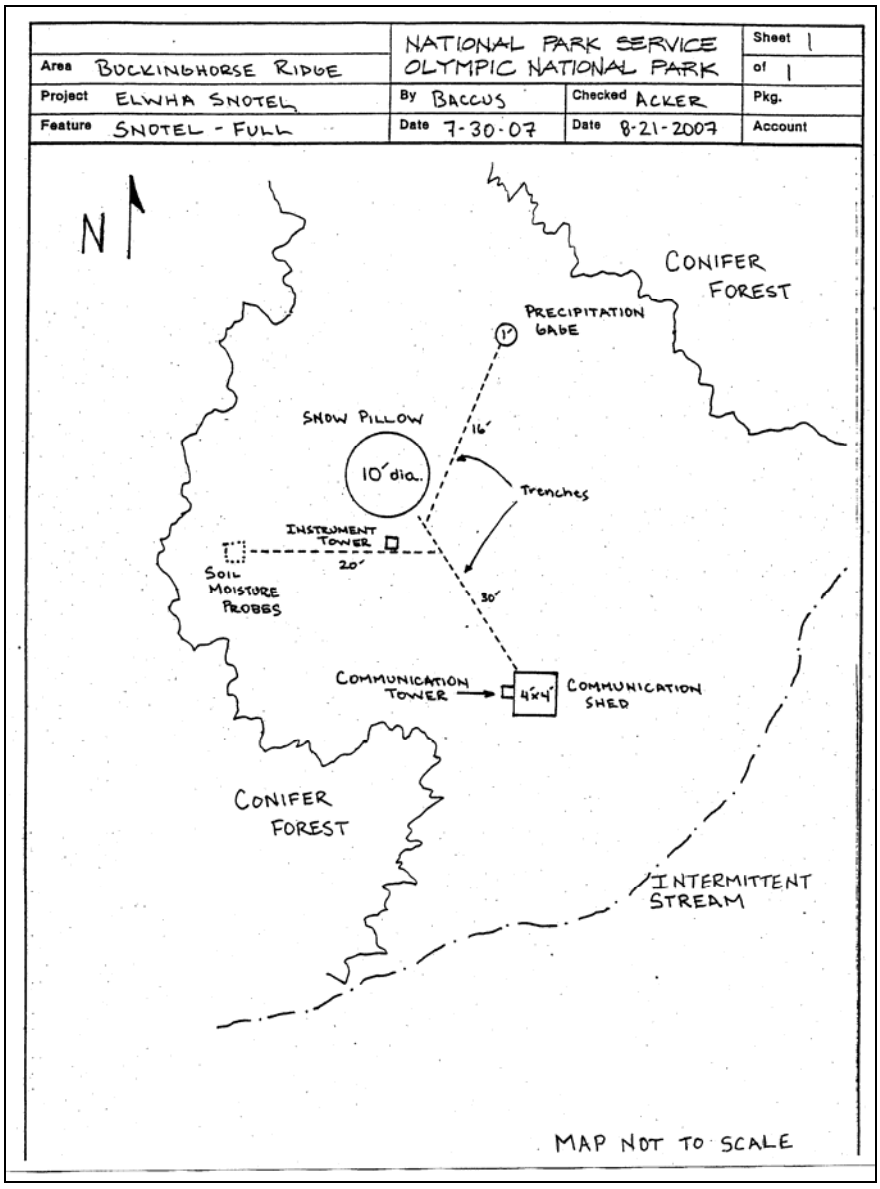


Photo 2. Typical SNOTEL site in summer months

Figure 4. Layout of Alternative B, the Full SNOTEL installation



The storage precipitation gauge would include a 24-foot tall, 1-foot diameter aluminum pipe painted brown (non-reflective) and mounted to a concrete foundation. The footprint of the foundation would be a 3' x 3' square with a foundation comprised of two 3' long x 1' wide x 1.5' deep concrete blocks on to which the gauge would be mounted with steel bolts. The gauge would be filled annually with a non-toxic glycol (anti-freeze) solution to prevent the precipitation from freezing. As snow or rainfall drops into the gauge, it mixes with the glycol and the pipe slowly fills. A set of tubes runs from the gauge to the communications shed, where pressure transducers measure the change in height. This change in height is translated to a total precipitation (rain and snow) measurement.
The instrument tower would be a standard 1' x 1' steel instrument or radio tower mounted to a small concrete foundation. The tower would be erected adjacent to the snow pillow so that a snow depth sensor can be hung to measure the depth of snow over the pillow.

Air temperature, relative humidity, wind speed and direction, and solar radiation sensors would also be mounted on this tower. The tower must be high enough that the snow depth sensor would never be buried within the snowpack. A 30-foot-high tower would be planned for this location and would be powder coat painted in a non-reflective brown or olive color to minimize visual impact. The foundation would be 18 inches in diameter and 2.5 feet deep.

Soil Moisture/Soil Temperature sensors would be buried in the ground to a maximum depth of 40 inches. Approximately five sensors would be placed throughout the profile in a hand dug hole 12 inches in diameter and 40 inches deep. The hole would be back filled with the same soil material removed for sensor installation.

The communications shed would be a prefabricated structure, much like an extra tall backcountry privy. Built of pressure treated lumber with plywood siding, the shelter would house the power system (2-12V batteries, solar charging regulators), datalogger, transmission radio and the pressure transducers and tubing. A radio antennae and solar panels would be mounted on a 30-foot-high communication tower with a foundation that would be 18 inches in diameter and 2.5 feet deep and attached to the side of the shed. The shed would be 4' x 4' square and built to the height of the expected snowpack (maximum 20 ft.). The shed would have ladders inside and outside and doors for bottom access as well as top access, in the event that repairs need to be made mid-winter when a full snowpack blocks access. The shed would be painted dark brown. The foundation would be composed of two concrete slabs, 4 feet long, 1 foot wide and 1.5 feet deep. A shallow trenches (2" wide x 6" deep) totaling approximately 66' in length would be extended from the shelter to the instrument tower, snow pillow, precipitation gauge and soil moisture sensors for tubing and instrument wires.

Installation of the site would occur in the mid- to late-fall of 2007 and would require 2 to 3 days. The site is not accessible by foot or packstock, so all supplies and personnel would be flown by helicopter to the site. Up to six individuals would be transported and camp on site and would include NRCS field technicians as well as NPS archeologists and restoration specialists. A total of 8 to 10 flights would be conducted to transport all personnel, instruments and construction materials. Flights would originate at Obstruction Point, and fly over the Elwha Valley and up to the project location. The site would be easily accessed by a small (Type III) helicopter. No clearing or other manipulation would be required for helicopter landings.

Annual Site Maintenance

The primary maintenance need of a SNOTEL involves the storage precipitation gauge. The instrument would be expected to capture 100 to 150 in. water equivalent of snow and rainfall each year. This dilutes the glycol and could overfill the gauge if glycol is not changed out annually. For this reason, the NRCS staff would maintain the SNOTEL site annually. Routine maintenance activities would involve checking and calibrating instruments and replacing the glycol in the precipitation gauges. The glycol would be hauled off-site and disposed of in an approved location outside the park. Staff would travel by helicopter directly from the Mt. Crag SNOTEL (east of the park in Olympic National

Forest) or from Obstruction Point to the Buckinghorse Ridge site. Maintenance would typically occur over a period of several hours. Annual maintenance flights would occur before winter but after Labor Day weekend to avoid busy summer months when the largest number of park visitors are using the park.

Additional long-term maintenance may require trimming, pruning or removing invading trees in order to keep the proposed installation site open. This would prevent any unusual snow loading and thus provide more accurate and consistent data collection. All work would be conducted as advised by the Park's vegetation specialist.

Emergency Site Maintenance
The SNOTEL network uses standardized instrumentation and communication systems which have an excellent track record of performance. In the unlikely event of instrument failure during the winter operational period, the NRCS may request access to the site for equipment repairs.

Site Calibration
During the first few years of a SNOTEL installation, manual measurements of snow depth and snow water equivalent might be taken to ensure that all instruments are calibrated and recording accurate data. In the case of a remote wilderness installation such as this, calibration trips would be minimized to one year or possibly eliminated altogether.

Alternative C: Modified SNOTEL Installation

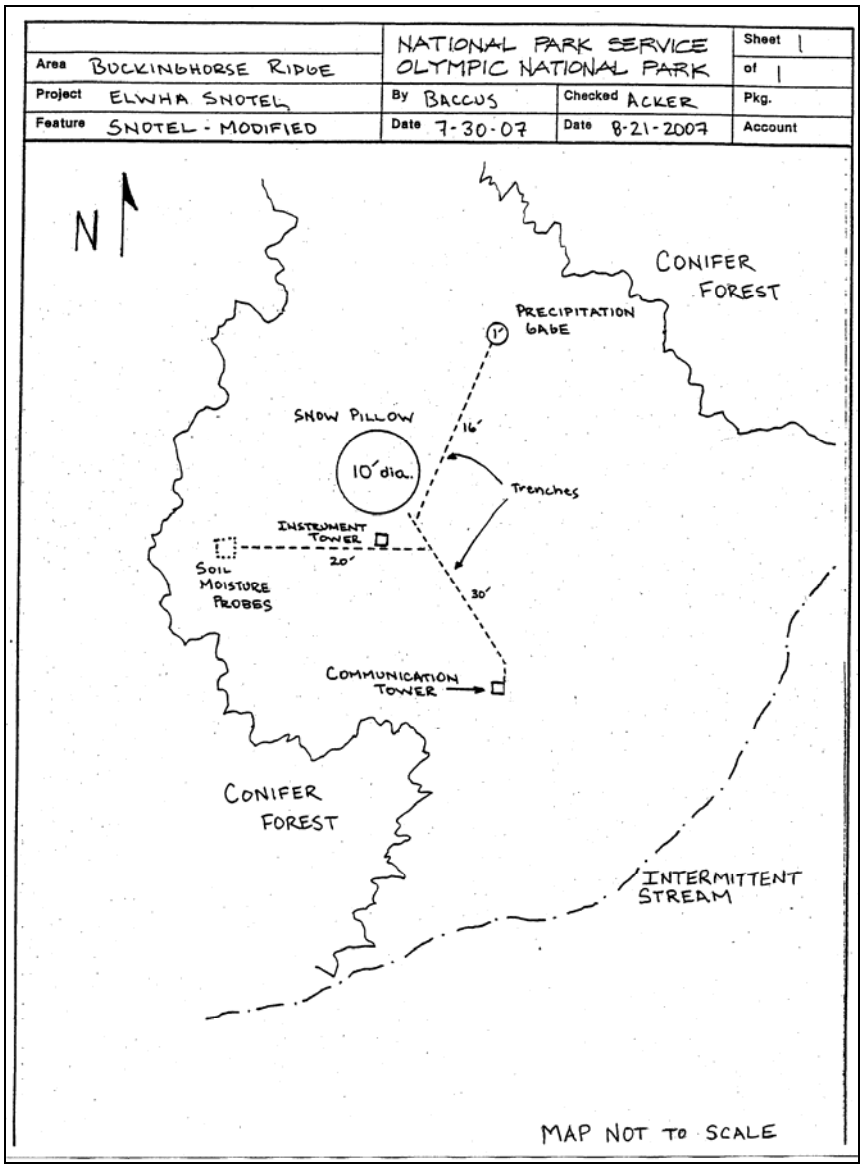
This alternative involves the installation of an experimental, modified SNOTEL with a slightly smaller footprint at the same location as alternative B. Under this alternative, a modified SNOTEL installation would be placed on Buckinghorse Ridge in the upper Elwha drainage (Figure 3). A modified SNOTEL would require installation of similar infrastructure as a full SNOTEL installation; however it replaces the communication shed with mounted boxes on the communications tower (Figure 5).

The pressure sensing snow pillow would consist of a 10-foot diameter "Hypelon" pillow that would be placed on a level or leveled area of ground. The pillow would be covered with a flexible mesh blanket to protect it from wildlife. The area of disturbance for this pillow would be approximately 16 ft. in diameter. This area is required to be perfectly level. The proposed area of installation is slightly sloped so some bank cutting would occur with subsequent material moved downhill as fill. The pillow would be filled with a non-toxic glycol (anti-freeze) solution, and a set of tubes would connect the pillow to instruments in the communications shed. As snowpack accumulates on top of the pillow, pressure forces glycol through the tubes where the change in head would be measured by pressure transducers. This change in height would be translated to a snow water equivalent measurement.

The storage precipitation gauge would include a 24-foot tall, 1-foot diameter aluminum pipe painted brown and mounted to a concrete foundation. The footprint of the foundation would be a 3' x 3' square with a foundation comprised of two 3' long x 1' wide

x 1.5' deep concrete blocks on to which the gauge would be mounted with steel bolts. The gauge would be filled annually with a non-toxic glycol (anti-freeze) solution to prevent the precipitation from freezing. As snow or rainfall drops into the gauge, it mixes with the glycol and the pipe slowly fills. A set of tubes connects from the gauge to the communications shed, where pressure transducers measure the change in height. This change in height is translated to a total precipitation (rain and snow) measurement.

Figure 5. Layout of Alternative C, the Modified SNOTEL installation



The instrument tower would be a standard 1' x 1' steel instrument or radio tower mounted to a small concrete foundation. The tower would be erected adjacent to the snow pillow so that a snow depth sensor can be hung to measure the depth of snow over the pillow. Air temperature, relative humidity, wind speed and direction, and solar radiation sensors would also be hung on this tower. The tower must be high enough that the snow depth

sensor would never be buried within the snowpack. A 30 ft. tower would be ideal for this location and would be powder coat painted in a non-reflective brown or olive color to minimize visual impact. The foundation would be 2 ft. in diameter and 3.5 ft. deep.

Soil Moisture/Soil Temperature sensors would be buried in the ground to a maximum depth of 40 in. Approximately five sensors would be placed through out the profile in a hand dug hole 12 in. in diameter and 40 in. deep. The hole would be back filled with the same soil material removed for sensor installation.

A single 1' x 1' steel communication tower, 30 ft. tall, would be erected. The tower would have a foundation, which would be 2 ft. in diameter and 3.5 ft. deep. This foundation is larger than the full SNOTEL due to the extra equipment being placed on the tower in this alternative. The tower would be painted in a brown or olive color to minimize visual impact. In place of a communication shed, waterproof boxes would be mounted on the tower to house the power system (2-12V batteries, solar charging regulators), datalogger and transmission radio. A custom enclosure and mounting system for the pressure transducers and tubing would be designed to withstand the force of being buried under a deep snowpack and mounted to the side of the tower. A radio antennae and solar panels would be mounted to the top of the tower. A shallow trench approximately 20' long x 2" wide x 6" deep would extend from the communication tower to the instrument tower, snow pillow, precipitation gauge and soil moisture sensors for tubing and instrument wires.

Installation of the site would occur in the mid- to late-fall of 2007 and would require 2 to 3 days. The site is not accessible by foot or packstock, so all supplies and personnel would be flown by helicopter to the site. Up to six individuals would be transported and camp on site and would include NRCS field technicians as well as NPS archeologists and restoration specialists. A total of 6 to 8 flights would be conducted to transport all personnel, instruments and construction materials. Flights would originate at Obstruction Point and fly over the Elwha Valley to the project location. The installation site is easily accessed by a small helicopter, and no site clearing or manipulation is required for helicopter landings.

Annual Site Maintenance

The primary maintenance need of a SNOTEL would involve the storage precipitation gauge. The instrument would be expected to capture 100 to 150 in. of water equivalent of snow and rainfall each year. This dilutes the glycol and could overfill the gauge if glycol is not changed out annually. The glycol would be hauled off-site and disposed of in an approved location outside the park. The NRCS staff would maintain the SNOTEL site annually. Routine maintenance activities would include checking and calibrating instruments, and replacing the glycol in the precipitation gauges. Staff would travel directly by helicopter from the Mt. Crag SNOTEL (east of the park in Olympic National Forest) or from Obstruction Point to the Buckinghorse Ridge site. Site maintenance would take several hours.

Additional long-term maintenance may require trimming, pruning or removing invading trees in order to keep the proposed installation site open. This would prevent any unusual

snow loading and thus provide more accurate and consistent data collection. All work would be conducted as advised by the Park's vegetation specialist.

Emergency Site Maintenance
The SNOTEL network uses standardized instrumentation and communication systems that have an excellent track record of performance. However, experimental installations such as the modified SNOTEL under this alternative remain untested. The ability of the modified tower and enclosures to withstand deep snowpacks as well as unknown forces of wind and rime may require the NRCS to access the site more frequently for emergency equipment repairs.

Site Calibration
During the first few years of a SNOTEL installation, manual measurements of snow depth and snow water equivalent might be taken to ensure that all instruments are calibrated and recording accurate data. In the case of a remote wilderness installation such as this, calibration trips would be minimized to one year or possibly eliminated altogether.

Mitigation Measures of the Action Alternatives

Soils and Vegetation
Careful site selection was used to find a level area for the proposed snow pillow installation to minimize the amount of soil disturbance for cut and fill purposes.

To minimize impacts to vegetation and decrease the overall footprint of the installation, all instruments would be installed in as tight an arrangement as possible (Figure 4 & 5), while allowing adequate spacing so that installations do not intercept or interfere with snow deposition.

Native vegetation would be carefully salvaged by revegetation experts and placed in holding areas during installation. Excavated soils would be placed onto clean tarps and stored until backfilled into trenches. Salvaged vegetation would be restored to all areas unless it interferes with the operation of instruments.

All equipment (including helicopter skids), tools, boots, clothes and packs would be cleaned to ensure that no exotic species are transported to the site. Any fill used would be from the local area and free of exotic seed sources.

Wilderness and Visitor Experience, Visual Resources
Potential impacts to wilderness visitor experience and visual resources were mitigated with careful selection of the proposed installation site. The chosen site is surrounded by trees at least 10 to 20 ft. higher than proposed equipment height. The site is situated out of sight and well away from any wilderness trails, campsites or cross-country routes frequented by visitors. All equipment would be painted in green or brown tones to provide additional camouflage. During installation and maintenance of the facility, "leave no trace" practices would be used.

Wilderness and Visitor Experience, Soundscapes
Impacts to the Elwha soundscape would be mitigated by using the minimum size helicopter (Type III) for all installation and maintenance flights. Direct soundscape impacts to park visitors would be mitigated by conducting maintenance and installation flights during late fall or winter months when fewer park visitors are in the project area.

Cultural Resources
Archeological resources in the project area would be further tested and evaluated by conducting archeological surveys prior to construction, and monitoring during construction. If significant archeological materials are found, then instrument locations would be moved or data recovery (archeological excavation and documentation) would occur. Park archeologists would be on site before and during the installation.

Safety
Impacts to safety from the use of helicopters can be mitigated through strict adherence to agency aircraft use policies. All flights associated with this project would be overseen by trained staff. Aircraft would follow standard aviation safety practices, such as flight following, air to ground communication and identification of operational hazards.

The Environmentally Preferred Alternative

In accordance with DO-12, the NPS is required to identify the "environmentally preferred alternative" in all environmental documents, including EAs. According to the Council on Environmental Quality (CEQ) guidelines, the environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in Section 101 of the National Environmental Policy Act (NEPA), which considers:

1. fulfilling the responsibilities of each generation as trustee of the environment for succeeding generations;
2. assuring for all generations safe, healthful, productive, and esthetically and culturally pleasing surroundings;
3. attaining the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
4. preserving important historic, cultural and natural aspects of our national heritage and maintaining, wherever possible, an environment that supports diversity and variety of individual choice;
5. achieving a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and
6. enhancing the quality of renewable resources and approaching the maximum attainable recycling of depletable resources (NEPA, section 101).

The NPS is required to identify the environmentally preferred alternative in its NEPA documents for public review and comment. Further guidance from the CEQ states that the environmentally preferred alternative means "the alternative that causes the least damage to the biological and physical environment; it also means the alternative which

best protects, preserves and enhances historic, cultural and natural processes" (CEQ 1981). The no action alternative (alternative A) would have no effect on the natural processes and would cause the least amount of damage to the biological and physical environment; therefore it is identified as the environmentally preferred alternative. Alternatives B and C would both establish a research facility in the wilderness which would allow for better understanding of the natural environment and processes, however those alternatives would result in an adverse effect on the wilderness resource by the placement of a human made structure. Alternative C, has a slightly smaller footprint than alternative B, however the greater likelihood of instrument failure, combined with the inability of technicians to conduct emergency repairs means that this alternative is less likely to meet project objectives and could require a greater number of emergency maintenance flights than alternative B. Therefore alternative B has fewer environmental effects than alternative C. Even though alternative A is the environmentally preferred alternative, it does not meet plan objectives and therefore is not the management preferred alternative.

To identify the management preferred alternative, the interdisciplinary planning team evaluated each alternative based on the ability to meet the plan objectives (Table 3) and the potential impacts on the environment ("Chapter 4: Environmental Consequences"). Alternative B is the only alternative that fully meets all of the plan objectives. Alternative C would not fully meet plan objectives. Therefore alternative B was identified as the management preferred alternative.

Alternatives Considered but Dismissed

Provide actual snow measurements by conducting routine snow surveys by foot travel. Snowpack data has been collected by federal scientists since 1935 and in Olympic National Park since 1949. Snow survey data is collected using a hand held instrument known as a "federal sampler" to take manual measurements of snow depth and snow water equivalent at the beginning of each month during snow season.

Conducting routine snow surveys by foot was dismissed for several reasons: (1) Reaching areas of the upper Elwha would require extensive backpacking and snowshoe trips. This would require travel across dangerous, avalanche prone slopes and fording of streams and rivers during high flows, making safe access impossible under certain conditions. (2) Extensive training and extreme endurance would be required to safely execute snow surveys, even in good conditions. (3) The park and/or NRCS does not currently have the staff or funding for staff, work and training that would be required to collect this data. (4) If snow courses were completed monthly, these measurements of snowpack would provide some meaningful data for summer streamflow forecasting and ecological studies. However, this data would not help with flood forecasting or provide daily measurements needed for park management and natural resources studies.

