



View of Diablo Lake from Sourdough.

WELCOME

You are now in the *Affected Environment Chapter*. Here are the topics you can read about:

Description of Project Area

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Wild and Scenic Rivers

Visitor Use and Experience

Interpretation and Education

Access and Transportation

Socioeconomic Environment

Management and Operations

Volunteer Program

CHAPTER 5: AFFECTED ENVIRONMENT

The purpose of this chapter is to describe the physical, biological, cultural, and social environments, including human uses, of Ross Lake National Recreation Area that could be affected from implementing any of the alternatives described in the preceding chapter. This chapter contains topics that were identified as important issues by the public and land management agencies during scoping. It also contains additional background data relevant to both NPS managers and a broader audience.

DESCRIPTION OF PROJECT AREA

The North Cascades NPS Complex includes North Cascades National Park (501,458 acres), Lake Chelan National Recreation Area (62,902 acres) and Ross Lake National Recreation Area (116,798 acres). The park and recreation areas are part of the greater North Cascades ecosystem and international socioeconomic region that stretches from Snoqualmie Pass to the Fraser River in Southern British Columbia, and from the Puget Sound to the eastern edge of the Columbia Plateau.

Approximately 6 million acres of public lands surround the North Cascades. These lands encompass two units of the National Forest System: the Mount Baker-Snoqualmie National Forest and the Okanogan-Wenatchee National Forest. On the Canadian side of the border, several Provincial Parks and protected areas are contiguous to North Cascades. Notable protected areas include E.C. Manning Provincial Park (177,110 acres), Skagit Valley Provincial Park (69,870 acres), and Chilliwack Lake Provincial Park (23,145 acres).

The Washington Parks Wilderness Act of 1988 (Public Law 100-668) designated approximately 94 percent of North Cascades NPS Complex as the Stephen Mather Wilderness (642,332 acres). The legislation designated over 80,000 acres of land as wilderness within Ross Lake NRA, including an additional 5,110 acres in the Big Beaver and Thunder Creek drainages as potential wilderness. The Stephen Mather Wilderness is immediately surrounded by approximately 1.3 million acres of federally designated wilderness: the Pasayten Wilderness (529,477 acres) forms the eastern boundary of the complex, the Lake Chelan-Sawtooth Wilderness (151,435 acres) lies to the southeast, the Glacier Peak Wilderness (570,573 acres) lies to the south and southwest, and the Mount Baker (117,528) and Noisy-Diobsud wilderness (14,133 acres) adjoin the complex on its western flank (acreage sources: <http://www.wilderness.net/index.cfm>). These wilderness areas collectively represent perhaps the

most rugged and remote alpine landscapes in the contiguous United States.

OVERVIEW OF ROSS LAKE NRA

Ross Lake National Recreation Area NRA was established in order to “provide for the public outdoor recreation use and enjoyment of portions of the Skagit River, and Ross, Diablo and Gorge lakes, together with the surrounding lands, and for the conservation of the scenic, scientific, historic and other values contributing to public enjoyment of such lands and waters...” (Public Law 90-544, October 2, 1968). Conservationists fought hard to have what is now the entire complex designated as North Cascades National Park, but Congress compromised and established Ross Lake NRA primarily to accommodate existing and proposed expansion of hydropower developments associated with Seattle City Light’s Skagit River Hydroelectric Project (Louter, 1998).

Today, Ross Lake NRA encompasses 116,798 acres of federal land. Elevations range from approximately 350 feet at Bacon Creek on the west boundary, to 8,066 feet on Hozomeen Mountain near the U.S.-Canada border. Approximately 69% percent of Ross Lake NRA (80,043 acres) is designated as the Stephen Mather Wilderness, plus an additional 4% percent (5,110 acres) designated as potential wilderness.

Research Natural Areas

Research Natural Areas (RNAs) are generally intended to be the most protected areas within Ross Lake NRA. RNAs are administratively designated areas identified for unique natural features with essentially no past human influence. Pyramid Lake RNA (164 acres) was established in 1972 by the Director of the National Park Service to protect a small oligotrophic lake and the surrounding habitat of the northern rough-skinned newt (*Taricha granulosa*) (Zobel and Wasseem, 1972). Big Beaver RNA (3,356 acres) was established in 1990 by the Director of the NPS for its unique plant and animal species, and diverse plant communities

including mature forests, non-forested uplands, swamps, bogs, and low elevation ponds (NPS, 1990 [from 5/22/1990 memo from NPS Director to PWR Regional Director]). Both RNAs contain trails and allow for recreational use, but camping is not allowed in order to minimize the potential for adverse impacts to educational or scientific values.