Conduct routine snow surveys using helicopters to access upper Elwha locations.
As previously discussed, snowpack data can be collected using snow surveys. Olympic National Park or NRCS staff would rely on helicopter transport to access sampling areas. This method is used routinely in rugged, inaccessible locations such as North Cascades National Park, where snow surveys are conducted to supplement to their four existing SNOTEL stations. This alternative minimizes the concern for avalanche safety and cost in staff time and provides relatively safe access to the snow survey courses. However, this alternative was dismissed for the following reasons: (1) helicopter transport and snow landings are inherently risky, (2) the cost of conducting monthly or bi-weekly helicopter flights would be high, (3) the impacts to winter soundscapes from repeated helicopter flights would be unacceptable, and (4) monthly or bi-weekly snow surveys, while providing periodic measurements of snowpack and some meaningful data for summer streamflow forecasting and ecological studies, would not help with flood forecasting or to interpret finer details (i.e., daily measurements) relevant to many management needs.

Place a reduced footprint, alternative instrument snow site in a high elevation basin.
A reduced footprint "minimum requirement" SNOTEL was designed and installed in a wilderness area in Rocky Mountain National Park in 2002. Using this design, the SNOTEL footprint and visual impact of the site is greatly reduced. In place of a snow pillow, a "Gamma Sensor" (a small instrument hung on the instrument tower) is used. This sensor is comprised of two electronic devices that measure gamma rays, one on the ground and one at the top of a pole well above the maximum snowpack. The difference between the two gamma readings allows interpretation of snow density. In place of the traditional precipitation can, optical rain gauges are used. These devices use a beam of light traveling through falling precipitation to calculate rate of rainfall. Datalogger, air temperature sensors and telemetry equipment are placed in plastic enclosures and hung on a second tower. This instrument does not require tubing and transducers, and therefore no instrument/communication shed is required.

This alternative was dismissed for two reasons: (1) Alternative sensors have been unreliable in remote sites. In Rocky Mountain National Park, the gamma sensors proved to be both unreliable and problematic. The optical rain gauge, while not inherently problematic, required more energy than standard solar panels could provide, even in the sunny mountain environment of the Colorado Rockies. More extensive solar panels would have a greater visual impact than a traditional storage precipitation gauge, so both the optical rain gauge and gamma sensors were eventually replaced at Rocky Mountain with traditional SNOTEL instruments. (2) With the heavy snowpacks, high rainfall, winter conditions conducive to rime (ice) build up, low sun angles and few sunny days, the Olympics are not likely to produce adequate power for an optical rain gauge. Failure of instruments would likely create the same results as the no-action alternative.

Place a SNOTEL installation outside of wilderness.
As described in Chapter 2, several project locations within wilderness for the SNOTEL installation were assessed and ruled out (Table 2). In addition to those sites, project sites outside of the wilderness were explored; however no high elevation areas within the "wet zone" (>100 in./year) exist in the area of concern. Because the placement of a SNOTEL

outside of wilderness did not meet the primary project objectives, this alternative was dismissed from further evaluation.

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Table 3. How Alternatives Meet Project Objectives

Objectives	Alternative A No Action	Alternative B Full SNOTEL Installation placed at Buckinghorse Ridge	Alternative C Modified SNOTEL Installation placed at Buckinghorse Ridge
Provide accurate snow and precipitation measurements from the Elwha watershed to verify modeling efforts.	**Does not meet objective:** The modeling effort would rely on data from a single existing SNOTEL near Hurricane Ridge in the dry zone of the drainage. The wet zone, which is estimated to contribute the majority of snow and precipitation to the Elwha watershed, would not be represented by current field measurements.	**Fully meets objective:** A full SNOTEL installation at this location would provide reliable, hourly snow and precipitation data from the wet zone of the Elwha drainage.	**Partially meets objective:** A modified SNOTEL installation at this location would provide hourly snow and precipitation data from the wet zone of the Elwha drainage; however reliability, especially in the first few years of operation may be decreased.
Improve daily runoff forecasts for the Elwha and Dungeness Rivers.	**Does not meet objective:** With no additional data, forecasts would continue to rely on data from the single existing SNOTEL near Hurricane Ridge. Daily runoff forecasts for the Elwha and Dungeness rivers would not improve.	**Fully meets objective:** A full SNOTEL installation at this location would provide reliable, hourly snow and precipitation data from the wet zone of the Elwha drainage. Incorporated into models, this data would greatly improve runoff forecasts.	**Partially meets objective:** A modified SNOTEL installation at this location would provide hourly snow and precipitation data from the wet zone of the Elwha drainage; however reliability, especially in the first few years of operation may be decreased.
Provide long-term climate data from a high elevation site in the park interior for the purpose of interpreting NPS long-term monitoring efforts.	**Does not meet objective:** No climate data would be collected from high elevation sites in the park interior.	**Fully meets objective:** A full SNOTEL installation would provide reliable climate data from a high priority interior location in the park. This data is considered of high importance for understanding the influence of global warming on park resources.	**Partially meets objective:** A modified SNOTEL installation would usually provide climate data from a high priority interior location in the park. However, limited ability to maintain the site in the event of damage or equipment failure might result in some data loss.
Provide emergency managers, meteorologists and avalanche forecasters with	**Does not meet objective:** No climate data would be available from the upper Elwha. Forecasters would continue to	**Fully meets objective:** Hourly climate data would be available from the upper Elwha and	**Partially meets objective:** Hourly climate data would be available from the upper Elwha

Objectives	Alternative A No Action	Alternative B Full SNOTEL Installation placed at Buckinghorse Ridge	Alternative C Modified SNOTEL Installation placed at Buckinghorse Ridge
real-time climate data from the upper Elwha to better predict timing and extent of flood, winter storm and avalanche events.	rely on data from a single existing SNOTEL near Hurricane Ridge and no improvement to forecasting would result.	provide a much better picture of conditions in the majority of the Elwha watershed. Forecast accuracy and geographical applicability would likely improve.	and provide a much better picture of conditions in the majority of the Elwha watershed. Forecast accuracy and geographical applicability would likely improve. However, extreme events, likely to trigger emergency situations, might have a greater likelihood of damaging or destroying a modified installation resulting in a loss of data during critical periods.

Table 4. Summary of Environmental Consequences

Impact Topic	Alternative A No Action	Alternative B Full SNOTEL Installation	Alternative C Modified SNOTEL Installation
Soils	There would be no new impacts or cumulative impact to soils under this alternative and therefore no impairment to soil resources.	Direct, localized, long-term minor adverse impacts to soil resources would occur in the immediate project area. This alternative would contribute slightly to the cumulative effects of soils within the Elwha area. Because the impacts to soils are minor, there would be no impairment to soils.	This alternative would result in direct, localized, long-term, minor adverse impacts to soil resources in the immediate project area. This alternative would contribute slightly to the cumulative effects to soils within the Elwha area. Because the impacts to soils are minor, there would be no impairment to soils.
Vegetation	There would be no impacts, no cumulative impacts, and no impairment to vegetation under this alternative.	Direct, localized, long-term, negligible to minor adverse impact to vegetation would occur in the immediate project area. Alternative B would contribute slightly to the long-term minor cumulative impacts. Because the impacts from this alternative would be negligible to minor, there would be no impairment to vegetation.	Direct, localized, long-term, negligible to minor impacts to vegetation would occur in the immediate project area. Alternative C would contribute slightly to the long-term minor cumulative impacts. Because the impacts from this alternative would be negligible to minor, there would be no impairment to vegetation.
Wildlife	There would be no new impacts to wildlife and therefore no impacts, cumulative impacts, or impairment to wildlife species under this alternative.	Overall, adverse impacts to wildlife species would be direct, localized, short-term and negligible to minor in the immediate project area. Cumulative impacts would be indirect, long-term and minor and this alternative would contribute slightly to the cumulative effects. Because impacts would be no more than minor, there would be no impairment to wildlife resources.	Overall, adverse impacts to wildlife species would be direct, localized, short-term and negligible to minor in the immediate project area. Cumulative impacts would be indirect, long-term and minor and this alternative would contribute slightly to the cumulative effects. Because impacts would be no more than minor, there would be no impairment to wildlife resources.
Wilderness Values	Because no new facilities or activities are proposed in this	The installation of a full SNOTEL would have local, direct, long-term	The installation of a modified SNOTEL would have a local, direct,

Impact Topic	Alternative A No Action	Alternative B Full SNOTEL Installation	Alternative C Modified SNOTEL Installation
	alternative, there would be no new impacts, cumulative impacts, and no impairment to wilderness resources under this alternative.	minor adverse impacts on wilderness values, and short-term moderate adverse impacts related to helicopter operations. Cumulative impacts would be indirect, short- and long-term and minor to moderate, and this alternative would contribute slightly to the overall cumulative effects. Under this alternative, because long-term impacts would be minor, and short-term impacts would be moderate, there would be no impairment to wilderness values.	long-term minor adverse impacts on wilderness values, and short-term moderate adverse impacts related to helicopter operations. Cumulative impacts would be indirect, short- and long-term and minor to moderate, and this alternative would contribute slightly to the overall cumulative effects. Under this alternative, because long-term impacts would be minor, and short-term impacts would be moderate, there would be no impairment to wilderness values.
Cultural Resources	There would be no impacts, cumulative impacts or impairment to cultural resources in this no action alternative.	This proposed alternative would have a negligible to minor impact on archeological resources. For the purposes of Section 106 and the National Historic Preservation Act, the determination of effect would be *no adverse effect* and any impacts would be minor. Because there would be no major adverse impacts to cultural resources, there would be no impairment of park resources or values related to archeological resources.	This alternative would have a negligible to minor impact on archeological resources. For the purposes of Section 106 and the National Historic Preservation Act, the determination of effect would be *no adverse effect* and any impacts would be minor. Because there would be no major adverse impacts, there would be no impairment of park resources or values related to archeological resources.
Visual Resources	Because no new facilities or activities are proposed in this alternative, there would be no new impacts, cumulative impacts, and no impairment to visual resources under this alternative.	Scenic values of the upper Elwha Valley where the proposed installation is visible could be impacted in this alternative, however the likelihood of visitation to these areas is extremely small, and due to the small area of the viewshed and the inaccessible nature of this area,	Scenic values of the upper Elwha Valley where the proposed installation is visible could be impacted in this alternative, however the likelihood of visitation to these areas is extremely small, and due to the small area of the viewshed and the inaccessible nature of this area,

Impact Topic	Alternative A No Action	Alternative B Full SNOTEL Installation	Alternative C Modified SNOTEL Installation
		the adverse impact is considered local, long-term and negligible. This is the only such facility in the greater project area, so there are no cumulative effects associated with the proposed installation. Because under this alternative the impacts would be negligible, there would be no impairment to visual resources.	the adverse impact is considered local, long-term and negligible. This is the only such facility in the greater project area, so there are no cumulative effects associated with the proposed installation. Because under this alternative the impacts would be negligible, there would be no impairment to visual resources.
Soundscapes	There would be no new impacts, cumulative impacts, and no impairment to soundscapes under this alternative.	Instruments that would be installed under this alternative would not create unnatural sounds and would have a negligible impact on soundscapes. Helicopter flights associated with the installation and annual maintenance would have a direct, short-term adverse, minor impact on soundscapes. Occasional flights in the Elwha drainage result in short-term, adverse, moderate impacts to the natural soundscapes in the park. This alternative would contribute slightly to those cumulative effects. Because there would be no major adverse impact under this alternative, there would be no impairment to natural soundscapes.	Instruments that would be installed under this alternative would not create unnatural sounds and would have a negligible impact on soundscapes. Helicopter flights associated with the installation and annual maintenance would have a direct, short-term adverse, minor to moderate impact on soundscapes. Occasional flights in the Elwha drainage result in short-term, adverse, moderate impacts to the natural soundscapes in the park. This alternative would contribute slightly to those cumulative effects. Because there would be no major adverse impact under this alternative, there would be no impairment to natural soundscapes.
Visitor Experience	If no real-time data were available from a SNOTEL installation, there would be an indirect, long-term, but minor impact to visitor experience. There would be no cumulative effects.	Real-time data and more accurate forecasting from a new SNOTEL installation would create an indirect, long-term, minor beneficial effect to the visitor experience. Views of or visits to the proposed SNOTEL site	Real-time data and more accurate forecasting from a new SNOTEL installation would create an indirect, long-term, minor beneficial effect to the visitor experience. Views of or visits to the proposed SNOTEL site

Impact Topic	Alternative A No Action	Alternative B Full SNOTEL Installation	Alternative C Modified SNOTEL Installation
		are highly unlikely, making that potential negative impact to the visitor experience negligible. Helicopter use would be a direct, short-term, moderate adverse impact to park visitors. Cumulative impacts from annual helicopter maintenance flights would be long-term, adverse, and moderate, with this alternative contributing slightly to the cumulative effects.	are highly unlikely, making that potential negative impact to the visitor experience negligible. Helicopter use would be a direct, short-term, moderate adverse impact to park visitors. Cumulative impacts from annual helicopter maintenance flights would be long-term, adverse, and moderate, with this alternative contributing slightly to the cumulative effects.
Safety and Park Operations	Under the no action alternative, flood forecasting, avalanche forecasting, natural resource studies and research would continue to rely on existing instrumentation and data resulting in an indirect, long-term, moderate adverse impact to safety and park operations at Olympic National Park.	Safety and natural resource management are vital missions of the NPS. This alternative, by increasing the accuracy of seasonal river flows forecasts, providing better data for predicting timing and extent of flood and avalanche events, and providing baseline data for better understanding impacts to park ecosystems from global climate change, would create an indirect, long-term, moderate beneficial effect to safety and park operations.	Safety and natural resource management are vital missions of the NPS. This alternative, by increasing the accuracy of seasonal river flows forecasts, providing better data for predicting timing and extent of flood and avalanche events, and providing baseline data for better understanding impacts to park ecosystems from global climate change, would create an indirect, long-term, moderate beneficial effect to safety and park operations.

Chapter 3: Affected Environment

Introduction

This chapter describes the resources associated with the project. More detailed information on resources in Olympic National Park may be found in the *Olympic National Park Draft General Management Plan and Environmental Impact Statement* (2006).

Soils
Soils within the project area are shallow, rocky and well developed. (Well developed soils have evidence of significant leaching of minerals & organics – indicative of areas with high rainfall amounts). Classified as silty loam and silty clay loams, the soils at this site are fairly typical for subalpine meadow areas of the Olympics. Throughout the site, the organic (O) or surface horizon is shallow (2 in.) with abundant charcoal and root masses throughout. This likely indicates a history of wildfire and the probable origin of this forest clearing. (Information provided by Olympic National Park archeologist and physical science technician)

Vegetation
The project area is located in a small forest clearing surrounded by mature subalpine forest. The forest is typical for the upper western slopes of the Olympic Mountains, dominated by mountain hemlock (*Tsuga mertensiana*) and subalpine fir (*Abies lasiocarpa*) with intermittent Alaska yellow cedar (*Chamaecyparis nootkatensis*). Trees surrounding the site average between 35 and 50 ft. in height.

Photo 3. Proposed project area

The project area itself consists of a shrubby meadow of pink mountain heather (*Phyllodoce empetriformis*) and dwarf huckleberry (*Vaccinium deliciosum*) which is being invaded by a young conifer forest. Invading trees comprise less than 25% of the clearing and are the same species found in the surrounding forest. The tallest trees within the site were measured at 8 ft. tall and are estimated at 30 years in age.

A site survey conducted by an NPS botanist found no threatened, endangered or plant species of concern within the project area.

Photo 4. Vegetation at project site, pink mountain heather and huckleberry

Table 5. Plant Species Found within the Project Area

Plant Species Found in Project Area with Potential to be Disturbed	
pink mountain heather	*Phyllodoce empetriformis*
dwarf huckleberry	*Vaccinium deliciosum*
avalanche lily	*Erythronium montanum*
Arctic lupine	*Lupine arcticus*
partridgefoot	*Luetkea pectinata*
bear grass	*Xerophyllum tenax*
common juniper	*Juniperus communis*
rush species (unidentified)	*Juncus sp.*
black alpine sedge	*Carex nigricans*
mountain hemlock	*Tsuga mertensiana*
subalpine fir	*Abies lasiocarpa*
Alaska yellow cedar	*Chamaecyparis nootkatensis*

Wildlife

Wildlife species are abundant throughout the montane and subalpine vegetation zones of the Olympic Mountains. The project area includes a small forest clearing (subalpine meadow) and subalpine forest.

The Roosevelt elk (*Cervus elaphus roosevelti*) and Columbia black-tailed deer (*Odocoileus hemionus columbianus*) are likely the most common ungulate occurring in this area. While elk were not directly observed during the site survey, the high southwestern slopes of the Olympic Mountains are crisscrossed with elk trails and this area is no exception. A narrow, but well established elk trail passes on the periphery of the forest clearing. Additional elk trails are found throughout the forest and meadows of this area.

Other mammals likely to frequent this area would include black bear (*Ursus americanus*), spotted skunk (*Spilogale putorius*), weasel (*Mustela* sp.), cougar (*Felis concolor*), bobcat (*Lynx rufus*), deer mouse (*Peromyscus maniculatus*), Olympic chipmunk (*Eutamias amoenus caurinus*), mountain heather vole (*Phenacomy intermedius*), snowshoe hare (*Lepus americanus*) and several shrew (*Sorex* sp.) species.

Two mammal species of particular management concern in subalpine areas of Olympic National Park are the Olympic marmot (*Marmota olympus*) and the Mazama pocket gopher (*Thomomys mazama melanops*). The project area, however, is not typical of habitat used by either of these species as they typically inhabit grassy, forb meadow habitats. Careful surveys were conducted to ensure no burrows or other evidence of either species occurred in or adjacent to the project area.

The project area is likely frequented by a number of resident and migratory bird species. Bird species likely to be found in the project area include the gray jay (*Perisoreus canadensis*), sooty grouse (*Dendragapus fuliginosus*), common raven (*Corvus corvus*), American robin (*Turdus migratorius*), hermit thrush (*Catharus guttatus*), dark-eyed junco (*Junco hyemalis*), chestnut-backed chickadee *(Parus rufescens)*, golden-crowned kinglet (*Regulus satrapa)*, yellow-rumped warbler (*Dendroica coronata*), winter wren (*Troglodytes troglodytes)* and olive-sided flycatcher (*Contopus borealis).*

Amphibians, while rarely encountered in open subalpine meadows, will occasionally traverse or reside in seeps and rotting logs in and adjacent to forest openings. Possible species would include the Northwestern salamander (*Ambystoma gracile*), long-toed salamander (*Ambystoma macrodactylum*), the rough-skinned newt (*Taricha granulose*), and the Cascades frog (*Rana cascadae*). A small seep and perennial stream occur adjacent to the site (30 ft. from nearest installation) and could provide habitat and breeding areas for these amphibians.

Wilderness Values

Encompassing 876,669 acres of designated wilderness, and 378 acres of potential wilderness additions, Olympic National Park is one of the largest wilderness areas in the contiguous United States. The Olympic wilderness is exceptionally diverse and is of inestimable value. The park's trails and wilderness camp areas are the most conspicuous human imprint on the wilderness. Several other structures are maintained in wilderness, including ranger stations, historic structures, privies, other administrative and emergency facilities (e.g. radio repeaters), and research equipment. The project area is located within designated wilderness and any travel to and from the site would be through or over designated wilderness.

Cultural Resources

Prior to this project there had been no cultural resource inventory in the immediate vicinity of the project area. There have been several archeological surveys within a 5-mile radius of the project, none of which resulted in the documentation of any significant resources. These projects were limited in scope and largely driven by park operations, such as trail reconstruction and sanitation projects (privy installation and relocation).

In general, the high country of the Olympic Mountains, specifically ridgelines, basins and saddles, exhibit a high density of archeological sites. For the park as a whole, archeological site density is around 13 sites per square kilometer surveyed, whereas for the area of the park above 4,000 ft. in elevation, the site density per square kilometer surveyed is 58. These figures highlight the importance of mountain environments to Native American groups on the peninsula and make clear the need for careful archeological survey. The proposed location of this project on a small bench off a major ridge system at an elevation of over 4,900 ft. suggests that archeological resources should be expected.

During an initial survey of the project area, two previously undocumented archeological sites were recorded in and near the project area. Both were precontact era lithic scatters comprised of dacite and quartz crystal artifacts. Documentation of these sites was accomplished by a combination of surface inspection and shovel probe excavation. One was found within the proposed footprint of the SNOTEL when two flaked stone artifacts were recovered from a shovel probe excavated at the location of the proposed equipment facility. Excavation of four more shovel probes within the SNOTEL footprint revealed no additional artifacts, features or cultural stratigraphy. A second site was found during surface inspection of a small ridge or knoll used as the helicopter landing zone near the proposed SNOTEL site. This site would not be affected by the installation of the facility.

Additional archeological testing would be conducted prior to installation of the facility. This work would be completed concurrently with SNOTEL installation and would be limited to archeological excavation within the exact footprint of this facility. Archeologists would be available to monitor ground disturbing activities associated with installation of the snow pillow, precipitation gauge and fluid lines.

Visual Resources

Buckinghorse Ridge is one of many high elevation ridgelines forming the upper watershed of the Elwha River. As a visual resource, these ridgelines form a backdrop to scenic views from climbing destinations, high elevation wilderness campsites and cross-country traverses. Buckinghorse Ridge is primarily forested with scatterings of small meadows, avalanche chutes, talus slopes and rocky ridgelines. One of the most obvious features of the ridge is a large historic fire scar, several miles north of the project site.

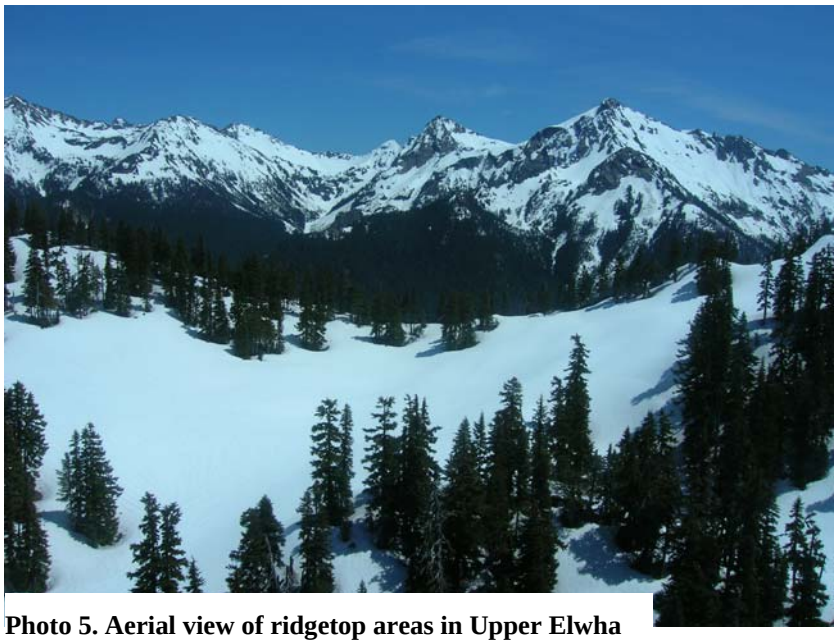

Photo 5. Aerial view of ridgetop areas in Upper Elwha

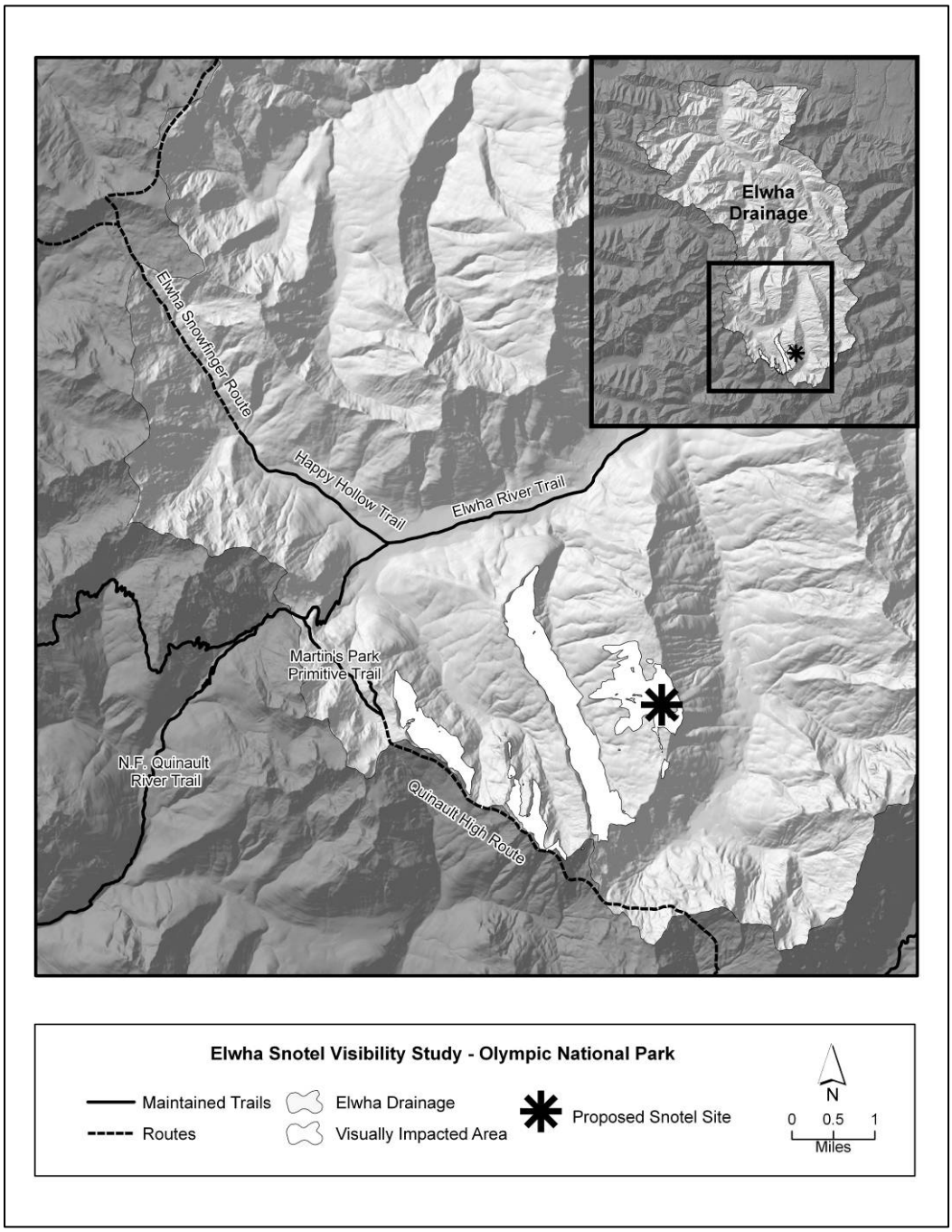

Figure 6. Visibility Study of Proposed SNOTEL Site

The proposed location of the SNOTEL was selected to minimize effects on visual resources. The clearing itself is small and sheltered by dense forest, with average tree size 10 to 20 ft. taller than the highest instrument. The ridge itself is relatively low compared to adjacent topography, and the site is positioned on the ridge such that it is visible from very few areas of the park, and no areas frequented by wilderness visitors (Figure 6). The site is remote enough and far enough from even infrequently used cross-country routes that the site is likely to be seen or visited only on extremely rare or extraordinary circumstances.

Soundscapes
The project area is dominated by natural sound. The sounds are those associated with natural phenomena such as wind, rain, trickling water, insects and bird song. Rarely, military or administrative aircraft overflights may result in brief periods of human-generated sound.

Visitor Experience
The proposed project site has little contribution to visitor experience. As a visual resource, ridgelines in the upper Elwha drainage form a backdrop to scenic views from climbing destinations, high elevation wilderness campsites and cross-country traverses. Buckinghorse Ridge and the project site, however, are situated within the landscape such that they are rarely visible and seldom if ever visited by wilderness users. In initial surveys of the area, no evidence of visitor use was found (e.g., bare ground, social trails, fire rings or litter).

Safety and Park Operations
Olympic National Park is managed by a park superintendent, deputy superintendent and several division chiefs housed at the headquarters area in Port Angeles. Administrative divisions include Administration, Natural Resources Management, Cultural Resources Management, Resource and Visitor Protection, Resource Education and Maintenance.

The project area is currently not used for park operations. The park operations that would most likely be affected by the proposed project include the Visitor Protection Division because of the coordination of flights within Olympic National Park, the Natural Resources Management Division for project oversight and data collection, and the Cultural Resource Management Division because of the archeological surveys and monitoring that are required prior to and during project implementation.

Snowpack data is currently used by scientists for a variety of purposes, including avalanche forecasting and forecasting potential natural disasters such as floods. The park currently conducts monthly snow surveys at three locations: at Deer Park, west of Hurricane Ridge adjacent to the Wolf Creek Road, and in Cox Valley. In 1989, the first SNOTEL was installed in the Olympic Mountains, near Mt. Crag on the northeast corner of the Olympic Peninsula. This installation served the Quilcene River watershed. Two SNOTEL sites were added in 1999. The first was in the upper Dungeness River and the second was installed in the “Waterhole” area, just east of Hurricane Ridge. The Dungeness SNOTEL services the Dungeness River, while the Waterhole site services both the Dungeness and Elwha watersheds. Rather than rely on a few (monthly) measurements, the SNOTEL instruments could effectively and reliably collect and transmit hourly snowpack and climate data. The finer scale of data allowed for better water supply forecasting and became an additional tool for short-term forecasting of events such as floods and avalanches.

Chapter 4: Environmental Consequences

This chapter analyzes both the beneficial and adverse impacts that would result from the implementation of any of the alternatives considered in this environmental assessment. It is organized by impact topics that were derived from internal park and external public scoping. This chapter includes definitions of impact thresholds, methods used to analyze impacts, and the analysis methods used for determining cumulative impacts. Impacts are evaluated based on context, duration, intensity, and whether they are direct, indirect, or cumulative impacts. NPS policy also requires that impairment of resources be evaluated in all environmental documents.

Methodology and Assumptions for Impact Analysis

This section contains the environmental impacts, including direct and indirect effects and their significance to the alternatives. The analysis is based on the assumption that the mitigation identified in the *Mitigation* section of this environmental assessment would be implemented under any of the applicable alternatives.

Impacts are evaluated based on the most current and comprehensive scientific and social data available. Overall, the NPS based these impact analyses and conclusions on the review of existing literature and Olympic National Park studies; information provided by experts at the park and other agencies; professional judgment and park staff insights; input from interested local American Indian tribes; and public input. Impacts can be beneficial or adverse. Beneficial impacts would improve resource conditions while adverse impacts would deplete or negatively alter resources.

There are several terms used within the environmental consequences section to assess the impacts of each alternative on each impact topic. Unless otherwise stated, the standard definitions for these terms are:

Negligible - the impact is at the lower level of detection; no measurable change would occur.

Minor - the impact is slight, but detectable; a small change would occur over the life of the plan.

Moderate - the impact is readily apparent; a measurable change would occur and could result in a small but permanent change.

Major - the impact is severe; resulting in a permanent measurable change.

Localized Impact - the impact occurs in a specific site or area. When comparing changes to existing conditions, the impacts are only detectable in the localized area.

Short-term - the impact occurs only during or immediately after the actual management or project activity.

Long-term - the impact could occur for an extended period of time after the management or project activity has been completed. The impact could take several years or more.

Direct – an effect that is caused by an action that occurs at the same time and in the same place.

Indirect – an effect that is caused by an action that is later in time or farther removed in distance, but is still reasonably foreseeable.

Criteria and Thresholds for Impact Analysis

Definitions of duration and intensity vary by resource. Therefore, the definitions for each impact topic are described separately. These definitions were formulated through the review of existing laws, policies and guidelines, and with assistance from park, region and Washington office specialists. In all cases the impact thresholds are defined for adverse impacts. Beneficial impacts are addressed qualitatively.

Soils

The area of consideration for this topic is the project area. Defining potential impacts from management actions is based on professional judgment and experience with similar actions. The thresholds of change for the intensity of an impact are defined as follows:

Impact Intensity	Intensity Description
Negligible	The effects to soils would be below or at the lower levels of detection. Any effects on productivity or erosion potential would be slight.
Minor	An action's effects on soils would be detectable. It would change a soil's profile in a relatively small area, but it would not appreciably increase the potential for erosion of additional soil. If mitigation were needed to offset adverse effects, it would be relatively simple to implement and would likely be successful.
Moderate	An action would result in a change in quantity or alteration of the topsoil, overall biological productivity, or the potential for erosion to remove small quantities of additional soil. Changes to localized ecological processes would be of limited extent. Mitigation measures would probably be necessary to offset adverse effects and would likely be successful.
Major	An action would result in a change in the potential for erosion to remove large quantities of additional soil or in alterations to topsoil and overall biological productivity in a relatively large area. Key ecological processes would be altered, and landscape-level changes would be expected. Mitigation measures to offset adverse effects would be necessary, extensive, and their success could not be guaranteed.

Vegetation

All available information on vegetation and vegetative communities potentially impacted in the project area park was compiled. Where possible, map locations of known sensitive vegetation species, populations and communities were identified and avoided. A park botanist conducted a thorough survey of the project area and documented the type and quantity of species likely to be affected in the project area. Predictions about short- and long-term site impacts were based on previous projects with similar vegetation. Also included in the evaluation of the vegetative

communities was the introduction or promotion of non-native species. The thresholds of change for the intensity of an impact are defined as follows:

Impact Intensity	Intensity Description
Negligible	No native vegetation would be affected or some individual native plants could be affected as a result of the alternative, but there would be no effect on native species populations. The effects would be on a small scale and no species of special concern would be affected.
Minor	The alternative would affect some individual native plants and would also affect a relatively minor portion of that species' population on a short-term basis. Mitigation to offset adverse effects, including special measures to avoid affecting species of special concern, could be required and would be effective. Mitigation may be needed to offset adverse effects and would be relatively simple to implement and likely be successful.
Moderate	The alternative would result in short-term effects to some individual native plants and could also affect a sizeable segment of the species' population and over a relatively large area. Permanent impacts could occur to native vegetation but in a relatively small area. Some species of special concern could also be affected. Mitigation measures, for both vegetation and soil, would be necessary to offset adverse effects and likely be successful
Major	The alternative would have a considerable effect on native plant populations, including species of special concern, and affect a relatively large area in and out of the park for a long-term basis or permanently. Mitigation measures to offset the adverse effects would be required, extensive; success of the mitigation measures would not be guaranteed.

Wildlife

Information on Olympic National Park wildlife was taken from park documents and records. ONP natural resource management staff surveyed and documented the immediate project area for evidence of wildlife. Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity and the ecological integrity of plants and animals. The thresholds of change for the intensity of an impact to wildlife are defined as follows:

Impact Intensity	Intensity Description
Negligible	There would be no observable or measurable impacts to native species, their habitats or the natural processes sustaining them. Impacts would be well within natural fluctuations.
Minor	Impacts would be detectable, short-term, and they would not be expected to be outside the natural range of variability of native species' populations, their habitats or the natural processes sustaining them. Mitigation measures, if needed to offset adverse effects, would be simple and successful.
Moderate	Breeding animals of concern are present; animals are present during particularly vulnerable life-stages, such as migration or juvenile stages; mortality or interference with activities necessary for survival can be expected on an occasional basis, but is not expected to threaten the continued existence of the species in the park unit. Impacts on native species, their habitats or the natural processes sustaining them would be detectable, short-term, and they could be outside the natural range of variability. Mitigation measures, if needed to offset adverse effects, would be extensive and likely successful.
Major	Impacts on native species, their habitats or the natural processes sustaining them would be detectable, long-term, and they would be expected to be outside the natural range of variability. Key ecosystem processes might be disrupted.

	Loss of habitat might affect the viability of at least some native species. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed.

Impacts would be considered short-term if the wildlife recovered in less than one year. Impacts would be considered long-term if wildlife recovery takes more than one year.

Wilderness Values

Working from definitions included in the Wilderness Act and the tradition of wilderness preservation at Olympic National Park, the following wilderness resource values have been identified for Olympic National Park and are a component of the wilderness character.

Naturalness

- absence of evidence of people and their activities
- perpetuation of natural ecological relationships and processes and the continued existence of native wildlife populations in largely natural conditions

Wilderness Experiences and Opportunities for Solitude

- the likelihood of not encountering other people while in wilderness; including privacy and isolation
- absence of distractions (such as large groups, mechanization, unnatural noise, signs and other modern artifacts)
- freedom from the reminders of modern society

Opportunities for Primitive, Unconfined Recreation

- the freedom of visitors to explore, with limited or no restrictions; the ability to be spontaneous
- self-sufficiency and absence of support facilities or motorized transportation; direct experience of weather, terrain and wildlife with minimal shelter or assistance from devices of modern civilization

Impacts on natural and cultural resources, visitor access, soundscape and other resources are evaluated elsewhere in the environmental consequences section. The analysis for this topic will focus on wilderness character and wilderness experience, which are integrally related because much of wilderness character can only be subjectively determined by the visitor's experience (for example, solitude or freedom of movement). For the purpose of this planning process, a wilderness "unit" is defined as those portions of wilderness located in one drainage area.

Impact Intensity	Intensity Description
Negligible	The action would have no discernable effect on opportunities for solitude. Opportunities for primitive and unconfined forms of recreation would essentially remain unchanged. The action would have no effect on prevalence of natural conditions, and wilderness area would continue to be primarily affected by forces of nature.
Minor	Action would have slightly beneficial or adverse effect on opportunities for solitude in a limited area of wilderness, such as along a single trail or an area of less than 100 acres. Action would slightly reduce or improve opportunities for primitive and unconfined forms of recreation in limited areas of the wilderness. Action would result in slightly detectable human-caused impacts (either beneficial or adverse) to the natural environment in limited areas of the wilderness; natural conditions would continue to predominate.

Moderate	Action would result in readily apparent beneficial or adverse effects on opportunities for solitude in limited areas of wilderness. Action would noticeably improve or reduce opportunities for primitive and unconfined forms of recreation in limited areas of the wilderness. Action would result in readily apparent human-caused impacts (either beneficial or adverse) in limited areas of the wilderness; natural conditions would continue to predominate.
Major	Action would have readily apparent beneficial or adverse impacts on opportunities for solitude in one or more wilderness units. Action would substantially improve or reduce opportunities for primitive and unconfined forms of recreation in one or more wilderness units. Action would result in readily apparent human-caused impacts (either beneficial or adverse) to the natural environment in one or more wilderness units.

Cultural Resources

Information used in this assessment was obtained from relevant literature and documentation, maps, consultation with park archeologists and site visits. The National Historic Preservation Act requires agencies to take into account the effects of their actions on properties listed or eligible for listing in the National Register of Historic Places (NRHP). The process begins with identification and evaluation of cultural resources for NRHP eligibility, followed by an assessment of effects on eligible resources. In Washington, this process includes consultation with the state historic preservation officer (SHPO). If an action could change in any way the characteristics that qualify the resource for inclusion in the national register, it is considered to have an effect. No adverse effect means there could be an effect, but the effect would not be harmful to the characteristics that qualify the resource for inclusion in the national register. Adverse effect means the action could diminish the integrity of the characteristics that qualify the resource for the national register. For the purposes of this analysis, the intensity of impacts on cultural resources was defined as follows:

Impact Intensity	Intensity Description
Negligible	The effects on cultural resources would be at the lowest levels of detection, barely measurable without any perceptible consequences, either beneficial or adverse to cultural landscape resources, historic buildings or structures, or archeological resources. For the purposes of Section 106 and the National Historic Preservation Act, the determination of effect would be *no adverse effect.*
Minor	The effects on cultural resources would be perceptible or measurable, but would be slight and localized within a relatively small area. The action would not affect the character or diminish the features of a National Register (NRHP) eligible or listed cultural landscape, historic structure, or archeological site, and it would not have a permanent effect on the integrity of any such resources. For the purposes of Section 106 and the National Historic Preservation Act, the determination of effect would be *no adverse effect.*
Moderate	The effects would be perceptible and measurable. The action would change one or more character-defining features of a cultural resource, but would not diminish the integrity of the resource to the extent that its National Register eligibility would be entirely lost. For the purposes of Section 106 and the National Historic Preservation Act, the cultural resources' NRHP eligibility would be threatened; the determination of effect would be *adverse effect.*
Major	The effects on cultural resources would be substantial, discernible, measurable and permanent. For National Register eligible or listed cultural landscapes, historic structures or archeological sites, the action would change one or more character-defining features, diminishing the integrity of the resource to the extent that it would no longer be eligible for listing in the national register. For purposes of Section 106, NRHP eligibility would be lost; the determination of effect would be *adverse effect*.

Visual Resources

A GIS (Geographic Information System) analysis was used to quantify the extent and location of visual impacts from the proposed installation (Figure 6). Visual resources are measured as the potential impact to park scenery a proposed action might have. Similar to visitor experience, the beneficial or adverse quality is somewhat qualitative and relies on the perspective of the park visitor. Because Olympic National Park is renowned for its natural qualities, for the purposes of this document we assume that a visitor in the upper Elwha Valley expects to have views of pristine landscapes generally free of human influences.

Impact intensity	Impact Description
Negligible	Effects to the visual quality of the landscape would be at or below the level of detection for nearly all visitors; changes would be so slight that they would not be of any measurable or perceptible consequence to the average visitor experience.
Minor	Effects to the visual quality of the landscape would be detectable, localized and would be small and of little consequence to the average visitor experience. Mitigation measures, if needed to offset adverse effects, would be simple and successful.
Moderate	Effects to the visual quality of the landscape would be readily detectable, localized, with consequences at the regional level. Mitigation measures, if needed to offset adverse effects, would be extensive and likely successful.
Major	Effects to the visual quality of the landscape would be obvious, with substantial consequences to the visitor experience in the region. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed.

Soundscapes

NPS *Management Policies 2006*, states that "the National Park Service will preserve, to the greatest extent possible, the natural soundscapes of parks." The policy requires the restoration of degraded soundscapes to the natural condition whenever possible, and the protection of natural soundscapes from degradation due to unnatural sounds (noise) (*Management Policies 2006,* sec. 4.9). The NPS is specifically directed to "take action to prevent or minimize all noise that, through frequency, magnitude or duration, adversely affects the natural soundscape or other park resources or values, or that exceeds levels that have been identified as being acceptable to, or appropriate for, visitor uses at the sites being monitored" (*Management Policies 2006*, sec. 4.9). Overriding all of this is the fundamental purpose of the national park system, established in law (e.g., 16 USC 1 et seq.), which is to conserve park resources and values (*Management Policies 2006*. sec. 1.4.3). NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values (*Management Policies 2006,* sec 1.4.3).

Noise can adversely affect park resources by modifying or intruding upon the natural soundscape, and can also interfere with sounds important for animal communication, navigation, mating, nurturing, predation and foraging functions. Noise can also adversely affect park visitor experiences by intruding upon or disrupting experiences of solitude, serenity, tranquility, contemplation, or a completely natural or historical environment.

The methodology used to assess noise impacts in this document is consistent with NPS *Management Policies 2006* and *Director's Order #47: Soundscape Preservation and Noise Management.*

Context, time and intensity together determine the level of impact for an activity. It is usually necessary to evaluate all three factors together to determine the level of noise impact. In some cases an analysis of one or more factors may indicate one impact level, while an analysis of another factor may indicate a different impact level, according to the criteria below. In such cases, best professional judgment based on a documented rationale must be used to determine which impact level best applies to the situation being evaluated.

- National literature was used to estimate the average decibel levels of the activity.
- Areas of use by visitors were identified in relation to where the activity is proposed. Personal observation from park staff and monthly use reports were used to identify these areas.