Non-Federal Lands and Facilities within Ross Lake National Recreation Area

The largest private land owner within the recreation area is Seattle City Light, a municipal electric utility for the City of Seattle organized under the laws of the State of Washington. Seattle City Light (SCL) owns approximately 1,129 acres of land and has limited rights on approximately 19,300 acres of federal land under the terms of two Federal Energy Regulatory Commission (FERC) licenses, one for the Skagit River Hydroelectric Project (FERC Number 553), and a second license for the substantially smaller Newhalem Creek Hydroelectric Project (FERC Number 2705) (See Table 5.1). Seattle City Light is authorized to utilize federal lands within the hydroelectric project boundary for various purposes related to hydroelectric power generation, including operations of dams, powerhouses, transmission lines, substations, and other works necessary for hydropower production (FERC, 1995).

NPS Parcel Number	Acreage
01-128	177.05
01-129	145.10
01-130	49.26
01-131	42.56
01-132	63.07
01-133	127.01
02-100	4.10
02-108	379.01
02-109	25.41
02-110	3.45
02-114	69.08
03-105	43.56
Total Acreage	1128.66

The Master Deed Listing for Ross Lake NRA depicts three remaining tracts of private land totaling 25.19 acres. The most recent acquisition of private land was the Skagit Talc Mine (82.64 acres) located downstream of Shovel Spur on the south side of the Skagit River. There are sub-surface mineral rights on five parcels totaling 746.24 acres; however, the NPS owns the surface estate. The State of Washington also asserts jurisdiction and ownership over approximately 481 acres of the bed of the Skagit River below the ordinary high water mark (Wayne Hill, NPS Lands Resources, pers. comm. 12/10/08).

Skagit River Hydroelectric Project

The Skagit River Hydroelectric Project (FERC Project No. 553) includes three dams and associated facilities owned and managed by Seattle City Light. Construction of the project spanned three decades, with the completion of Gorge Dam in 1924, Diablo Dam in 1936, and Ross Dam in 1952. Ross Dam created Ross Lake, the namesake for Ross Lake NRA and a focal point of this management plan.

The reservoirs of the Skagit River Hydroelectric Project are hydraulically coordinated to supply approximately one-fourth of SCL's power generation requirements, while maintaining instream flows beneficial to salmon reproduction and rearing. In addition, the project provides flood control, water storage, and a variety of recreational opportunities, including hiking, sport fishing, boating, and guided tours. Ross Dam, the project's uppermost facility, impounds Ross Lake, a 22-mile-long reservoir extending about one mile north of the U.S.-Canada border.

Seattle City Light maintains the reservoir near full-pool elevations from July through October for recreational and aesthetic purposes. Reservoir elevations remain high through the migratory and spawning periods of native char (bull trout and Dolly Varden) and rainbow trout, allowing these species access from the lake to spawning grounds in the tributaries. Lands bordering Ross Lake are moderately to steeply sloped and forested; glaciers draining to the basin contribute cool waters that provide important habitat for native bull trout and native rainbow trout. Major tributaries to Ross Lake include Big Beaver, Little Beaver, Ruby, Lightning, and Devil's creeks.

Diablo Dam, located downstream from Ross Dam, creates 4½ mile long Diablo Lake, which is used primarily for daily and weekly regulation of discharge

from Ross. Much of the land surrounding Diablo Dam consists of steep, exposed rock or talus sparsely covered with scattered conifers and shrubs. The remaining areas are moderately to steeply sloped and forested. Thunder Creek is the major tributary to Diablo Lake.

The third and last generating facility of the Skagit River Project downstream from Ross and Diablo Dams, the Gorge Dam and Powerhouse, is located about 4 miles from Diablo Dam. Gorge Lake is the smallest of the three Skagit reservoirs; there is very limited water storage in either Gorge or Diablo Reservoirs when compared to Ross Lake. Gorge Lake is aptly named for the cliffs and talus slopes comprising much of the area bordering the reservoir.

In 1991 SCL entered into a series of settlement agreements with twelve stakeholders as part of Federal Energy Regulatory Commission (FERC) Project relicensing. The stakeholders included federal and state agencies, Native American tribes, and an environmental group. The settlement agreements addressed fisheries, wildlife, recreation and aesthetics, erosion control, cultural resources (archeological and historic resources), and traditional cultural properties. FERC issued a 30 year license for this project in 1995.



Seattle City Light's hydroelectric facility at Gorge Dam.

Newhalem Creek Hydroelectric Project

The Newhalem Creek Hydroelectric Project (FERC No. 2705) is a run-of-the-river facility that derives approximately 2.3 megawatts of power from Newhalem Creek. The facility was built in 1921 to provide power for construction of Gorge and Diablo dams. It now supplements power to the Skagit River Hydroelectric project. FERC issued the most recent operating license for the Newhalem Creek Project in February 1997.