Other considerations, such as topography and prevailing winds, were then used to identify areas where noise levels could be exacerbated or minimized. The thresholds of change for the intensity of an impact to soundscape are defined as follows:

Impact Intensity	Intensity Description
Negligible	Natural sounds would prevail. Effects to natural sound environment would be at or below the level of detection and such changes would be so slight that they would not be of any measurable or perceptible consequence to the visitor experience or to biological resources.
Minor	Natural sounds would prevail. Effects to natural sound would be localized, short-term and would be small and of little consequence to the visitor experience or to biological resources. Mitigation measures, if needed to offset adverse effects, would be simple and successful.
Moderate	Natural sounds would prevail, but activity noise could occasionally be present at low to moderate levels. Effects to the natural sound environment would be readily detectable, localized, short- or long-term, with consequences at the regional or population level. Natural sounds would be occasionally heard during the day. Mitigation measures, if needed to offset adverse effects, would be extensive and likely successful.
Major	Natural sounds would be impacted by activity noise frequently for extended periods of time. Effects to the natural sound environment would be obvious, long-term, and have substantial consequences to the visitor experience or to biological resources in the region. Extensive mitigation measures would be needed to offset any adverse effects and success would not be guaranteed.

Visitor Experience

NPS *Management Policies 2006* state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Part of the purpose of Olympic National Park is to offer opportunities for recreation, education, inspiration and enjoyment. Consequently, one of the park's management goals is to ensure that visitors safely enjoy and are satisfied with the availability, accessibility, diversity, and quality of park facilities, services and appropriate recreational opportunities.

Public scoping input and observation of visitation patterns combined with assessment of what is available to visitors under current management were used to estimate the effects of the actions in the alternatives in this document. The impact on the ability of the visitor to experience a full range of park resources was analyzed by examining resources and objectives presented in the

park significance statements, as derived from its enabling legislation. The potential for change in visitor use and experience proposed by the alternatives was evaluated by identifying projected increases or decreases in access and other visitor uses, and determining whether or how these projected changes would affect the desired visitor experience and to what degree and for how long. The thresholds of change for the intensity of an impact to visitor experiences are defined as follows:

Impact Intensity	Intensity Description
Negligible	Changes in visitor use, experience and recreational resources would be below or at the level of detection. The visitor would not likely be aware of the effects associated with the alternative.
Minor	Changes in visitor use, experience and recreational resources would be detectable, although the changes would be slight. The visitor would be aware of the effects associated with the alternative, but the effects would be slight.
Moderate	Changes in visitor use, experience and recreational resources would be readily apparent. The visitor would be aware of the effects associated with the alternative and would likely be able to express an opinion about the changes.
Major	Changes in visitor use, experience and recreational resources would be readily apparent and severely adverse or exceptionally beneficial. The visitor would be aware of the effects associated with the alternative and would likely express a strong opinion about the changes.

Safety and Park Operations

NPS *Management Policies 2006* state that although there are limitations on the NPS ability to totally eliminate all hazards, the NPS will strive to provide a safe and healthful environment for visitors and employees, to protect human life and to provide for injury-free visits.

Safety, for the purposes of this analysis, refers to the potential for each alternative to directly or indirectly inflict injury to park visitors and staff. The project alternatives have the potential to affect safety in two ways:

1. There are inherent, direct risks associated with the use of helicopters for installation and maintenance of a SNOTEL. Mitigation measures and compliance with required policies serve to reduce these risks; however, they can never be completely eliminated. Therefore, there is the potential for injury and loss of human life during these operations.
2. The accuracy of climate and snowpack information to evaluate and predict catastrophic events such as floods and avalanches could have an indirect effect on staff and visitor safety.

Impact to park operations refers to the potential of the alternatives to interfere or benefit the activities relating to park management. In this EA, the analysis relates to the indirect effect the quality of climate and snowpack information would have on Elwha dam removal operations, park wilderness operations, and park research and monitoring objectives. Park staff members knowledgeable about these issues were members of the planning team that evaluated the impacts of each alternative. Impact analysis is based on the current description of park operations presented in the "Affected Environment" section of this document.

Impact intensity	Impact Description
Negligible	The impacts to visitor or staff safety would not be measurable or perceptible. Park operations would not be affected.
Minor	The effect would be detectable, short-term, but would be limited to a relatively

	small number of visitors or park staff at a localized area and would not have an appreciable effect on public health and safety. For park operations, the effect would be detectable, but short-term and would not have an appreciable effect on park operations.
Moderate	The effects would be sufficient to cause a permanent change in forecasting accuracy or would be readily apparent and result in substantial, noticeable effects to safety on a local scale on a short- or long-term basis. For park operations, the effects would be readily apparent, short-or long-term, and would result in a substantial change in park operations in a manner noticeable to park staff and the public.
Major	The impact to visitor or staff safety would be substantial. Effects would be readily apparent and result in substantial, noticeable effects to safety on a regional scale and long-term basis. For park operations, the effects would be readily apparent, would result in a substantial change in park operations in a manner noticeable to park staff and the public, and be markedly different from existing operations.

Cumulative Effects

To determine potential cumulative impacts, affected resources were first identified through internal and external scoping. These resources were then evaluated to determine whether the resource is particularly vulnerable to incremental effects, whether the action is one of several similar actions in the same geographic areas, whether other activities in the area have similar effects on the resource, whether these effects have been historically significant for this resource, and whether other analyses in the area have identified a cumulative effect concern.

Through this process, the appropriate boundaries for each resource were identified on both a spatial and temporal basis. Spatial boundaries are the geographical boundaries within and outside the project area where potential impacts could occur. This generally is considered to be the distance an effect can travel, or an appropriate regional boundary, and varies with each resource impact topic. Temporal boundaries are the appropriate past and future time frames to consider for the project-specific analysis. Temporal boundaries were developed considering the timing of past impacts and the timing of resource recovery from those past actions, and the identification of future proposed or planned activities and the potential for resource impacts, either beneficial or adverse.

Projects near the proposed project area or within and directly adjacent to the Elwha drainage were identified. Potential projects identified as cumulative actions included any planning or development activities that occurred in the past; those currently being implemented; or that are planned or would be implemented in the reasonably foreseeable future. These projects were then assessed to determine whether they would have similar effects to identified resources as the proposed project.

Summary of Cumulative Effects

The following actions were considered in the cumulative impacts analysis.

The immediate, proposed project area on Buckinghorse Ridge is extremely remote and unlikely to have any additional actions in the foreseeable future.

The greater project area is generally considered the Elwha River watershed. This drainage is the largest in the park, is a popular wilderness destination and is of great interest to park natural resource managers, local tribes, governments and outside researchers. This interest has increased recently due to the planned restoration of the river involving removal of two major hydroelectric dams.

Two types of actions related to the proposal could result in additional cumulative impacts to the drainage.

1. Installation of additional instruments in the valley in order to measure climate, environmental or biological conditions for management, monitoring or research purposes.

2. Use of helicopters for park management and its potential effect on wilderness users.

Instrument installation:
A river gauge to measure river height and runoff was installed by the United States Geological Survey (USGS) several years ago during early planning for Elwha River restoration. This gauge is located at the base of Elwha Canyon where it exits into Lake Mills. The gauge is temporary and will be removed sometime after river restoration activities are completed.

Small radio antennas and telemetry stations are located along the Elwha River, from the mouth (outside of the park) to areas within park wilderness, but many miles below the project site. These stations track radio tagged bull trout as part of a short-term study. It is likely that similar studies would be conducted in the future to monitor and study fish populations throughout river restoration activities.

In 2006, a small remote climate station was placed at Hayes River Ranger Station as part of Olympic National Park's long-term climate monitoring program. These instruments record low elevation climate data in the park's interior. It is likely that data collected from an upper elevation site, such as the proposed SNOTEL, would eventually eliminate the need for this climate station and it would be removed. No additional climate stations are planned for the Elwha Valley.

As society becomes more focused on the issue of global warming and its potential effects on both park and regional natural resources, there will be increased interest in better data from mountainous areas dominated by winter snowpack. A recent meeting of eWaCH.net, a multi-agency organization headed by the State Climatologist's Office whose charter is "enhancing Washington's Climate and Hydrology Networks," emphasized the need for additional high elevation climate sites throughout Washington State. It is possible that further installations might be requested within Olympic National Park. One of the main purposes of this project, however,

is to develop a more accurate model to use remote sensing in lieu of further installations within the Olympics.

Helicopter Flights:
Helicopters are occasionally used in the Elwha drainage for a variety of park management tasks including trail and bridge construction, maintenance activities, search and rescue, wildland fire response and animal (e.g., elk, mountain goat and bear) surveys. The number of flights varies each year.

While no animal (e.g., elk, mountain goat and bear) surveys are routinely conducted in the Elwha drainage, there has been regular aircraft use in the last few years associated with short-term research studies. It is conceivable, but not currently planned, that researchers and tribes may request the use of helicopters during and after river restoration, to support specific research and monitoring efforts associated with fish recovery or other wildlife species.

Impairment of Park Resources or Values

In addition to determining the environmental consequences of the preferred and no-action alternatives, NPS *Management Policies 2006* and DO-12 require an analysis of potential effects to determine if actions would impair park resources. The fundamental purpose of the national park system established by the *Organic Act* and reaffirmed by the *General Authorities Act*, as amended, begins with a mandate to conserve park resources and values. NPS managers must seek ways to avoid, or minimize to the greatest degree practicable, adversely impacting park resources and values. Congress has given NPS managers direction, however, to allow impacts to park resources and values when necessary and appropriate to fulfill the purpose of the park, so long as the impact does not constitute impairment of the affected resources and values.

The prohibited impairment is an impact that would, in the professional judgment of the responsible NPS manager, harm the integrity of park resources or values, including opportunities that would otherwise be present for the enjoyment of those resources or values. An impact would be more likely to constitute impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- Necessary to fulfill specific park purposes identified in the establishment legislation or proclamation of the park;
- Key to the natural and cultural integrity of the park or to opportunities for enjoyment of the park; or, is
- Identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from NPS activities in managing the park, visitor activities or activities undertaken by concessionaires, contractors and others operating in the park. In this "Environmental Consequences" section, a determination on impairment is made in the conclusion statement of the appropriate impact topics for each alternative. Impairment statements are not required for recreational values/visitor experience, park operations, or health and safety topics. In addition, neither NPS policies nor managerial determinations regarding impairment apply to non-NPS lands or resources.

ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVE A – NO ACTION

Under alternative A, no SNOTEL instruments would be placed within the Upper Elwha Valley or elsewhere in park wilderness. Seasonal runoff estimates on the Elwha and Dungeness rivers would continue to rely on existing data from outside of park wilderness. Annual climate summaries and changes in climate due to global warming would continue to be inferred from existing models or indirect methods such as downstream gauges and glacier mass balance despite the errors associated with the inaccuracies of interpolation.

Soils
No action would be taken in this alternative; therefore there would be no impacts to soils.

Cumulative Effects: Soils in the immediate project area are generally not impacted. Slight erosion associated with natural disturbance, such as surface flow and frost action on soils naturally free of vegetation, does occur but is limited to a few small areas and elk trails. In the greater project area, the Elwha drainage, 137 wilderness campsites and 75 miles of maintained trails are sources of soil impact. Because the no action alternative would have no additional effect on soils, there would be no cumulative impacts on soil resources.

Conclusion: There would be no new impacts or cumulative impacts to soils under this alternative and therefore no impairment to soil resources.

Vegetation
No action would be taken in this alternative; therefore there would be no direct or indirect impacts to vegetation.

Cumulative Effects: Vegetation in the immediate project area is generally not disturbed. Impacts on site are from natural disturbance, most obviously from elk forming trails adjacent to the project site. Other evidence of natural disturbance can be found in adjacent areas and includes occasional lightning ignited wildfires and trees thrown or damaged by high wind events. In the greater project area, the Elwha drainage, 137 wilderness campsites and 75 miles of maintained trails are sources of vegetation impact. Because the no action alternative would have no additional effect on vegetation, there would be no cumulative impacts.

Conclusion: There would be no impacts, no cumulative impacts and no impairment to vegetation under this alternative.

Wildlife
No action would be taken in this alternative; therefore there would be no direct impacts to wildlife species. However, the lack of climate data would negatively impact the ability to interpret data from long-term wildlife monitoring programs.

Cumulative Effects: The proposed project site is subject to completely natural processes, and its location far from trails or human activity ensures that no human caused factors add cumulative impacts to wildlife. Far ranging wildlife species such as elk and bear may occasionally be

influenced by human activity in trail and campsite areas such as Low Divide and the Elwha River Trail, all of which are at least 5 miles from the project area.

Conclusion: There would be no new impacts to wildlife and therefore no impacts, cumulative impacts or impairment to wildlife species under this alternative.

Wilderness Values
No action would be taken in this alternative; therefore there would be no impacts to park wilderness.

Cumulative Effects: The proposed project site has had no recent human disturbance and is therefore a completely pristine area of wilderness. Its location is far from trails or human activity ensuring that no future human caused factors are likely to add cumulative impacts to the immediate site area. The larger project area, including the Elwha River watershed, is a popular wilderness destination and is of great interest to park natural resource managers, local tribes, governments and outside researchers. The popularity of the drainage as a visitor destination and research site means that the larger project area does have existing impacts to wilderness including hiking trails, trail structures, privies, bear wires, ranger stations, occasional overflights (helicopter and fixed-wing) and scientific instrument installations.

Conclusion: Because no new facilities or activities are proposed in this alternative, there would be no new impacts, cumulative impacts and no impairment to wilderness resources under this alternative.

Cultural Resources
No action would be taken in this alternative; therefore there would be no impacts to cultural resources existing at the proposed project site.

Cumulative Effects: The proposed project site has had no recent human disturbance and archeological resources in this area remain intact. As part of routine park service cultural resource management activities the site will be tested and evaluated against National Register of Historic Places eligibility criteria when feasible. The Elwha is also an extremely popular and relatively developed wilderness destination. Facilities such as hiking trails, trail structures, privies and signs have likely impacted many cultural resources. Because no action would be taken in this alternative, no additional cumulative impacts would occur.

Conclusion: There would be no impacts, cumulative impacts or impairment to cultural resources in this no action alternative.

Visual Resources
No action would be taken in this alternative; therefore the project site would remain in a completely natural state and there would be no impacts to visual resources.

Cumulative Effects: Visual resources are measured as the potential impact to scenery from the perspective of a park visitor. Because the immediate project area is not in view from any areas even occasionally accessed by park visitors, cumulative impacts are not likely to occur even if human caused changes did occur at the project site. Other impacts do exist in the Elwha

drainage, due to previously existing park infrastructure such as trails, ranger stations and privies. Because no action would be taken in this alternative, no cumulative impacts would occur.

Conclusion: Because no new facilities or activities are proposed in this alternative, there would be no new impacts, cumulative impacts and no impairment to visual resources under this alternative.

Soundscapes
No action would be taken in this alternative; therefore no additional impacts to soundscapes would occur at the project site.

Cumulative Effects: The immediate project area is a large distance from any areas frequented by park visitors. The only sounds at the site are natural, with the exception of occasional low elevation overflights associated with park management or unregulated flights at higher elevations (> 500 ft. above ground level) associated with military training, private planes and commercial aircraft. The larger project area, including the Elwha River watershed, is subject to soundscape impacts from trail clearing (chainsaw use) and occasional overflights. Because no action would be taken in this alternative, no cumulative impacts would occur.

Conclusion: There would be no new impacts, cumulative impacts and no impairment to soundscapes under this alternative.

Visitor Experience
The no action alternative could have a minor impact on visitor experience at Olympic National Park. Providing for visitor enjoyment is one of the elemental purposes of the NPS according to the *Organic Act*. One can assume that reasonable and safe access (roads, trailheads, trails and bridges), some facilities (campsites, bear wires and privies), personal freedoms (the ability to travel off trail, camp wherever one wants, and seek hazardous or unknown areas), solitude (natural sounds and absence of visitors), scenery and wildlife encounters are some of the experiences that would comprise a positive park visitor experience. However, the quality of a visitor experience can be difficult to quantify. What one set of visitors perceives as a positive experience, another set might find detracts greatly from the overall experience. Each visitor seeks his or her own unique experience.

Climate information, current snow conditions, weather and avalanche forecasts are products of high importance to many park and wilderness visitors. Climate stations providing real-time data on the web are routinely accessed by park visitors inquiring about the conditions they might find in park wilderness. Initial scoping of this project found a public interest in real-time climate data from this site. This group of people might, therefore, experience a minor adverse impact to their visitor experience if this project were not completed.

Cumulative Effects: The immediate project area is a large distance from any areas frequented by park visitors. There is no evidence that this area is visited, even occasionally, by park visitors. In the Elwha River watershed, there are existing facilities related to visitor use and administration of the wilderness, including historic structures, trails and trail-related facilities, campsites, and ranger stations. Depending on visitor expectations, these may have either an adverse or beneficial effect on the visitor experience. There are also occasional overflights associated with park maintenance, search and rescue, and fire activities, in addition to

commercial flights. These flights may adversely affect the visitor experience. Since there would be no additional facilities constructed under this alternative, and no additional flights, there would be no cumulative effects to the visitor experience from project flights.

If, in the future, additional facilities are constructed in the park to enhance Washington's climate network because the existing snow measuring devices are inadequate, there could be adverse effects to the visitors from the construction and maintenance of these facilities. Since no facilities would be constructed under this alternative, there would be no cumulative effects.

Conclusion: If no real-time data were available from a SNOTEL installation, there would be an indirect, long-term, but minor impact to visitor experience. There would be no cumulative effects.

Safety and Park Operations

By not placing a SNOTEL in the upper Elwha, this alternative would have a moderate adverse impact to safety and park operations at Olympic National Park. As previously described throughout this document, accurate real-time climate and snowpack data is needed from the interior Olympics for the purposes of more accurately forecasting seasonal river flows, predicting timing and extent of flood and avalanche events, and understanding impacts to park ecosystems from global climate change. Without this project, the park would continue to rely on less accurate, existing models or on indirect methods of data collection such as downstream gauges and glacier mass balance.

Cumulative Effects: There are no additional cumulative safety and operations factors associated with this alternative.

Conclusion: Under the no action alternative, flood forecasting, avalanche forecasting, natural resource studies and research would continue to rely on existing instrumentation and data resulting in an indirect, long-term, moderate adverse impact to safety and park operations at Olympic National Park.

ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVE B: INSTALL A FULL SNOTEL

Under alternative B, a full SNOTEL installation would be placed within the Buckinghorse Ridge area of the Upper Elwha Valley. This installation would include all instrumentation and infrastructure found throughout the SNOTEL network, including a pressure sensing snow pillow, a storage precipitation gauge, an instrument tower, soil moisture and temperature sensors, and a communication shed.

Soils

The proposed action would involve excavation and manipulation of small areas of soil for the installation of the instruments (Table 6). The total area of soil disturbance would be 235 sq. ft. (sq. ft.). Approximately 200 sq. ft. of the disturbance would be surface disturbance associated with leveling the snow pillow site. The additional 35 sq. ft. of disturbance would be caused by excavating for concrete foundations for instrument installations. There would be little potential for soil erosion associated with the disturbance because the site is flat and the majority of the

disturbed area would be replaced with concrete or covered by instrumentation (such as the snow pillow). Site peripheries would be revegetated using salvaged vegetation from disturbed sites. This alternative would result in direct, localized, long-term minor adverse impact to soil resources in the project area.

Table 6. Area of Soil Disturbance for Alternative B

Area of Soil Disturbance – Full SNOTEL Installation	
Installation Type	**Area of Disturbance**
Pressure sensing snow pillow (10 ft. dia., 16 ft. dia. cut & fill)	200 sq. ft.
Storage precipitation gauge (3′ x 3′ square, two- 3′ long x 1′ wide x 1.5′ deep blocks)	9 sq. ft.
Instrument tower (small concrete foundation 18″ dia. x 2.5′ deep)	2 sq. ft.
Communication shed (two- concrete slabs 4’ long x 1 ft. wide x 1.5′ deep) Instrument tower (small concrete foundation 18” dia. x 2.5′ deep)	18 sq. ft.
Soil moisture probes (1′ dia. hole, 1.5′ deep)	3 sq. ft.
Cable trenches (66′ long, 2” width, 6″ deep)	11 sq. ft.
TOTAL	**243 sq. ft.**

Cumulative Effects: The immediate project area currently has few soil impacts. A single elk trail is located adjacent to the site, and while soil is exposed, little erosion is apparent. The total area of disturbance in the immediate area would therefore be 243 sq. ft.

In the greater project area, the Elwha drainage, 137 wilderness campsites and 75 miles of maintained trails are existing sources of soil impact. The average area of soil disturbance associated with a wilderness campsite is 400 sq. ft.; therefore, campsites contribute 54,800 sq. ft. (1.25 acres) of soil disturbance in the Elwha Valley. Assuming average trail tread widths of 2 ft., each mile of maintained trail contains 10,500 sq. ft. of disturbed soil, for a total of 787,500 sq. ft. or 18 acres. Total human-caused soil disturbance is estimated at 798,000 sq. ft. or 18.25 acres. Alternative B would add an additional 243 sq. ft. to this total (the equivalent of half of a wilderness campsite). Because this would result in negligible effects to the soils, it would contribute slightly to the cumulative effects to soils within the Elwha area of the park.

Conclusion: Direct, localized, long-term minor adverse impacts to soil resources would occur in the immediate project area. This alternative would contribute slightly to the cumulative effects of soils within the Elwha area. Because the impacts to soils are minor, there would be no impairment to soils.

Vegetation

The proposed action would involve removal of small areas of vegetation for the installation of the SNOTEL instruments (Table 7). The total area of vegetation disturbance would be 243 sq. ft. This would include removal of 5 conifer saplings and 24 conifer seedlings. Approximately 80 sq. ft. of the disturbed area would be revegetated with salvaged plants. Approximately 155 sq. ft. would remain free of vegetation, replaced with instrument installations. In the event that young trees continued to invade the proposed installation site during the lifetime of the monitoring station, trimming, pruning or removing saplings might be necessary to keep the proposed installation site open. This would prevent any unusual snow loading and thus provide more accurate and consistent data collection. All work would be conducted as advised by the Park’s vegetation specialist. This would result in negligible to minor adverse effects to vegetation.

Table 7. Area of Vegetation Disturbance and Species Disturbed from Alternative B

Area and Type of Vegetation Disturbance – Full SNOTEL Installation		
Installation Type	**Area of Disturbance**	**Species Disturbed # of Saplings Removed**
Pressure sensing snow pillow	200 sq. ft.	huckleberry (*Vaccinium deliciosum*), pink mountain heather (*Phyllodoce empetriformis*) 5 conifer saplings, 23 seedlings
Storage precipitation gauge	9 sq. ft.	huckleberry, pink mountain heather, avalanche lily (*Erythronium montanum*), partridge foot (*Luetkea pectinat*) and rush (*Juncus* sp.) 1 conifer seedling
Instrument tower	2 sq. ft.	huckleberry, pink mountain heather
Communication Shed & Tower	18 sq. ft.	huckleberry, pink mountain heather black sedge (*Carex nigricans*)
Soil Moisture Probes	3 sq. ft.	huckleberry, pink mountain heather
Cable Trenches	11 sq. ft.	huckleberry, pink mountain heather
TOTAL	**243 sq. ft.**	

Cumulative Effects: The immediate project area is estimated at 10,000 sq. ft. (a forest gap approximately 150 ft x 65 ft) or 0.23 acre. This area currently has few areas of impacted vegetation associated with natural erosion or elk travel. The elk trail incorporates approximately 250 sq. ft. of vegetation disturbance (a 500 foot long elk trail, 6 ft. wide). Alternative B would add an additional 243 sq. ft. of disturbance for a total area of disturbance of 493 sq. ft.

In the greater project area in the Elwha drainage, 137 wilderness campsites and 75 miles of maintained trails have impacted native vegetation. The average area of vegetation impact associated with a wilderness campsite is 400 sq. ft.; therefore, campsites contribute 54,800 sq. ft (1.25 acres) of vegetation disturbance in the Elwha Valley. Assuming average trail tread widths of 2 ft., each mile of maintained trail contributes 10,500 sq. ft. of damaged or eliminated vegetation, for a total of 787,500 sq. ft. or 18.3 acres. Total human-caused vegetation disturbance is estimated at 798,000 sq. ft. or 18.31 acres resulting in a minor adverse impact to vegetation in the Elwha Valley. Alternative B would add an additional 243 sq. ft to this total (the equivalent of half of a wilderness campsite). Because alternative B would result in negligible to minor adverse impacts, it would contribute slightly to the overall minor cumulative effects on vegetation.

Conclusion: Direct, localized, long-term, negligible to minor adverse impact to vegetation would occur in the immediate project area. Alternative B would contribute slightly to the long-term minor cumulative impacts. Because the impacts from this alternative would be negligible to minor, there would be no impairment to vegetation.

Wildlife

The installation of SNOTEL instruments under alternative B would disturb small areas of soil and vegetation which may provide food or cover for birds, amphibians and small mammals. This loss of habitat would be minimal, as total affected area would be very small when compared with the amount of similar habitat in the immediate project area. SNOTEL equipment would be located adjacent to elk trails, but would not block or deter travel of large mammals such as elk, deer or bear. The installations would have a local, long-term negligible impact on wildlife resources.

Helicopter flights and camping associated with the initial installation, as well as annual or emergency maintenance flights, would have a direct, short-term impact on some wildlife species. Noise and turbulence from helicopter engines and rotors is extensive and non-natural. It is a reasonable assumption that birds as well as small and large mammals would flee the immediate area in response to this disturbance. Installation of a SNOTEL under this alternative would involve 7 to 9 flights over 2 days. The actual time a helicopter would be on or above the area per flight is approximately 2 minutes per flight, for a maximum of 15 minutes of intense (high decibel) disturbance. Assuming repeated flights every 0.5 hour, total time including intense disturbance and time between disturbances would be 4 hours for 2 days, or 8 hours total. This adverse impact would be localized, short-term and minor.

Annual maintenance flights would entail a single flight each fall. Maintenance would take 2 to 3 hours. Total impact would be 4 minutes of intense, helicopter impact, and 2 to 3 hours of influence from human presence. This impact would be localized, indirect, short-term and negligible.

Emergency maintenance flights would entail a single flight during winter months, a period of time when most wildlife species are absent or dormant. No impacts to wildlife would be associated with this activity.

Cumulative Effects: No other wildlife impacts occur in the immediate project area; therefore the 243 sq. ft. loss of potential habitat and disturbance associated with installation and maintenance are the only impacts to wildlife.

In the greater project area, the Elwha watershed, existing wilderness campsites and maintained trails have impacted the area through visitor presence, maintenance projects and through habitat loss (estimated at 18.25 acres). The Elwha watershed is over 180,000 acres, so the area of impact is a small proportion of the total available habitat. Alternative B would result in 243 sq. ft. of additional habitat disturbance and would be long-term and negligible. Possibly more significant is the popularity of Elwha Valley trails and campsites throughout spring, summer and winter months. Visitor use likely creates some level of disturbance to small mammals, amphibians and birds. Likewise, large mammals such as elk and bear may alter their travel or feeding areas to avoid areas with high human use.

Ongoing park maintenance activities and associated flights can have an adverse effect on wildlife species, especially around landing or drop zones for helicopter operations. Flights are generally scheduled to occur after the key nesting and breeding seasons for most native wildlife; however some flights (such as fire related or search and rescue flights) occur during the summer months. Since the project flights would occur after the critical seasons for most wildlife, they would contribute only slightly to wildlife disturbance associated with ongoing flight activities.

The addition of 8 park staff for 4 days of installation and archeological monitoring would likely be an insignificant increase in total visitor use for the larger project area. The cumulative impact of this alternative, in combination with the ongoing activities in the greater project area, would be short-term, indirect and minor. Because the impacts associated with alternative B would be minor, it would contribute slightly to the overall cumulative effects to wildlife.

Conclusion: Overall, adverse impacts to wildlife species would be direct, localized, short-term and negligible to minor in the immediate project area. Cumulative impacts would be direct, long-term and minor and this alternative would contribute slightly to the cumulative effects. Because impacts would be no more than minor, there would be no impairment to wildlife resources.

Wilderness Values

The proposed project site, a small forested gap on Buckinghorse Ridge, has no evidence of recent human occupation and is miles from the nearest area with evidence of visitor use (e.g., trail corridors, cross-country routes or campsites). It is therefore a prime example of an undisturbed, pristine wilderness where natural and primitive conditions dominate. Placement of modern instruments into this setting would effectively alter the character of this site. Where there was originally a forest gap of primeval character there would be a site with direct evidence of human presence. This effect would be localized because the proposed project site is surrounded by tall, dense, subalpine trees and the site is visible from few other areas of the drainage (see also, visual resources). Direct impacts to wilderness lands from the installation would be less than 0.25 acre, however impacts from distant views could be as great as 1,528 acres, based on the GIS analysis of the viewshed (Figure 6). The view of the installation would have a local, direct, long-term minor adverse impact to wilderness values.

Helicopter flights over park wilderness and landings within park wilderness also create direct impacts to wilderness values. Installation of a full SNOTEL under this alternative would involve 7 to 9 flights over 2 days. During these days, a helicopter would fly above park wilderness for approximately 4 hours, for a total of 8 hours for the total project. The noise associated with helicopter use travels long distances. Helicopter noise would likely intrude upon large portions of the Elwha Valley during the period of installation flights. This impact would be direct, short-term and moderate.

Annual and emergency maintenance flights would entail a single flight each fall, after the busy summer visitor season. On site maintenance would take 2 to 3 hours with a total flight time of 0.5 hour over the Elwha drainage. This adverse impact would be direct, short-term and minor.

Cumulative Effects: The larger project area, defined as the Elwha River watershed, is a popular wilderness destination and an area of great interest to park natural resource managers, local tribes, governments and outside researchers. The popularity of the drainage as a visitor destination and research site means that the larger project area does have existing impacts to wilderness including hiking trails, trail structures, privies, bear wires, ranger stations and scientific instrument installations. These human-made features are concentrated along 75 miles of trail corridors and can have localized impacts to the wilderness landscape. In the upper Elwha drainage, probably the largest wilderness landscape impact is the camp area and ranger station at Low Divide. This open area near the pass is visible from the main trail and several popular climbing destinations in the southwestern Olympics. In addition to these landscape impacts, approximately 1,528 acres of additional park wilderness would be affected by the installation of the SNOTEL, based on the GIS analysis of the viewshed, which would add slightly to the overall cumulative effects.

Helicopters are occasionally used in the Elwha drainage for a variety of park management tasks including trail and bridge construction, search and rescue, wildland fire response and animal (elk, mountain goat and bear) surveys. The number of construction, search and rescue, and fire

response flights varies each year, primarily in response to natural, catastrophic or emergency events out of the control of park management. While no animal (elk, mountain goat and bear) surveys are routinely conducted in the Elwha drainage, there has been regular aircraft use in the last few years associated with short-term research studies. It is conceivable, but not currently planned, that researchers and tribes may request the use of helicopters during and after river restoration to support specific research and monitoring efforts associated with fish recovery or other wildlife species. Annual maintenance flights associated with a proposed SNOTEL would add an average of 0.5 hours to the annual overflights in the park.

Existing facilities, trails, park operations and periodic flights result in adverse, moderate cumulative effects to the wilderness resource. The cumulative adverse impact of alternative B, including the placement of the facility and the annual maintenance flight, would be localized and minor to moderate, and would contribute slightly to the overall cumulative effects.

Conclusion: The installation of a full SNOTEL would have local, direct, long-term minor adverse impacts on wilderness values, and short-term moderate adverse impacts related to helicopter operations. Ongoing cumulative impacts would be short- and long-term and minor to moderate, and this alternative would contribute slightly to the overall cumulative effects. Under this alternative, because long-term impacts would be minor, and short-term impacts would be moderate, there would be no impairment to wilderness values.

Cultural Resources

The proposed action would involve excavation and manipulation of small areas for the installation of the instruments (see Table 6). The total area of soil disturbance would be 235 sq. ft. Approximately 200 sq. ft. would be surface disturbance (12-18 inches deep) associated with leveling the snow pillow site. The additional 32 sq. ft. of disturbance would be excavation associated with concrete foundations for instrument installations.

Archeological surveys within the project area revealed a low density of precontact artifacts in the area proposed for construction of the communication shed. Additional archeological testing and evaluation would be performed prior to installation of the facility. This work would occur within the exact footprint of the proposed instrument shed, where cultural material was identified. Ground disturbance associated with the snow pillow, cable trenches and precipitation gage would be carefully monitored. Following completion of the testing and evaluation the facility could be installed without additional impact to the site area.

Cumulative Effects: The proposed project site has had no recent human disturbance and archeological resources in this area remain intact. A single elk trail roughly bisects the project area, and while soil is exposed, little erosion is apparent. Once installation is completed there would be no additional disturbance to the ground surface. There are no present or reasonably foreseeable future actions that would impact archaeological resources in the immediate area.

Conclusion: This proposed alternative would have a negligible to minor impact on archeological resources. The area of proposed project disturbances is essentially the same as the area that will be tested and evaluated. Archeological testing activities and installation of environmental monitoring units are covered under programmatic exclusion in the NPS nation-wide programmatic agreement. For the purposes of Section 106 and the National Historic Preservation

Act, the determination of effect would be *no adverse effect* and any impacts would be minor. Because there would be no major adverse impacts to cultural resources, there would be no impairment of park resources or values related to archeological resources.

Visual Resources

Visual resources are measured as the potential impact on scenery from the perspective of a park visitor. The expectation of a visitor in the upper Elwha Valley is to have views of pristine landscapes generally free of human influences. Scientific instruments in this setting would adversely impact the visual resources in this area.

The SNOTEL installation would be quite obvious to visitors entering the small clearing of trees; however the lack of recent (non-prehistoric) human evidence, combined with the remoteness of this site make the chances of visitation extremely small. The location of the proposed project site, surrounded by 50 foot tall trees in a forest gap midway down a forested ridge, allows distant views of the site from only a few other areas of the park (Figure 6). These views would be somewhat obscured by brown and green paint on most of the instruments. The single most likely object to be seen would be occasional glimpses of the reflective surface of solar panels on the upper reaches of towers. The likelihood of visitors achieving distant views of the proposed site, however, is fairly rare. None of the areas from which the site is visible fall along existing trails, campsites or climbing destinations. One rarely used cross-country route (Pyrites Creek to Martin's Lake–The Quinault High Route) might allow occasional views of the proposed site although the route generally follows the slope opposite and out of the viewshed of the proposed site. Park visitor use records also indicate this route is rarely used. Total acreage of the Elwha drainage is 180,036 acres. The total acreage of the park with possible views of the proposed site is 1,528 acres. For these reasons, installation of a full SNOTEL facility would have a localized, long-term, but negligible adverse impact to visual resources within the Elwha drainage.

Cumulative Effects: Wilderness travelers using the trail system in the Elwha Valley are likely to expect views of pristine landscapes on the horizon. An additional assumption is that trail facilities, abundant in the Elwha and having existed for many years, are expected by visitors. As long as these facilities are rustic in nature, they should not detract from the visitor's experience of visual resources. The only (modern) climate station currently found in the Elwha drainage is at Hayes River Ranger Station. Instrumentation at this site is minimal and is housed in a rustic enclosure fitting in to the existing landscape. The installation of the proposed SNOTEL could eventually eliminate the need for the climate station at Hayes River, and it would be removed.

Small radio antennas and telemetry stations are located along the Elwha River but are many miles below the project site and carefully hidden. The implementation of this alternative would likely eliminate the need for additional high elevation climate sites in the park. Overall, the impacts of alternative B, when combined with the existing or future planned projects, would result in long-term negligible impacts to visual resources.

Conclusion: Scenic values of the upper Elwha Valley where the proposed installation is visible could be affected in this alternative; however the likelihood of visitation to these areas is extremely small. Due to the small area of the viewshed and the inaccessible nature of this area, the adverse impact is considered local, long-term and negligible. This is the only such facility in the greater project area, so there are no cumulative effects associated with the proposed

installation. Because under this alternative the impacts would be negligible, there would be no impairment to visual resources.

Soundscapes

The project area is dominated by natural sound. The sounds are those associated with natural phenomena such as wind, rain, trickling water, insects and bird song. Instruments that would be installed in this alternative are electronic or hydraulic rather than mechanical and therefore do not create unnatural sounds during day to day operation. Use of helicopters for installation and annual and emergency maintenance, however, will adversely impact the soundscape of the project area.

Installation of a full SNOTEL would involve 7 to 9 helicopter flights over 2 days. Each day during project work, a helicopter would fly over the Elwha Valley for approximately 4 hours, for a total of 8 hours. The noise associated with helicopter use travels long distances. Helicopter noise would intrude upon large portions of the Elwha Valley during the period of installation flights. However, the project would be timed to occur after the primary visitor use season. This impact would be direct, short-term, adverse and minor.

Annual and emergency maintenance flights would entail a single flight each fall, after the busy summer visitor season. On site maintenance would take 2 to 3 hours with a total flight time of 0.5 hour over the Elwha drainage. This impact would be direct, short-term, adverse and minor.

Cumulative Effects: Helicopter and fixed-wing aircraft are occasionally used in the Elwha drainage for a variety of park management tasks including trail and bridge construction, search and rescue, wildland fire response and animal surveys. In addition, military or civilian aircraft overflights (> 500 ft. above ground level) may occasionally occur in the area. These flights would cumulatively affect soundscapes in the greater project area, and occasionally affect sound in the direct vicinity of the project site.

The number of construction, search and rescue, and fire response flights can vary each year, primarily in response to natural, catastrophic or emergency events out of the control of park management. While no animal surveys are routinely conducted in the Elwha drainage, there has been regular aircraft use in the last few years associated with short-term research studies. It is conceivable, but not currently planned, that researchers and tribes may request the use of helicopters during and after river restoration, to support specific research and monitoring efforts associated with fish recovery or other wildlife species. Occasional flights in the Elwha drainage result in short-term, adverse, moderate impacts to the natural soundscapes in the park.

Annual maintenance flights under alternative B would add an average of 0.5 hours to the annual park-related overflights in the park, contributing only slightly to the existing flight operations in the Elwha drainage.

Conclusion: Instruments that would be installed under this alternative would not create unnatural sounds and would have a negligible impact on soundscapes. Helicopter flights associated with the installation and annual maintenance would have a direct, short-term adverse, minor impact on soundscapes. Occasional flights in the Elwha drainage result in short-term, adverse, moderate impacts to the natural soundscapes in the park. This alternative would

contribute slightly to those cumulative effects. Because there would be no major adverse impact under this alternative, there would be no impairment to natural soundscapes.

Visitor Experience

Placing a SNOTEL in the upper Elwha could have minor beneficial or adverse impacts to visitor experience at Olympic National Park. Park managers assume that reasonable and safe access (roads, trailheads, cleared trails and bridges), some facilities (campsites, bear wires and privies), personal freedoms (the ability to travel off trail, camp wherever one wants and seek hazardous or unknown areas), solitude (natural sounds and the absence of visitors), scenery and wildlife encounters are some but not all of the possible items that could comprise a positive park wilderness visitor experience. However, the nature of a visitor experience can be difficult to quantify. What one set of visitors perceives as a positive experience, another set might find detracts greatly from the overall experience. Each visitor seeks his or her own unique park experience.

Climate information, current snow conditions, weather and avalanche forecasts are of high importance to many park wilderness visitors. Climate stations providing real-time data on the web are routinely accessed by park visitors inquiring about the conditions they might find in the backcountry. Initial scoping of this project found a public interest in real-time climate data from this site. This group of people might, therefore, experience a direct, long-term, minor beneficial impact to their visitor experience if this project were completed.

In contrast, some visitors seeking a pristine wilderness experience might happen upon or view the proposed SNOTEL site. Climate instruments, reflecting modern society and its trappings, could have a direct, long-term, minor negative impact on these visitors' experiences. Likewise, some visitors might be negatively affected by the noise of a helicopter flying to maintain the SNOTEL instruments. The adverse impact to solitude and natural sound, important components of some individuals' wilderness experiences, would be short-term, adverse and moderate.

The proposed project site and associated instruments are only visible from a small portion (<1%) of rarely visited park wilderness (see Visual Resources). Installation and maintenance flights could negatively affect the wilderness experience of some visitors hiking within the Elwha Valley on days that flights occur. This impact is mitigated by scheduling flights after the busy visitor season. However there still may be impacts to those visitors in the Elwha drainage who view or hear the flights, resulting in short- or long-term, adverse, minor to moderate effects.

Cumulative Effects: Currently, there is one (modern) climate station found in the Elwha drainage at the Hayes River Ranger Station. Instrumentation at this site is minimal and is housed in a rustic enclosure to minimize visual impact. Since most visitors are unaware of this station and it is not easily viewed, it is not considered to be an impact to visitor experience in the larger project area.

As discussed in the Soundscapes section, annual maintenance and park operational flights can adversely impact visitor wilderness experience. This alternative would add an average of 0.5 hour to the annual overflights in the park, resulting in a minor adverse cumulative effect.

Conclusion: Real-time data and more accurate forecasting from a new SNOTEL installation would create a direct, long-term, minor beneficial effect to the visitor experience. Views of or

visits to the proposed SNOTEL site are highly unlikely, making that potential negative impact to the visitor experience negligible. Helicopter use would be a direct, short-term, moderate adverse impact to park visitors. Cumulative impacts from annual helicopter maintenance flights would be long-term, adverse and moderate, with this alternative contributing slightly to the cumulative effects.

Safety and Park Operations
As previously described throughout this document, accurate real-time climate and snowpack data from the interior Olympics would increase the accuracy of forecasting seasonal river flows, predicting timing and extent of flood and avalanche events, and understanding impacts to park ecosystems from global climate change. Placement of a full SNOTEL in the upper Elwha and its beneficial affect on forecasting accuracy would have a moderate beneficial impact to safety and park operations at Olympic National Park. In contrast, the inherent risk of helicopter flights and staff time to properly mitigate for safety hazards (e.g. safety planning, additional staff for operations) would have a minor negative impact on park safety and operations.

Cumulative Effects: There are no additional cumulative safety and operations factors associated with this alternative.

Conclusion: Safety and natural resource management are vital missions of the NPS. This alternative, by increasing the accuracy of seasonal river flows forecasts, providing better data for predicting timing and extent of flood and avalanche events, and providing baseline data for better understanding impacts to park ecosystems from global climate change, would create an indirect, long-term, moderate beneficial effect to safety and park operations. The inherent risk of helicopter flights and staff time to properly mitigate for safety hazards would have a short-term, direct minor negative impact on park safety and operations.

ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVE C: INSTALL A MODIFIED SNOTEL

Under alternative C, a modified SNOTEL installation would be placed within the Buckinghorse Ridge area of the Upper Elwha Valley. This installation would include most instrumentation and infrastructure commonly used throughout the SNOTEL network; however the communication shed would be replaced with a single tower with mounted, water proof boxes to protect transducers, telecommunications and power supply equipment.

Soils
The proposed action would involve excavation and manipulation of a slightly smaller area of soil than alternative B (table 8). The total area of soil disturbance would be 227 sq. ft. (16 sq. ft. less than alternative B). Approximately 200 sq. ft. of the total area of disturbance would be surface disturbance associated with leveling the snow pillow site. The additional 27 sq. ft. of disturbed area would be excavation associated with concrete foundations for instrument installations. There would be little potential for soil erosion, as the majority of areas would be replaced with concrete or covered by instrumentation (such as the snow pillow). Site peripheries would be revegetated using salvaged vegetation from excavated sites. This alternative would result in direct, localized, long-term minor adverse impact to soil resources in the project area.