The Newhalem Project includes several historic-cultural resources and recreational amenities that are also tied to the Skagit River Project. These include the National Register listed “company towns” and associated hydroelectric infrastructure in Diablo and Newhalem, the Ladder Creek Falls Trail and the Trail of the Cedars.

North Cascades Highway

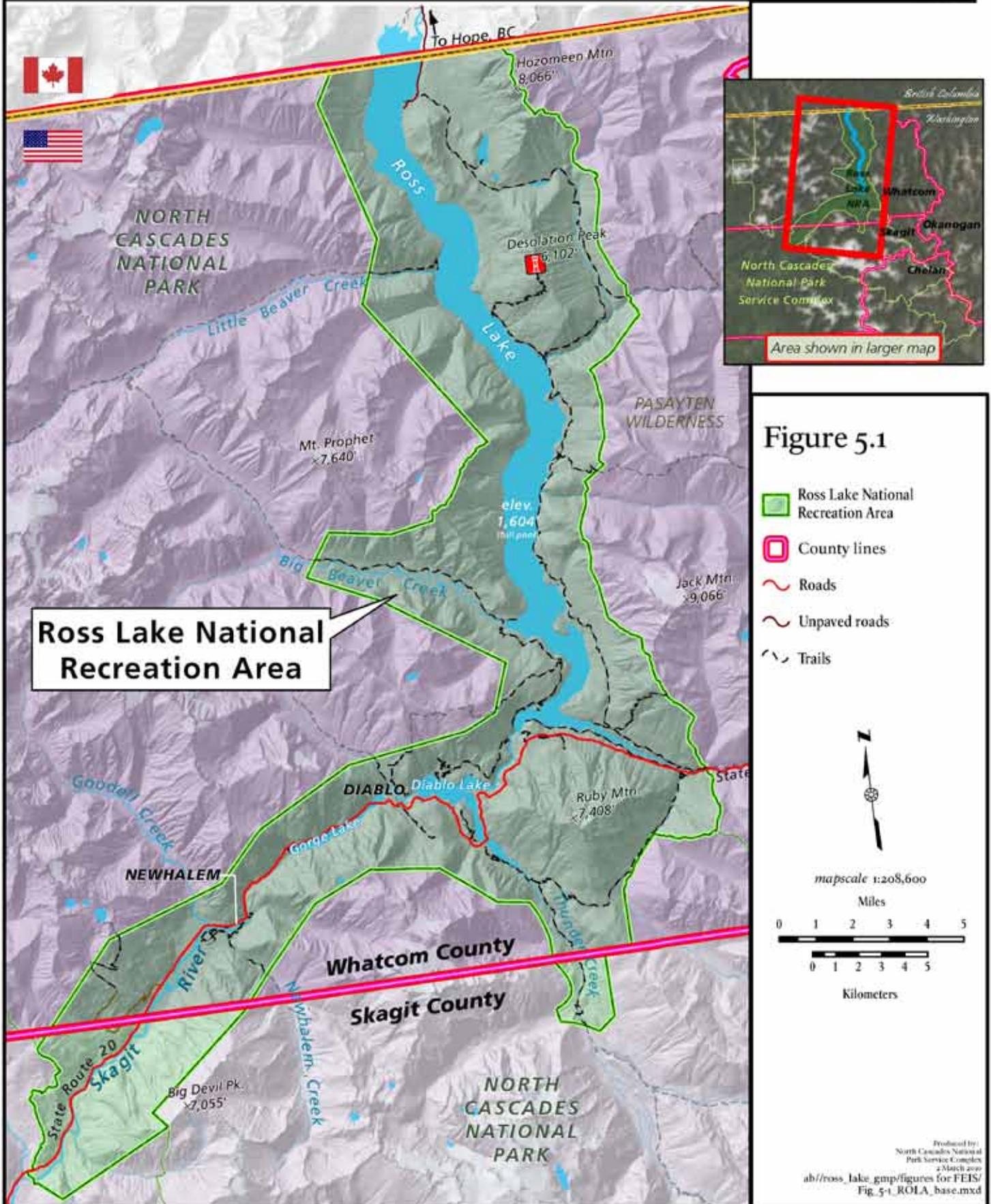
The North Cascades Highway, otherwise known as Washington State Route 20, bisects Ross Lake NRA and serves as the only transportation corridor across the northern portion of the Cascade Range, linking the greater metropolitan area of Puget Sound with Eastern Washington. Completed in 1973, the scenic highway is typically open from mid to late spring through November, when heavy winter snowfall and severe avalanche dangers render the highway impassable. Twenty-eight miles of the North Cascades Highway cross through Ross Lake NRA, providing key access to various trailheads, scenic overlooks, campgrounds, and associated facilities. The Washington Department of Transportation operates and maintains the highway in accordance with the terms of a highway easement deed issued by the National Park Service through the U.S. Department of Transportation in May of 2001.