Table 8. Area of Soil Disturbance for Alternative C

Area of Soil Disturbance – Modified SNOTEL Installation	
Installation Type	**Area of Disturbance**
Pressure sensing snow pillow (10′ dia., 16′ dia. cut & fill)	200 sq. ft.
Storage precipitation gauge (3′x 3′ square, two- 3′ long x 1′ wide x 1.5′ deep blocks)	9 sq. ft.
Instrument tower (small concrete foundation 18″ dia. x 2.5′ deep)	2 sq. ft.
Communication instrument tower (concrete foundation 18″ dia. x 2.5′ deep)	2 sq. ft.
Soil moisture probes (1′ dia. hole, 1.5′ deep)	3 sq. ft.
Cable trenches (20′ long , 2″ wide, 6″ deep)	11 sq. ft.
TOTAL	**227 sq. ft.**

Cumulative Effects: Cumulative effects would be the same as described under alternative B. alternative C would add an additional 227 sq. ft. to existing total disturbance (the equivalent of half of a wilderness campsite). Because this alternative would result in minor effects to the soils in the project area, it would contribute slightly to the cumulative effects on soils within the Elwha area of the park.

Conclusion: This alternative would result in direct, localized, long-term, minor adverse impacts to soil resources in the immediate project area. This alternative would contribute slightly to the cumulative effects to soils within the Elwha area. Because the impacts to soils are minor, there would be no impairment to soils.

Vegetation

This alternative would result in the removal of a slightly smaller area of vegetation than the full SNOTEL installation (alternative B). The total area of vegetation disturbed would be reduced by 16 sq. ft. (from 243 sq. ft. to 227 sq. ft.). Removal of 5 conifer saplings and 24 conifer seedlings would still be required. Approximately 88 sq. ft. of the disturbed vegetation area would be revegetated with salvaged plants. The remaining 139 sq. ft. would remain free of vegetation, replaced with instrument installations. This would result in negligible to minor adverse effects to vegetation.

Table 9. Area of Vegetation Disturbance and Species Disturbed for Alternative C

Area and Type of Vegetation Disturbance – Modified SNOTEL Installation		
Installation Type	**Area of Disturbance**	**Species Disturbed # of Saplings Removed**
Pressure sensing snow pillow	200 sq. ft.	huckleberry, pink mountain heather 5 conifer saplings, 23 seedlings
Storage precipitation gauge	9 sq. ft.	huckleberry, avalanche lily, partridge foot and rush 1 conifer seedling
Instrument tower	2 sq. ft.	huckleberry, pink mountain heather
Communication instrument tower	2 sq. ft.	huckleberry, pink mountain heather
Soil moisture probes	3 sq. ft.	huckleberry, pink mountain heather
Cable trenches	11 sq. ft.	huckleberry, pink mountain heather, black sedge
TOTAL	**227 sq. ft.**	

Cumulative Effects: The immediate project area was estimated to be 10,000 sq. ft. (a forest gap approximately 150 ft x 65 ft) or 0.23 acre. This area currently has only a few areas of impacted

vegetation associated with natural erosion or elk travel. Existing vegetation impacts associated with the elk trail is estimated at 250 sq. ft. alternative C would add an additional 227 sq. ft. of impact for a total area of disturbance of 577 sq. ft.

Cumulative effects are the same as described under alternative B. alternative C would add an additional 227 square feet to this total. Because alternative C would result in negligible to minor adverse impacts, it would contribute slightly to the overall minor cumulative effects on vegetation.

Conclusion: Direct, localized, long-term, negligible to minor impacts to vegetation would occur in the immediate project area. Alternative C would contribute slightly to the long-term minor cumulative impacts. Because the impacts from this alternative would be negligible to minor, there would be no impairment to vegetation.

Wildlife

The installation of a modified SNOTEL would disturb small areas of soil and vegetation which may provide food or cover for birds, amphibians and small mammals. The total loss of habitat would be 16 sq. ft. less than alternative B. Loss of habitat would be minimal, as total affected area would be small when compared to the amount of similar habitat in the immediate project area. SNOTEL equipment would be located adjacent to elk trails, but would not block or deter travel of large mammals such as elk, deer or bear. The installations would have a local, long-term negligible impact on wildlife resources.

Helicopter flights and camping associated with the initial installation, as well as annual or emergency maintenance flights, would have a direct, short-term adverse impact on some wildlife species. Noise and turbulence from helicopter engines and rotors is extensive and non-natural. It is a reasonable assumption that birds as well as small and large mammals would flee the immediate area in response to this disturbance. Installation of a modified SNOTEL would require one less load (plywood and lumber for the communications shed) than the full SNOTEL (alternative B) resulting in a total of 6 to 8 flights over 2 days. The actual time a helicopter would be on or above the area per flight is approximately 2 minutes per flight, for a maximum of 16 minutes of intense disturbance. Assuming repeated flights every 0.5 hour, total time of intense disturbance combined with time between would be approximately 3.5 hours for 2 days, or 7 hours (alternative B resulted in 8 hours total). This adverse impact would be localized, short-term and minor.

Annual maintenance flights would entail a single flight each fall. Maintenance would take 2-3 hours. Total impact would be 4 minutes of intense helicopter noise, and 2 to 3 hours of influence from human presence. This impact would be localized, short-term and negligible.

Emergency maintenance flights would entail a single flight during winter months, a period of time when wildlife species are absent or dormant. No impacts to wildlife would be associated with this activity.

Cumulative Effects: No other wildlife impacts occur in the immediate project area, therefore the 227 sq. ft. loss of potential habitat and disturbance associated with installation and maintenance are the only impacts to wildlife.

In the greater project area, as described under alternative B, the Elwha watershed contains wilderness campsites and maintained trails that have impacted wildlife habitat. Total habitat loss within the drainage from human impact is estimated at 18.25 acres. The Elwha watershed is over 180,000 acres so the proportion of disturbance when compared to the total available habitat would be small. Alternative C would result in 227 sq. ft. of additional habitat disturbance and would be long-term and negligible. Possibly more significant is the popularity of Elwha Valley trails and campsites throughout spring, summer and winter months. Visitor use likely creates some level of disturbance to small mammals, amphibians and birds. Likewise, large mammals such as elk and bear may alter their travel or feeding areas to avoid areas with high human use.

Ongoing park maintenance activities and flights can have an adverse effect on wildlife species, particularly in and around the landing or drop zones for helicopter operations. Flights are generally scheduled to occur after the key nesting and breeding seasons for most native wildlife; however some flights (such as fire related or search and rescue flights) occur during the summer months. Since the project flights would occur after the critical seasons for most wildlife, they would contribute only slightly to wildlife disturbance associated with ongoing flight activities.

The addition of 8 park staff for 4 days of installation and archeological monitoring would likely be an insignificant increase in total visitor use for the larger project area. The cumulative impact of this alternative in combination with the ongoing activities in the greater project area would be short-term, direct and minor. Because the impacts associated with alternative C would be minor, it would contribute slightly to the overall cumulative effects to wildlife.

Conclusion: Overall, adverse impacts to wildlife species would be direct, localized, short-term and negligible to minor in the immediate project area. Cumulative impacts would be direct, long-term and minor, and this alternative would contribute slightly to the cumulative effects. Because impacts would be no more than minor, there would be no impairment to wildlife resources.

Wilderness Values

The proposed project is an undisturbed, pristine wilderness where natural and primitive conditions dominate. Placement of a modified SNOTEL, while having a slightly smaller (16 sq. ft.) footprint and incorporating one less structure, would still effectively alter the wilderness character of this site. Where there was originally a forest gap of primeval character there would now be a site with direct evidence of human presence. This effect would be localized as the proposed project site is surrounded by tall, subalpine trees and is visible from few other areas of the drainage (see also, Visual Resources). Direct impacts to wilderness lands from the installation would be less than 0.25 acre and impacts from distant views could be as great as 1,528 acres. The installation would have a local, direct, long-term minor adverse impact to wilderness values.

Helicopter flights over park wilderness and landings within park wilderness also create direct impacts to wilderness values. Installation of a modified SNOTEL under this alternative would involve 6 to 8 flights over 2 days, one less flight than with alternative B (Full SNOTEL). Each day, a helicopter would fly above park wilderness for approximately 3.5 hours, for a total of 7 hours for project work. The noise associated with helicopter use travels long distances. Helicopter noise will likely intrude upon the majority of the Elwha Valley during the period of installation flights. This impact would be direct, short-term and moderate.

Annual and emergency maintenance flights would entail a single flight each fall, after the busy summer visitor season. On site maintenance would take 2-3 hours with total flight time of 0.5 hour over the Elwha drainage. Due to the unknown suitability of this modified SNOTEL design for deep, northwest snowpacks, SNOTEL technicians may require several additional visits over the first 2 to 3 years to conduct additional emergency repairs and equipment replacement. This could effectively add 2 to 5 additional flights. Although possibly requiring several additional flights and visits, adverse impacts associated with maintenance flights in alternative C would still be considered direct, short-term and minor.

Cumulative Effects: As described under alternative B, the larger project area, defined as the Elwha River watershed, is a popular destination and an area of great interest to park and non-park resources managers. The popularity of the drainage as a visitor destination and research site means that the larger project area does have existing impacts to wilderness including hiking trails, trail structures, privies, bear wires, ranger stations and scientific instrument installations. These human-made features are concentrated along 75 miles of trail corridors and can have localized impacts to the wilderness landscape. In the upper Elwha drainage, probably the largest wilderness landscape impact is the camp area and ranger station at Low Divide. This open area near the pass is visible from the main trail and several popular climbing destinations in the southwestern Olympics. In addition to these landscape impacts, approximately 1,528 acres of additional park wilderness would be affected by the installation of the SNOTEL, based on the GIS analysis of the viewshed, which would add slightly to the overall cumulative effects.

Helicopters are occasionally used in the Elwha drainage for a variety of park management tasks including trail and bridge construction, search and rescue, wildland fire response and animal surveys. The number of flights can vary each year, primarily in response to natural, catastrophic or emergency events out of the control of park management. While no animal surveys are routinely conducted in the Elwha drainage, there has been regular aircraft use in the last few years associated with short-term research studies. It is conceivable, but not currently planned, that researchers and tribes may request the use of helicopters during and after river restoration to support specific research and monitoring efforts associated with fish recovery or other wildlife species.

Existing facilities, trails, park operations and periodic flights results in adverse, moderate cumulative effects to the wilderness resource. The cumulative adverse impact of alternative C, including the placement of the facility and the annual maintenance flight, would be localized and minor to moderate, and would contribute slightly to the overall cumulative effects.

Conclusion: The installation of a modified SNOTEL would have local, direct, long-term minor adverse impacts on wilderness values, and short-term moderate adverse impacts related to helicopter operations. Existing cumulative impacts would be indirect, short- and long-term and minor to moderate, and this alternative would contribute slightly to the overall cumulative effects. Under this alternative, because long-term impacts would be minor, and short-term impacts would be moderate, there would be no impairment to wilderness values.

Cultural Resources

The proposed action would involve excavation and manipulation of a slightly smaller area of soil for the installation of the instruments than alternative B, (see Table 8). The total area of soil disturbance would be 219 sq. ft. Approximately 200 sq. ft. of that disturbance would be surface disturbance associated with leveling the snow pillow site. The additional 19 sq. ft. of disturbed area would be excavation associated with concrete foundations for instrument installations. There would be little potential for soil erosion associated with the disturbance. The majority of areas would be replaced with concrete or covered by instrumentation (such as the snow pillow). Site peripheries would be revegetated using salvaged vegetation from disturbed sites.

An archeological survey within the project area revealed a low density of precontact artifacts in the area proposed for construction of the communication shed. Additional archeological testing and evaluation would be performed prior to installation of the facility. This work would occur within the exact footprint of the proposed instrument tower, where cultural material was identified. Ground disturbance associated with the snow pillow, cable trenches and precipitation gage would be carefully monitored. Following completion of the testing and evaluation the facility could be installed without additional impact to the site area.

Cumulative Effects: The proposed project site has had no recent human disturbance and archeological resources in this area remain intact. A single elk trail roughly bisects the project area, and while soil is exposed, little erosion is apparent. There are no present or reasonably foreseeable future actions that would impact archaeological resources. Once installation is completed there will be no additional disturbance to the ground surface. The total area of disturbance in the immediate area would therefore be 219 sq. ft.

Conclusion: This alternative would have a negligible to minor impact on archeological resources. The area of proposed project disturbances is essentially the same as the area that will be tested and evaluated. Archeological testing activities and installation of environmental monitoring units are covered under programmatic exclusion in the NPS nation-wide programmatic agreement. For the purposes of Section 106 and the National Historic Preservation Act, the determination of effect would be *no adverse effect* and any impacts would be minor. Because there would be no major adverse impacts, there would be no impairment of park resources or values related to archeological resources.

Visual Resources

Visual resources are measured as the potential impact of scenery from the perspective of a park visitor. The expectation of a visitor in the upper Elwha Valley is to have views of pristine landscapes generally free of human influences. Scientific instruments in this setting would effectively impact the visual resources in this area.

A modified SNOTEL installation would result in the same impacts to visual resources as the full SNOTEL installation described under alternative B.

Cumulative Effects: Cumulative effects would be the same as described under alternative B.

Conclusion: Scenic values of the upper Elwha Valley where the proposed installation is visible could be impacted in this alternative; however the likelihood of visitation to these areas is

extremely small, and due to the small area of the viewshed and the inaccessible nature of this area, the adverse impact is considered local, long-term and negligible. This is the only such facility in the greater project area, so there are no cumulative effects associated with the proposed installation. Because under this alternative the impacts would be negligible, there would be no impairment to visual resources.

Soundscapes
The project area is dominated by natural sound. Instruments installed as part of a modified SNOTEL are electronic or hydraulic rather than mechanical, and therefore do not create unnatural sounds when operating. Use of helicopters for installation and annual and emergency maintenance, however, will impact the soundscape of the project area. The effects to the natural soundscape would be very similar to those described under alternative B, with one less flight required for installation. On two days, a helicopter would fly over the Elwha Valley for approximately 3.5 hours, for a total of 7 hours. Helicopter noise would intrude upon large portions of the Elwha Valley during the period of installation flights. However, the project would be timed to occur after the primary visitor use season. This impact would be direct, short-term, adverse and minor.

Annual and emergency maintenance flights would generally entail a single flight each fall. However, the modified SNOTEL is an untested design in this region and there is a possibility that additional emergency maintenance flights might be required in the first few years after installation, resulting in more flights than needed in alternative B and increased adverse effects to the soundscape from the use of helicopters. The adverse impact of these flights would be direct, short-term and minor to moderate.

Cumulative Effects: The ongoing and future planned activities that could result in impacts to the natural soundscape are described under alternative B. Under this alternative, there could be more flights related to long-term maintenance of the facility, thus resulting in increased adverse impacts.

Conclusion: Instruments that would be installed under this alternative would not create unnatural sounds and would have a negligible impact on soundscapes. Helicopter flights associated with the installation and annual maintenance would have a direct, short-term adverse, minor to moderate impact on soundscapes. Occasional flights in the Elwha drainage result in short-term, adverse, moderate impacts to the natural soundscapes in the park. This alternative would contribute slightly to those cumulative effects. Because there would be no major adverse impact under this alternative, there would be no impairment to natural soundscapes.

Visitor Experience
This alternative would have the same impacts to the visitor experience as those described under alternative B.

Cumulative Effects: The cumulative effects of this alternative would be the same as described under alternative B.

Conclusion: Real-time data and more accurate forecasting from a new SNOTEL installation would create an indirect, long-term, minor beneficial effect to the visitor experience. Views of or visits to the proposed SNOTEL site are highly unlikely, making that potential negative impact to

the visitor experience negligible. Helicopter use would be a direct, short-term, moderate adverse impact to park visitors. Cumulative impacts from annual helicopter maintenance flights would be long-term, adverse, and moderate, with this alternative contributing slightly to the cumulative effects.

Safety and Park Operations

Placement of a full SNOTEL in the upper Elwha and its beneficial effect on forecasting accuracy would have a moderate beneficial impact to safety and park operations at Olympic National Park. The experimental nature of the modified SNOTEL site used under this alternative would have a higher probability of instrument failure. This could result in this installation not always providing the information necessary to allow for the increased accuracy for forecasting. For this reason, beneficial impacts could be less than in alternative B. The inherent risk of helicopter flights and the staff time to properly mitigate for safety hazards (e.g. safety planning, additional staff for operations) would have a minor negative impact on park safety and operations.

Cumulative Effects: There are no additional cumulative safety and operations factors associated with this alternative.

Conclusion: Safety and natural resource management are vital missions of the NPS. This alternative, by increasing the accuracy of seasonal river flows forecasts, providing better data for predicting timing and extent of flood and avalanche events, and providing baseline data for better understanding impacts to park ecosystems from global climate change, would create an indirect, long-term, moderate beneficial effect to safety and park operations. In contrast, the inherent risk of helicopter flights and the staff time to properly mitigate for safety hazards (e.g. safety planning, additional staff for operations) would have a minor negative impact on park safety and operations.

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Chapter 5: Consultation and Coordination

A scoping letter initiating public scoping and describing the project was issued on February 7, 2007 (Appendix B). The press release was sent to approximately 50 media outlets, interested groups, public officials, agencies, and individuals in the Puget Sound and Olympic Peninsula area. Comments were solicited during a public scoping period that ended March 9, 2007. Six responses were received. Comments received were generally in support of the project, although one organization expressed opposition and one individual expressed ambivalence, questioning the need for the project. Commenters expressed concern about the impacts a SNOTEL placement would have on park wilderness. There was interest in the park carefully choosing an appropriate site which would minimize the footprint on the land and would be hidden from public view. Individuals also desired direct benefits such as real-time access to data.

Agencies and Individuals Consulted

Agencies and organizations contacted to assist in identifying issues and provided an opportunity to review or comment on this EA include, but are not limited to, the following:

Federal Agencies

Department of Agriculture, Natural Resource Conservation Service
National Water and Climate Center

Department of Agriculture, U.S. Forest Service
Olympic National Forest

Department of Commerce
National Oceanic and Atmospheric Administration
Olympic Coast National Marine Sanctuary

Department of Interior
U.S. Fish and Wildlife Service, Western Washington Office

Department of Transportation
Federal Highway Administration

Congressional Representatives

Senator Parry Murray
Senator Maria Cantwell
Senator Jim Hargrove
Rep. Norm Dicks
Rep. Lynn Kessler

State Agencies

Department of Natural Resources
Department of Ecology
Department of Fish and Wildlife
Department of Parks and Recreation
Office of Archeology and Historic Preservation

Local Agencies

Port Angeles Chamber of Commerce
Forks Chamber of Commerce
Grays Harbor Chamber of Commerce
Clallam Bay-Sekiu Chamber of Commerce
Grays Harbor County Commissioners
Jefferson County Commissioners
City of Sequim
City of Forks
City of Hoquiam

American Indian Tribes

Lower Elwha Klallam Tribe
Jamestown S'Klallam Tribe
Port Gamble S'Klallam Tribe
Hoh Tribal Business Council
Quileute Tribal Council
Quinault Indian Nation
Point No Point Treaty Council

Organizations and Businesses

Clallam Networks Economic Development Council
Conservation Northwest
Friends of Lake Crescent
Institute for Policy Research
National Audubon Society
National Parks and Conservation Association-NW Regional District
North Cascades Conservation Council
North Olympic Peninsula Resource Conservation & Development Council
Northwest Ecosystem Alliance
Olympic Forest Coalition
Olympic Natural Resource Center
Olympic Park Associates
Olympic Peninsula Audubon Society
Olympic Peninsula Intertribal Cultural Advisory Committee
Olympic Region Clean Air Agency
Protect the Peninsula's Future
Sierra Club-Cascade Chapter
Sunnydell Shooting Grounds
The Wilderness Society
Washington Environmental Council
Washington's National Park Fund
Wilderness Watch

Area Libraries

North Olympic Library System
- Port Angeles Branch
- Sequim Branch
- Forks Branch
- Clallam Bay Branch

Timberland Regional Library
Aberdeen Branch
Amanda Park Branch
Hoquiam Branch
Kitsap Regional Library
Seattle Public Library
The Evergreen State College Library
University of Washington Library
Washington State University Library

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Steve Acker, Botanist, Olympic National Park
Ruth Scott, Wilderness Specialist, Olympic National Park
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2002 *Wild Basin Snow Survey Improvement Project Environmental Assessment*, prepared by Rocky Mountain National Park and the Natural Resources Conservation Service, Colorado, August 2002

2005 *Olympic National Park Draft General Management Plan and Environmental Impact Statement*. Olympic National Park, Port Angeles, Washington

2006 *Weather and Climate Inventory National Park Service North Coast and Cascades Network*, Natural Resource Technical Report NPS/NCCN/NRTR—2006/010,

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APPENDICES

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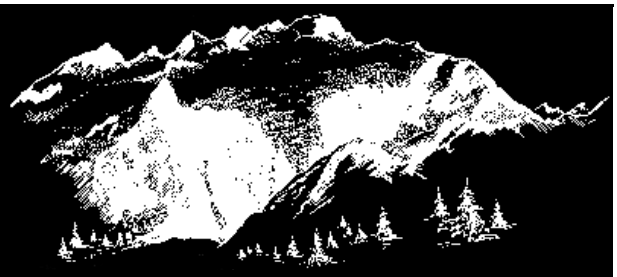
Appendix A
Wilderness Minimum Requirement Analysis

Minimum Requirement Worksheet

Olympic National Park Wilderness



March 15, 2005 Version

Issue to be Addressed: Installation of a high elevation SNOTEL in the upper Elwha Valley to verify a NASA snowpack model, provide critical data for managing the Elwha and westside Olympic Rivers, and fill important data gap in the park's long-term climate program.

Background: Olympic National Park is mandated to provide accurate scientific information for management of park resources. Climate data is critical to understanding and interpreting a wide variety of research and monitoring activities, including wilderness management and protection. Climate was one of the highest ranked items in a prioritized list for the Olympic National Park Vital Signs program and is considered a necessary component. A panel of scientists evaluating the park's climate program rated the addition of several high elevation SNOTEL sites the number one climate monitoring priority for this park. In addition, the NPS Pacific West regional director recently referred to global climate change as "the most challenging resource management issue confronting the National Parks in the West" and has specified it is a high priority to understand "the current and potential effect of climate change on park resources, explore the management implications of these changes, and begin to frame strategies for future action."

The Olympic Mountains have one of the steepest precipitation gradients in North America, and the rugged, complex topography makes the use of models for understanding ONP's microclimates extremely difficult. This complex topography also limits the usefulness of the small cluster of existing SNOTEL sites located outside of wilderness on the north and east sides of the park. Snow conditions at high elevations on the west side and interior of the park are largely unknown. One well established climate modeler referred to this data as "the holy grail of northwest climate." [Christopher Daly, developer of the PRISM spatial climate modeling system, pers. comm.]

NASA and associated researchers are developing remote sensing methods that may help scientists estimate water equivalent in mountain snowpacks; however these models require additional development and the use of on-site instrumentation to verify results. One of the purposes of installing this proposed SNOTEL is to test the accuracy of a model which use remote sensing and meteorological data for estimating snowpack. If this site helps to verify the model, it is likely to reduce the need for additional instrumentation within Olympic National Park and other wilderness areas.

Snowpack data has been collected by federal scientists since 1935 and in Olympic National Park since 1949 (Deer Park, Cox Valley and Hurricane Ridge). Before the development of the reliable, automated instruments found in a SNOTEL installation, monthly snow surveys were

conducted to assess snowpack conditions. Park staff currently conduct snow surveys in areas that can be safely reached during winter months (Deer Park, Hurricane); however, in remote areas, access by foot is generally not feasible (unless accessed by helicopter–see Alternative 3).

Several years ago, National Resource Conservation Service (NRCS) staff worked closely with Rocky Mountain National Park to create an adequate, minimum requirement snow monitoring site. This site used new technology (gamma sensors and an optical rain gauge), which resulted in a much reduced footprint and less visual impact. The gamma sensors were unreliable and problematic, however. In addition, the manufacturer stopped supporting the instruments, and newer more reliable ones were not created. After several years of poor performance and lost data, the NRCS returned to a traditional snow pillow at these sites. The optical rain gauges worked well, but they consumed more power than the sites could generate, even with a large array of solar panels and over 300 days of sunlight a year. Loss of power and the inability to easily replace batteries mid-winter (without constant helicopter support) caused the NRCS and NPS to return to use of a storage precipitation gauge.

The most effective and reliable method for collection of hourly snowpack and climate data is the installation of a full SNOTEL. Automated SNOTEL stations began replacing manual snow courses in the mid-1980s. For the last 25 years, the SNOTEL network has grown to over 700 sites in remote, mountainous areas throughout the western United States.

The primary reason automated stations have replaced manual surveys is the wealth of detailed, “real-time” information that can be collected and relayed by a SNOTEL. Traditionally, monthly snowpack data is used to develop water supply forecasts. These are issued for 4 month periods following each snow survey. Water users and land managers rely on these forecasts to implement water or fisheries management decisions. According to many forecast users, the greatest shortcomings of the current water supply forecasts is that they are based on monthly data and do not provide daily guidance in changing situations. The North Olympic Peninsula Resource Conservation & Development Council received grant money to pursue installation of this SNOTEL and development of a more detailed model, specifically because they felt a compelling need to improve long and short-term decisions by creating a model to provide daily, rather than monthly, data. Real-time data is also critical for the forecasting of extreme weather events. The National Weather Service and Northwest Avalanche Center rely on remote hourly data to make provide winter flood and avalanche forecasts for use by the public and government agencies.

Project Initiator(s): Olympic Peninsula Resource Conservation & Development Council, Scott Pattee (USDA-NRCS) and Bill Baccus (Olympic National Park)

MRW Preparer(s): Bill Baccus Updated: 8/21/07

STEP ONE: Determine if action is necessary

1 Is the resolution of this issue covered by a Categorical Exclusion, Environmental Assessment/Finding of No Significant Impact, or an Environmental Impact Statement/Record of Decision that includes minimum requirement considerations?

Answer: Yes____ No__**X**__

Yes → Implement action as approved

No → Continue MRW and include in environmental analysis

2 Is this an emergency?

Answer: Yes____ No__**X**__

Yes → Follow approved emergency SOPs/management plans. If they do not exist or have not gone through MRW, continue MRW.

No

Emergency: A situation that involves inescapable urgency and temporary need for speed beyond that available by primitive means (loss of human life or serious injury, staff safety, law enforcement efforts involving serious crime or fugitive pursuit, retrieval of the deceased, fire suppression).

3 Is resolution of this issue addressed in an approved Wilderness Plan? (or equivalent plan that included MR considerations?)

Answer: Yes____ No__**X**__

Yes → Follow plan direction

No

Cite Wilderness Plan or equivalent plan section/page:

4	Is resolution of this issue necessary or appropriate to meet wilderness management objectives or the requirements of other laws, policies and directives? Yes No Do not proceed with action	Answer: Yes__**X**_ No____ Explain: Collection of remote climate data is considered an important component of ONP's Vital Signs monitoring program. Mountain snowpack is one of the most important system drivers in Olympic, affecting the wilderness and virtually all aquatic and many forest ecosystems and their associated flora and fauna. Snowpack is also known to be one of the drivers most affected in the Pacific Northwest by impending global warming, an important strategic issue recently listed by the NPS Pacific West Regional Director. Currently, only a single site (at Hurricane Ridge) collects snowpack data in the park, and virtually nothing is known about snowpack in the interior or on the west side of the park. For these reasons, a panel of scientists evaluating the park's climate program recently rated the addition of several high elevation SNOTEL sites the number one climate measurement priority for Olympic National Park.
5	Can the issue be resolved through visitor education? Yes No Carry out visitor education	Answer: Yes____ No__**X**_ Explain:
6	Can the issue be resolved through actions outside of wilderness? Yes No Conduct actions outside wilderness Continue on next page	Answer: Yes____ No__**X**_ Explain: Several SNOTEL stations occur outside of the park on the north and east sides of the Olympic Range. These areas, however, occur on the drier, "rainshadow" slopes of the Olympic Range where precipitation averages less than 60 inches per year. Models indicate that the majority of ONP and a large portion of the Elwha Valley receive far more rainfall, averaging 80 to 200 inches annually. No SNOTELs or manual measurements currently exist in this "wet zone" of the Olympic Mountains. ONP wilderness encompasses virtually all of the west side and interior areas above 4000' on the Olympic Peninsula. The result is that no areas exist for snowpack measurements except within the park's wilderness.

STEP TWO: Determine the minimum tools, techniques and actions that will effectively resolve the issue

7	List guidance provided in law and policy for resolution of the issue (use in development of #8 below)	See Management Policies Chapter 6 and Director's Order #41

National Parks Omnibus Management Act of 1998

This act gave National Parks clear guidance to use sound scientific methods to better achieve the park service mission.

Section 101 describes protection, interpretation, and research in the national park system:

Recognizing the ever increasing societal pressures being placed upon America's unique natural and cultural resources contained in the National Park System, the Secretary shall continually improve the ability of the National Park Service to provide state-of-the-art management, protection, and interpretation of and research on the resources of the National Park System.

Section 201 describes the purposes of a park inventory and monitoring program:

1. to more effectively achieve the mission of the National Park Service;
2. to enhance management and protection of national park resources by providing clear authority and direction for the conduct of scientific study in the National Park System and to use the information gathered for management purposes;
3. to ensure appropriate documentation of resource conditions in the National Park System;
4. to encourage others to use the National Park System for study to the benefit of park management as well as broader scientific value, where such study is consistent with the Act of August 25, 1916 (commonly known as the National Park Service Organic Act; 16 U.S.C. 1 et seq.); and
5. to encourage the publication and dissemination of information derived from studies in the National Park System.

Section 202*. The Secretary [of the Interior] is authorized and directed to assure that management of units of the National Park System is enhanced by the availability and utilization of a broad program of the highest quality science and information.*

NPS Management Policies 2006

4.2 Studies and Collections*: The Service will encourage appropriately reviewed natural resource studies whenever such studies are consistent with applicable laws and policies. These studies support the NPS mission by providing the Service, the scientific community, and the public with an understanding of park resources, processes, values, and uses that will be cumulative and constantly refined.*

4.2.1 NPS-conducted or -sponsored Inventory, Monitoring, and Research Studies:
The Service will

- identify, acquire, and interpret needed inventory, monitoring, and research, including applicable traditional knowledge, to obtain information and data that will help park managers accomplish park management objectives provided for in law and planning documents;
- define, assemble, and synthesize comprehensive baseline inventory data describing the natural resources under NPS stewardship, and identify the processes that influence those resources;
- use qualitative and quantitative techniques to monitor key aspects of resources and processes at

regular intervals;
- analyze the resulting information to detect or predict changes (including interrelationships with visitor carrying capacities) that may require management intervention and provide reference points for comparison with other environments and time frames; and
- use the resulting information to maintain—and where necessary restore—the integrity of natural systems.

Section 6.3.6 Scientific Activities*: The statutory purposes of wilderness include scientific activities, and these activities are encouraged and permitted when consistent with the agency's responsibilities to preserve and manage wilderness.*

Section 6.3.6.1 General Policy*: The National Park Service has a responsibility to support appropriate scientific activities in wilderness, and to use science to improve wilderness management. The National Park Service recognizes that wilderness can and should serve as an important resource for long-term research, study, and observation of ecological processes and the impact of humans on these ecosystems. The National Park Service further recognizes that appropriate scientific activities may be critical to the long-term preservation of wilderness.*

Scientific activities are to be encouraged in wilderness. Even those scientific activities (including inventory, monitoring, and research) that involve a potential impact to wilderness resources or values (including access, ground disturbance, use of equipment, and animal welfare) should be allowed when the benefits of what can be learned outweigh the impacts on the wilderness resource or values. However, all such activities must also be evaluated using the minimum requirement concept and include documented compliance that assesses impacts against benefits to wilderness.

Research and monitoring devices (e.g., video cameras, data loggers, 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.

Park Managers will work with researchers to make NPS wilderness area research a model for the use of low-impact, less intrusive techniques. New technology and techniques will be encouraged if they are less intrusive and cause less impact. The goal will be for studies in NPS wilderness to lead the way in "light on the resource" techniques.

Devices located in wilderness will be removed when determined to be no longer essential. Permanent equipment caches are prohibited within wilderness. Temporary caches must be evaluated using the minimum requirement concept.

All scientific activities, including the installation, servicing, removal, and monitoring of research devices, will apply minimum requirement concepts and be accomplished in compliance with *Management Policies*, director's orders, and procedures specified in the park's wilderness management plan.

8	Describe in detail alternative ways to resolve the issue (include use of primitive tools and skills)

Note: Alternatives described in other compliance documents that address this issue may be referenced. If minimum requirement considerations were not included, develop below.

Questions to answer for each alternative:
- What is proposed?
- Where will the action take place?
- When will the action take place?
- What design and standards will apply?
- What methods, tools and techniques will be used?
- How long will it take to complete the action?
- Why is it being proposed in this manner?
- What mitigation will be taken to minimize action impacts on wilderness resources and character?

Alternative 1: No Action

Park managers, visitors, researchers, tribes, and local governmental agencies would rely on data from existing SNOTEL sites (outside of wilderness), remote sensing, and current models to estimate snowpack. Snowpack data from west or interior portions of the park would not be collected.

Alternative 2: Conduct Routine Snow Surveys by foot travel in place of a SNOTEL installation.

Snowpack data would be collected using routine snow surveys and foot travel in place of a SNOTEL installation. This alternative would require establishment of a marked transect or "snow course" in an open area that would be visited by 2 people traveling on ski or snowshoe. Using a hand held instrument known as a "federal sampler," the data collectors would take manual measurements of snow depth and snow water equivalent at the beginning of each month considered most relevant to spring and summer stream flows (Feb, March, April, May). Reaching areas of the upper Elwha would require a 3-4 day backpack trip to reach the base of the sampling area. Staff would then have to travel cross-country uphill 4000' feet and go across or near avalanche-prone slopes.

Alternative 3: Conduct routine Snow Surveys with helicopters, in place of a SNOTEL installation.

Snowpack data would be collected using routine snow surveys, and staff and sampling equipment would be transported by helicopter. Data would be collected using the methods described in Alternative 2. Helicopters would fly over and land in park wilderness 4 times annually (in Feb, March, April, and May).

Location Discussion for Alternatives 4-6 (Placement of a SNOTEL)

Measurement of environmental parameters, such as precipitation and snowpack, require careful placement of equipment to ensure comparable and accurate values.

Several different sites were evaluated for this project. Determining an appropriate location for a SNOTEL involved careful consideration of many factors. The following are the installation parameters that were considered for site selection. Site evaluators recognized that not all objectives could be met (certain objectives contradicted others), and therefore, site selection would ultimately require prioritization of these objectives:

- The site must be above 4000' elevation where snow currently dominates winter precipitation.
- To meet the purposes of the North Olympic Peninsula Resource Conservation & Development Council's grant and Elwha River restoration activities, the site must be within or representative of the Elwha basin.
- The site should be placed in a "wet" area of the drainage where models predict high precipitation amounts.
- The site must be well positioned for accurate capture of precipitation. A preferred site should be a small, tree sheltered opening located away from ridge tops, major divides or other areas subject to wind or unusual snow loading.
- A preferred site should be out of park wilderness.
- To minimize impacts to visitors, a preferred site should be hidden from and situated well away from hiking trails, wilderness campsites, climbing destinations and popular cross-country routes.
- Site characteristics should allow for a minimum amount of disturbance to soils and vegetation. (i.e. level, well drained, minimal vegetation).
- The site should be easily accessible for annual maintenance.
- The site should not be placed in cultural landscapes or areas likely to have extensive archeological resources.

The goal of accessibility directly contradicted the goals of low visibility and low impact to wilderness users and required prioritization. Few areas meeting even the limited site requirements were found along accessible trail corridors. These locations occur along popular hiking and climbing destinations where installations would have a direct impact on wilderness users. For this reason, remote access requiring infrequent and short-term impacts from helicopter use was prioritized over the easily accessible sites which would have frequent and long-term effects on park wilderness users.

Park and NRCS scientists studied climate records, modeling results, topographic maps, aerial photographs and remote sensing images to identify potential areas. These sites were then ranked, using the aforementioned parameters. Finally, a reconnaissance flight and site visit was conducted to evaluate actual snow conditions and snow characteristics of considered sites. During this process, several potential areas were considered then dismissed.

Locations considered then dismissed:

Considered Location	Primary Reason for Dismissal
Bailey Range–Mt. Carrie, Stephen Basin or Mt. Barnes areas	Cross-country lake basin along the popular Bailey Range traverse. Known as one of the most scenic and remote wilderness destinations in Olympic NP. Likely to impact high quality wilderness experience.
Scott/Ludden Saddle	Alternative route into Bailey Range and along Bailey traverse. Likely to impact wilderness experience.
NW Mt. Wilder	No areas found with appropriate site characteristics.
Low Divide/Elwha Basin	High visibility due to location along major trail corridor or cross-country routes. Avalanche and snow loading conditions.
Rustler/Godkin Saddle	Possible snow loading conditions. Located along occasionally used high country traverse. High likelihood of archeological resources.
Hayden Pass	Drier site characteristics. Suitable sites were too close to trails and cross-country routes.
Crystal Peak	No areas found with appropriate site characteristics.

After careful evaluation, the best suitable site identified for a potential installation was a clearing located in a high elevation basin at Buckinghorse Ridge.

Alternative 4: Place a full SNOTEL in a high elevation basin at Buckinghorse Ridge within Olympic National Park.

Real-time, hourly snowpack data would be collected by installing a standard SNOTEL in a high elevation basin in Olympic National Park. The SNOTEL would produce hourly, real-time data for snowpack, climate and soil water conditions. Detailed and immediately accessible data on snow and climate conditions would be available to local tribes, park managers, researchers and water users to make management decisions. This would enhance their ability to predict the size and frequency of flood or avalanche events, enhance river restoration and dam removal activities, forecast in-season stream flow and water allocation priorities, establish instream flow requirements, and evaluate current groundwater reserves.

The standard (full) SNOTEL site would include a pressure sensing snow pillow, a snow depth sensor and air sensor mounted on a 30-foot instrument tower, a storage precipitation gauge, buried soil moisture sensors, and a 20-foot tall communication shed with a 30-foot tower to house the datalogger, instruments, telemetry equipment and power supplies for the SNOTEL. The snow pillow, storage precipitation gauge and the communication shed would probably have the greatest footprint on the land and create the greatest visual impact of a SNOTEL installation (see figures 1 and 2). Altogether, the installation of the snow pillow, communication shed, instrument tower, and sensors would create approximately 243 sq. ft. of disturbed ground.

The snow pillow would be a large, Hypelon pillow filled with antifreeze. Its installation would require the clearing and leveling of a roughly 16 ft. diameter area. As snow accumulates on the pillow, it would force antifreeze from the pillow through a tube to a pressure transducer in the communication shed. This information would be combined with snow depth and total precipitation to derive the amount of snow water equivalent held in the snowpack.

The precipitation gauge would be an 8 in. diameter can partially filled with antifreeze. Any water or snow falling over the can would collect inside. As the can fills, a pressure transducer would measure the depth of total precipitation received. To be effective, the can would need to be taller than the total amount of snowpack the area receives. Because of high precipitation in the Olympic Mountains, the can would need

to be 20 or 25 feet in height. This would also be the case for air temperature, snow depth instruments and solar panels. They would be mounted on a tower higher than the maximum snowpack. To ensure the stability of the tower and gauge, concrete anchors would be used, requiring excavation of small areas for the gauge, shed, and towers. The SNOTEL site would be visited annually for maintenance of the precipitation gauge.

Soil Moisture/Soil Temperature sensors would be buried in the ground to a maximum depth of 40 in. Approximately five sensors would be placed throughout the profile in a hand-dug hole 12 in. in diameter and 40 in. deep. The hole would be backfilled with the same soil material removed for sensor installation.

A datalogger, telemetry equipment, batteries and transducers would be housed in the communication shed, which is designed to provide shelter for instruments and allow mid-winter access to equipment even in deep snowpacks. The shed would be constructed of a wood frame with painted plywood siding and several doors (bottom and the top) for access.

Instruments and structures (for measuring snowpack and housing instruments) would be installed in wilderness. A helicopter would land in wilderness for installation of the equipment and then once per year to transport staff for equipment maintenance.

Alternative 5: Place a reduced footprint, alternative instrument "Rocky Mountain" Snow Site in a high elevation basin at Buckinghorse Ridge within Olympic National Park.

Real-time, hourly snowpack data would be collected by installing a minimum requirement SNOTEL, with a reduced footprint and alternative instruments, in a high elevation basin in the Upper Elwha.
In place of a snow pillow, gamma sensors would be used. This instrument would consist of 2 electronic sensors that measure gamma rays, one on the ground and one at the top of a pole, well above the maximum snow pack. The difference between the two gamma readings would allow interpretation of snow density. In place of the traditional precipitation can, optical rain gauges would be used. (These devices, which use a beam of light traveling through falling precipitation to calculate rate of rainfall, have been effectively used at airports for several years.) Datalogger, air temperature sensors, telemetry equipment and solar panels would be placed in plastic enclosures and hung on a single tower. No shelter would be required due to the lack of tubing and transducers. All instruments would be hung on a single tower with a concrete base. This alternative would greatly reduce the footprint of the site. Impact to vegetation and soils would be reduced from 243 sq. ft. to 9 sq. ft.

Instruments would still be placed in wilderness and a helicopter would still be required for installation and for occasional maintenance.

Alternative 6: Place a modified SNOTEL in a high elevation basin at Buckinghorse Ridge within Olympic National Park.

Real-time, hourly snowpack data would be collected by installing a modified SNOTEL with a slighltly reduced footprint. Instruments and structures (for measuring snowpack and housing instruments) would be placed in wilderness, but the footprint would be reduced to the "minimum required" as determined through experience at Rocky Mountain National Park. A helicopter would land in wilderness for installation of the equipment and then once per year to transport staff to maintain the equipment.

A modified SNOTEL would require installation of similar infrastructure as a full SNOTEL (Alternative 4), with the exception of the communication shed, which would be replaced by mounting boxes on the communications tower to house the datalogger, tubing and transducers, and telemetry and power equipment. This box would house the tubing and transducers for the pillow and precipitation can. Altogether, the installation of the snow pillow, instrument towers, and sensors would create approximately 227 sq. ft. of disturbed ground, 16 sq. ft. less than a full SNOTEL.

9	Evaluate the impacts of each alternative	Potential impacts to evaluate under each alternative: - Wilderness character effects - Effects on natural resources - Cultural resources considerations - Social/recreational/experiential effects - Societal/political effects - Health/safety concerns - Economic/timing/sustainability considerations

Alternative 1: No Action

Wilderness character: None
Effects on natural resources: None
Cultural resource considerations: None
Social/recreational/experiential effects: None
Societal/political effects: If no action is taken, then less information would be available to verify a new NASA water supply forecasting model. This model would not be verified and would not lead to better models for understanding snowpacks in other park watersheds and would not decrease the need for future equipment installations.

The climate program for the North Coast and Cascades Network would not address the number one climate need for Olympic National Park: adequate information about interior Olympic mountain snowpacks. This need was identified by the network's climate working group as crucial for understanding the ecosystem changes being brought about by global climate change; however no NPS funds are currently available.

Tribes, local government agencies and North Olympic Peninsula water users would have less future ability to forecast flow of Peninsula rivers and predict flooding and droughts on Peninsula rivers.

Park resource managers and researchers would have less information about one of the major system drivers affecting the Elwha ecosystem: snowpack. This information may be an important component to pre- and post-dam-removal research as well as global climate change studies.

Health/safety concerns: Less ability to predict catastrophic floods and avalanches.
Economic/sustainability considerations: None

Alternative 2: Conduct routine Snow Surveys by foot travel in place of a SNOTEL installation.

Wilderness character: None
Effects on natural resources: None
Cultural resource considerations: None
Social/recreational/experiential effects: None
Societal/political effects: If snow courses were completed monthly, these measurements of snowpack would provide some meaningful data for summer stream flow forecasting and ecological studies. This data, however, would not help determine daily measurements that are critical to flood and avalanche forecasting and many other natural resource or water use studies.
Health/safety concerns: There would be serious safety concerns. Reaching areas of the upper Elwha would require extensive backpacking and snowshoe trips. Most areas would require travel across dangerous, avalanche-prone slopes, making safe access impossible under some conditions. Extensive training and extreme endurance would be required to safely execute snow surveys, even in good conditions.
Economic/sustainability considerations: Safe access, with 2 park staff, 4 times a year, would be expensive and difficult. No funding or employee time currently exists for this option.

Alternative 3: Conduct routine Snow Surveys with helicopters, in place of a SNOTEL installation.

Wilderness character: Monthly helicopter flights during winter and early spring would impact some wilderness visitors.
Effects on natural resources: None
Cultural resource considerations: None
Social/recreational/experiential effects: None
Societal/political effects: As in Alternative 2, monthly measurements of snowpack would provide some meaningful data; however monthly or bi-monthly measurements would still not provide the daily measurements needed for flood and avalanche forecasting or other studies.
Health/safety concerns: Park staff would be exposed to moderate risk, as helicopter transport and snow landings are inherently risky. This alternative is more safe, however, than foot travel to a snow course location.
Economic/sustainability considerations: While monetary costs of helicopter use can be high, this alternative would probably break even or be less costly then Alternative 2 (foot travel) as it would require much less overall staff time. The park does not currently have staffing or funding for this alternative.

Alternative 4: Place a Full SNOTEL in a high elevation basin at Buckinghorse Ridge within Olympic National Park

Wilderness character: This alternative would have the greatest effect on wilderness. A full SNOTEL would involve leveling and removal of vegetation for placement of a snow pillow. The 30-foot towers and precipitation gauge would require a concrete base for stabilization. Transducers and equipment would be placed in a plywood structure. All of these items are inherently out of place in a wilderness setting. Helicopter use in wilderness would be required for installation and annual maintenance of the SNOTEL.
Effects on natural resources: Some vegetation would be removed or covered by equipment. There would be about 243 sq. ft. of disturbance.
Cultural resource considerations: Excavation for pillow, tower and rain gauge could affect archeological resources.
Social/recreational/experiential effects: None
Societal/political effects: This alternative would provide hourly, real-time data including snowpack, climate and soil water conditions. This data would replace less adequate watershed data (from existing SNOTEL installations) or monthly snow surveys. The data would enhance the ability of local tribes, park managers, researchers and water users to make management decisions by producing detailed and immediately available reports of snow and climate conditions in a large portion of the Elwha watershed that we are currently unable to measure. This data could be used to improve predictions for the size and frequency of flood or avalanche events, enhance river restoration and dam removal activities, forecast in-season stream flow and water allocation priorities, establish instream flow requirements, and evaluate current groundwater reserves.
Health/safety concerns: Access with helicopters has some risk; however installation and maintenance would only occur during fall days with excellent weather conditions, mitigating most of the risk factors.
Economic/sustainability considerations: For long term monitoring, installation of a SNOTEL is the most cost effective option. This is especially the case in that the RCDC will cover all costs of installation and the NRCS will cover maintenance costs.

Alternative 5: Place a reduced footprint, alternative instrument "Rocky Mountain" Snow Site in a high elevation basin at Buckinghorse Ridge in Olympic National Park.

Wilderness character: This alternative would have the least effect on wilderness of the three SNOTEL installation alternatives. A single, 30 ft. high tower with instruments would still intrude on visitor wilderness experience. Helicopter use in wilderness would still be required for installation and regular maintenance of SNOTEL.
Effects on Natural Resources: About 9 sq. ft. of vegetation would be removed for the base of the tower.
Cultural Resource Considerations: Excavation for tower base could impact archeological resources.
Social/recreational/experiential effects: None
Societal/political effects: This alternative would provide hourly, real-time data including snowpack,

climate and soil water conditions with the same benefits described in Alternative 4. However, this type of SNOTEL site proved extremely unreliable at Rocky Mountain National Park and was eventually abandoned.
Health/safety concerns: Access with helicopters has some risk; however installation and maintenance would only occur during fall days with excellent weather conditions, mitigating most of the risk factors.
Economic/sustainability considerations: This alternative instrument option did not function well in Rocky Mountain National Park and is unlikely to function well at Olympic. With heavier snowpacks, more rainfall, lower sun angles and fewer sunny days, the Olympics are not likely to produce adequate power for an optical rain gauge. The RCDC and the NRCS would not be willing to risk installation and maintenance costs on an instrument array which did not function adequately elsewhere.

Alternative 6: Place a Modified SNOTEL in a high elevation basin at Buckinghorse Ridge within Olympic National Park.

Wilderness character: This alternative would have a slightly smaller effect on wilderness than Alternative 4, a standard SNOTEL. It would still involve leveling and removal of vegetation for placement of a snow pillow. A 30-foot tower and precipitation collector would still require a concrete base for stabilization. Transducers and equipment would be placed in boxes on the 30-foot communications tower, eliminating the need for an additional structure. The existing instruments would still be out of place in a wilderness setting. Helicopter use in wilderness would still be required for installation and annual maintenance of SNOTEL. This option would have a higher risk of failure, potentially resulting in a higher number of emergency maintenance flights.
Effects on natural resources: Vegetation would be removed or covered by equipment, although there would be 16 sq. ft. less disturbance than in a Full SNOTEL installation.
Cultural resource considerations: Excavation for pillow, tower and rain gauge could affect archeological resources.
Social/recreational/experiential effects: None
Societal/political effects: This alternative would provide hourly, real-time data including snowpack, climate and soil water conditions with the same benefits described in Alternative 4.
Health/safety concerns: Access with helicopters has some risk; however installation and maintenance would only occur during fall days with excellent weather conditions, mitigating most of the risk factors.
Economic/sustainability considerations: For long-term monitoring, installation of a SNOTEL (either minimum requirement or standard) is the most cost effective option. This modified configuration is currently used in Rocky Mountain National Park (RMNP) wilderness and has provided reliable data for several years. It should be noted, however, that conditions at the RMNP site are different from those found in the interior Olympics. At the Rocky Mountain site, average snow depth is 8 feet and the snow has low density. Conversely, Olympic snowpacks are nearly twice as dense and can routinely exceed 20 feet in depth. This modified arrangement has never been tried under ONP conditions, and NRCS engineers are unsure of the ability of the infrastructure and equipment to function in this environment. Hence, there is a higher risk of failure, especially in the first year of operation, and the lack of a communications shed would limit the ability of staff to conduct emergency winter repairs because of the inaccessibility of the buried equipment. Data from this period is critical to the needs of model developers funding this project.

10	Select the alternative that will most effectively resolve the issue while having the least overall negative impact on wilderness resources, character and the visitor experience

Note: When selecting the preferred alternative the potential disruption of wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience. If a compromise of wilderness resources or character is unavoidable, only those actions that preserve wilderness character and/or have localized, short-term adverse impacts will be acceptable.

Preferred alternative: #___4_____
Describe rationale for selecting this alternative including how it meets minimum requirement guidelines and how impacts to wilderness will be minimized, and mitigated (if needed).

This is the alternative which has the greatest likelihood of meeting all the project goals, including:

- Provide accurate hourly and daily snow and precipitation measurements from the upper Elwha watershed.
- Improve daily runoff forecasts for the Elwha and Dungeness Rivers.
- Provide emergency managers, meteorologists and avalanche forecasters with real-time climate data from the upper Elwha to better predict timing and extent of flood, winter storm and avalanche events.
- Provide long-term climate data from a high elevation site in the park interior for the purpose of interpreting NPS long-term monitoring efforts and understanding the impacts of global warming on park resources and developing improved knowledge for the purpose of understanding the health and improving the management of park wilderness.
- Provide the for the highest visitor and staff safety
- Require the least number of maintenance flights over park wilderness (while still achieving the above objectives).

11	Forward MRW for review and approval

Recommended by:_Cat Hawkins-Hoffman_____ Date____8/24/2007_____
Division Chief
Reviewed by:_____ Date_____
Wilderness Specialist
Approved by: _____ Date_____
Superintendent

Comments:_____
_____
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_____

Comments by: _____ Date_____

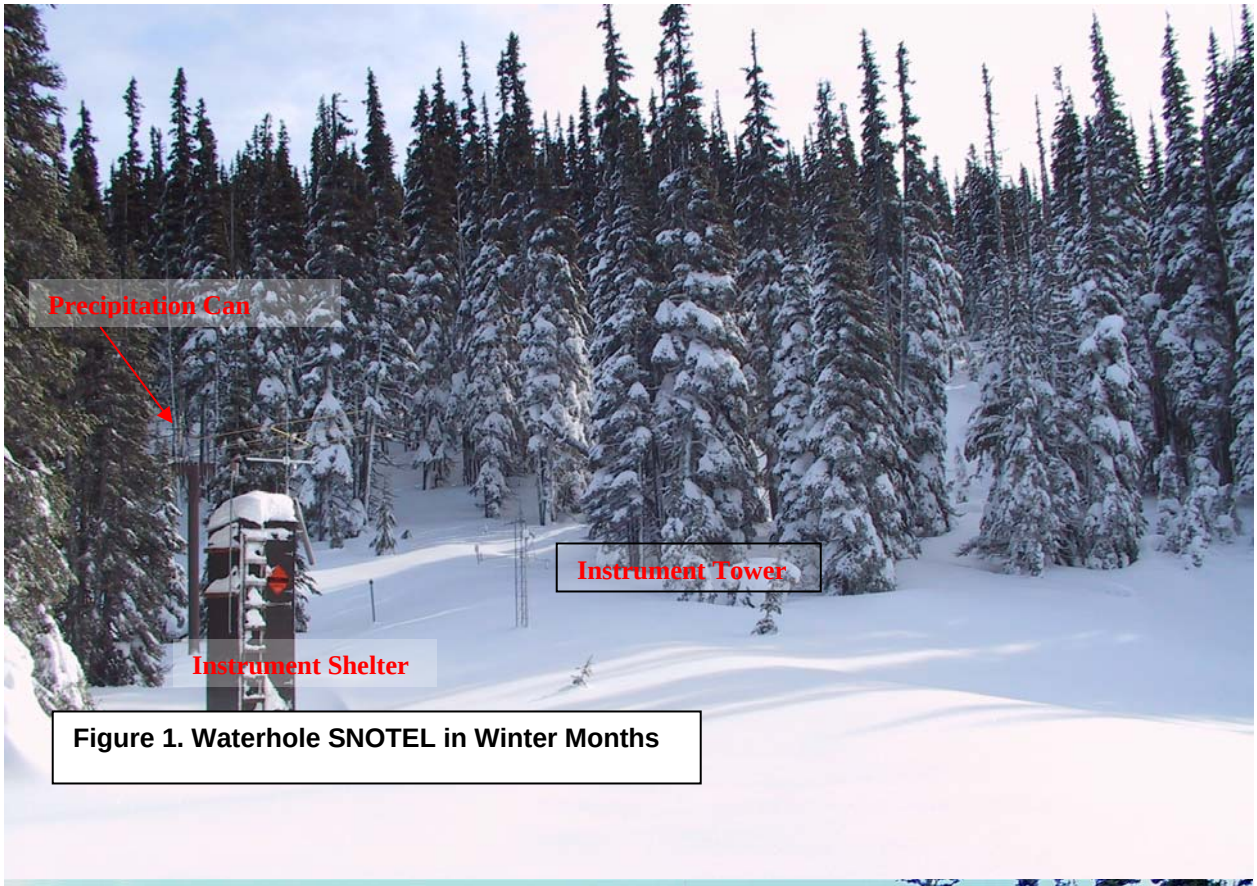

Figure 1. Waterhole SNOTEL in Winter Months

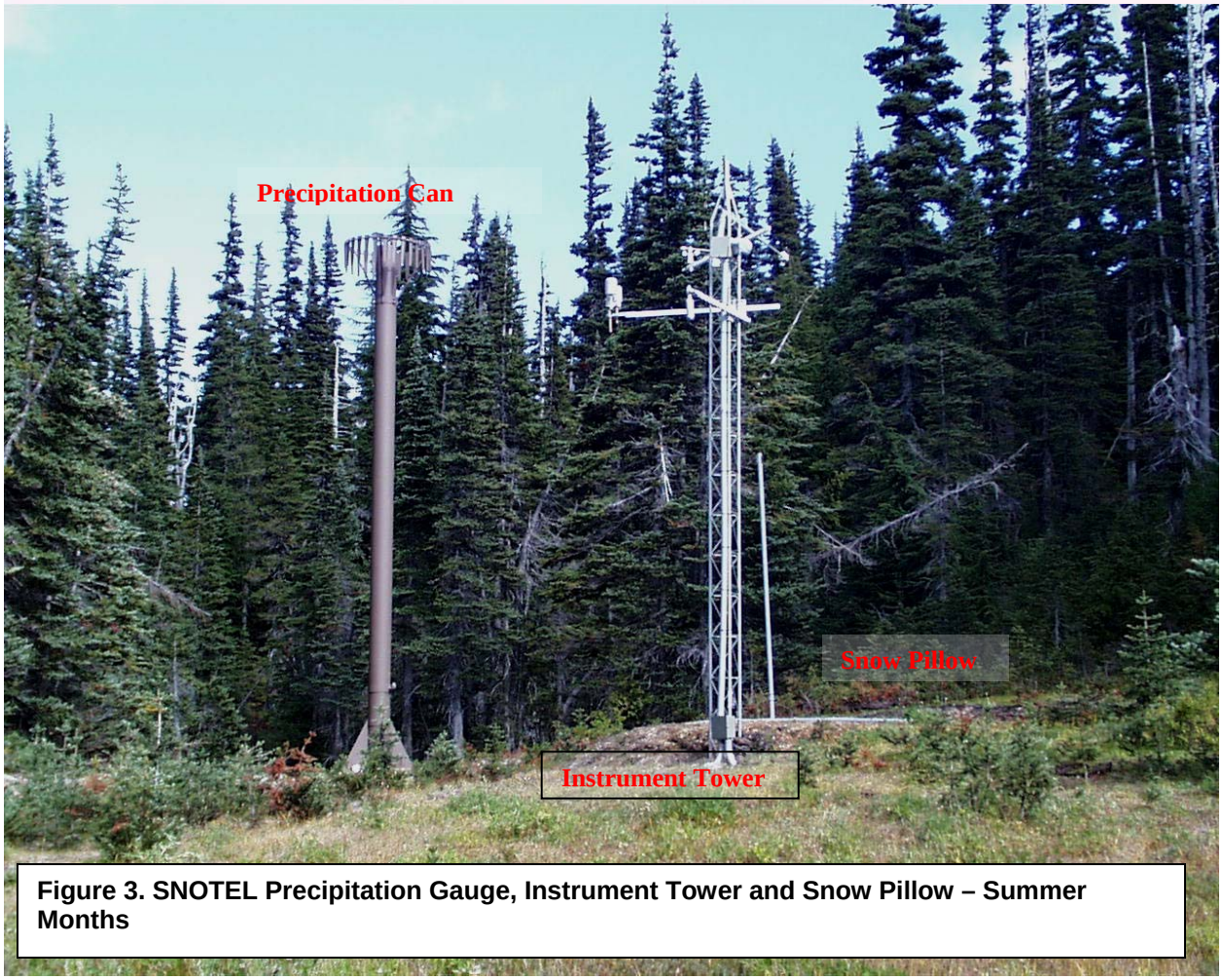

Figure 3. SNOTEL Precipitation Gauge, Instrument Tower and Snow Pillow – Summer Months

Appendix B. Scoping Letter

United States Department of the Interior
NATIONAL PARK SERVICE
Olympic National Park
600 East Park Avenue
Port Angeles, Washington 98362-6798

IN REPLY REFER TO:
L7615 (OLYM-S)

February 7, 2007

Dear Interested Party:

Olympic National Park is seeking public input about a proposal to place a Snow Telemetry (SNOTEL) site within the park's interior to gather important information about mountain snow pack, weather patterns and climate change.

This proposal is being made in partnership with the Natural Resources Conservation Service (NRCS) and the North Olympic Peninsula Resource Conservation and Development Council (RC&DC), which has recently received a grant to use remote sensing and meteorological data to provide daily estimates of snow pack and water supply.

Snow pack and other climate information are critical to community and watershed planning and provide important indicators about global climate change. The NRCS (formerly the Soil Conservation Service) has collected such data since the 1930s to help forecast summer water supplies for urban and rural communities and provide critical information for agriculture and fisheries management.

Since the 1980s, automated SNOTEL stations have become the most reliable method for collecting snow pack and climate data. A network of over 700 SNOTEL sites measure snow depth, air temperature and the "snow water equivalent" or the amount of water contained in the snow pack. The data is then transmitted to a central computer facility and made available online.

Snow pack monitoring began on the outer eastern slopes of the Olympics (Deer Park, Cox Valley and Hurricane Ridge) in the late 1940s. The Waterhole SNOTEL site near Hurricane Ridge is operated by the NCRS and provides hourly updates that are available online by visiting the Current Weather Conditions page of the Olympic National Park website: http://www.nps.gov/olym/planyourvisit/current-weather-conditions.htm.

Olympic National Park is preparing an Environmental Assessment (EA) to evaluate the environmental effects of placing a SNOTEL site in one of several locations within the upper Elwha watershed. We are now seeking your input to help us define the issues and concerns that should be addressed within the EA.

Please send your comments to the following address by March 9, 2007.

Superintendent – Elwha SNOTEL Scoping
Olympic National Park
600 East Park Avenue
Port Angeles, WA 98362

Fax: 360-565-3015
Website: **http://parkplanning.nps.gov**
Email: **olym_ea@nps.gov**

You may also submit your comments on-line by visiting **http://parkplanning.nps.gov,** the website for the National Park Service's Planning Environment and Public Comment system.

Commentors should be aware that their entire comment – including personal identifying information – may be made publicly available at any time. While commentors can ask that their personal identifying information be withheld from public review, the NPS cannot guarantee that this will be possible.

For more information about this project, please visit the National Park Service Planning Environment and Public Comment website at **http://parkplanning.nps.gov** or call the park at 360-565-3004.

Thank you for your interest in Olympic National Park.

Sincerely,

William G. Laitner
Superintendent

National Park Service
U.S. Department of the Interior

Olympic National Park

600 East Park Avenue
Port Angeles, WA
98362

360-565-3005 phone
360-565-3015 fax

Olympic National Park News Release

February 7, 2007
For Immediate Release
Barb Maynes 360- 565- 3005

Remote Snow Telemetry (SNOTEL) Station Proposed for Olympic National Park; Public Invited to Comment

In partnership with the North Olympic Peninsula Resource Conservation and Development Council (RC&DC) and the Natural Resources Conservation Service (NRCS), Olympic National Park is considering the placement of a Snow Telemetry (SNOTEL) site within the park's interior to gather important information about mountain snowpack, weather patterns and climate change.

"Placing a SNOTEL site high within the Elwha watershed would provide valuable climate information for park staff, along with regional weather and water supply forecasters," said park Superintendent Bill Laitner. "We're asking now for the public to help us define the issues and concerns that should be addressed as we analyze this proposal."

Snow pack and other climate information are critical to community and watershed planning and provide important indicators about global climate change. The NRCS (formerly the Soil Conservation Service) has collected such data since the 1930s to help forecast summer water supplies for urban and rural communities and provide critical information for agriculture and fisheries management.

Since the 1980s, automated SNOTEL stations have become the most reliable method for collecting snow pack and climate data. A network of over 700 SNOTEL sites measure snow depth, air temperature and the "snow water equivalent" or the amount of water contained in the snow pack. The data is then transmitted to a central computer facility and made available online.

Snow pack monitoring began on the outer eastern slopes of the Olympics (Deer Park, Cox Valley and Hurricane Ridge) in the late 1940s. The Waterhole SNOTEL site near Hurricane Ridge is operated by the NCRS and provides hourly updates that are available online by visiting the Current Weather Conditions page of the Olympic National Park website: http://www.nps.gov/olym/planyourvisit/current- weather- conditions.htm.

This project would be funded through the NRCS and the North Olympic Peninsula RC&D, which has recently received a grant to use remote sensing and meteorological data to provide daily estimates of snow pack and water supply.

(more)

Olympic National Park is preparing an Environmental Assessment (EA) to be released this summer that will evaluate the environmental effects of placing a SNOTEL site in one of several locations within the upper Elwha watershed. Comments received during this scoping period will be used to help define the issues and concerns to be addressed in the EA.

Comments should be sent to the following address no later than March 9, 2007.

Superintendent – Elwha SNOTEL Scoping
Olympic National Park
600 East Park Avenue
Port Angeles, WA 98362

Fax: 360- 565- 3015
Website: **http://parkplanning.nps.gov**
Email: **olym_ea@nps.gov**

Comments may also be submitted on- line by visiting **http://parkplanning.nps.gov,** the website for the National Park Service's Planning Environment and Public Comment system.

Commentors should be aware that their entire comment – including personal identifying information – may be made publicly available at any time. While commentors can ask that their personal identifying information be withheld from public review, the NPS cannot guarantee that this will be possible.

For more information about this project, people may visit National Park Service's Planning Environment and Public Comment website at **http://parkplanning.nps.gov** or call the park at 360- 565- 3004.

- - NPS- -

EXPERIENCE YOUR AMERICA
The National Park Service cares for special places saved by the American people so that all may experience our heritage.

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historic places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-56 (March 2003)