North Cascades Environmental Learning Center

The North Cascades Environmental Learning Center (ELC) is a state-of-the-art facility used for a wide variety of environmental education programs. The ELC is located along the shoreline of Diablo Lake, at the site of a former construction camp for Ross Dam and subsequently Diablo Lake Resort. Seattle City Light funded the majority of the construction (\$11.6 million) of the North Cascades Environmental Learning Center as partial mitigation for renewal of its FERC license. The non-profit North Cascades

Counties

Ross Lake National Recreation Area GMP/EIS



Institute operates the ELC in partnership with the City of Seattle and the National Park Service. Access to the ELC campus is generally restricted to program participants.

In 2009, the facility earned the US Green Building Council's "Leadership in Energy and Environmental Design" or LEED® Silver certification. This certification recognizes a high level of achievement in sustainability and integration with natural systems. Buildings at the ELC have passive solar design and increased insulation, which enhance heating systems and lighting, maximize natural ventilation instead of air conditioning, and reduce energy consumption. The entire project was constructed with more than 90% percent Forest Stewardship Council-certified wood.

Demonstrating earth-friendly design and operations, the tree-sheltered campus features numerous buildings and facilities including:

- multimedia classrooms, a research library and aquatic and terrestrial labs
- overnight lodging for up to 69 participants, graduate students and staff
- a lakeside dining hall with recycling/composting center
- an amphitheater, outdoor learning shelters, and trails leading into the surrounding landscape
- a dock on Diablo Lake for paddling adventures
- accessible facilities and paths along the lakeshore and nearby Deer Creek

Refer to the Partnerships section later in this chapter for a description of programs offered by the North Cascades Institute.

NATURAL RESOURCES

Weather and Climate

Climate of the North Cascades is controlled by prevailing westerly winds off the Pacific Ocean and the topography of the North Cascades mountains. The mountains create a large gradient in precipitation and temperature, which is defined by a maritime climate on western slopes (mild winters, cool summers) and continental climate on eastern slopes (cold winters, hot summers) of these ranges. Marblemount, 3 miles from the west end of Ross Lake NRA, is at the eastern edge of the maritime climate zone, has a mean annual temperature of 49°F, and mean annual precipitation of 68 inches. The presence of two high mountain divides

on either side of the upper Skagit Valley results in a mixed maritime-continental climate at Hozomeen, where mean annual temperature and precipitation are 46°F and 37 inches, respectively.

Climate also varies systematically from high to low elevation across the area, with precipitation increasing significantly above 4000 feet. Annual snowfall at elevations above 5900 feet is typically 16 - 33 feet and, along with cold temperatures at higher elevations, results in more than 300 glaciers in the park complex.

An important aspect of the area's weather and climate is the large seasonal and interannual variability in precipitation and temperature. More than 80 percent of the annual precipitation falls between October and April, making summers warm and dry. During El Niño events in the Pacific Ocean, winter precipitation tends to be below normal and summer temperatures tend to be above normal. In contrast, La Niña conditions result in above average precipitation and below average temperature. Climate also varies on longer time scales associated with the Pacific Decadal Oscillation, which tends to enhance La Niña conditions during its cold phase.

To understand spatial patterns, trends, and variability, weather and climate are monitored throughout the park complex at a network of sites representing low, medium and high elevations along west (Baker), central (Ross) and eastern (Stehekin) transects. These sites are operated by park staff and cooperators including the National Resource Conservation Service and the National Weather Service.

The NPS glacier monitoring program provides an excellent indicator of long-term trends in climate. Since 1900 the NPS estimates that glacier area has declined 50 percent, resulting in significant reduction of summer stream flow. The park complex began monitoring the mass balance of four glaciers in 1993, including two that drain into the Ross Lake NRA: Silver Glacier in the Ross Lake basin, and North Klawatti Glacier in Thunder Creek. The long-term trend in mass balance of these glaciers shows significant retreat with a net loss of 18 billion gallons of water between 1993 and 2008. Several have retreated more than a mile since the late 19th century.

Climate Change

Climate change is defined by the United Nations Framework Convention on Climate Change as "a change of climate which is attributed directly or

indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (United Nations Framework Convention on Climate Change, 1992). In recent years, scientific data have shown that human influence on climate systems is taking place, and evidence of climate change has already presented itself.

Climate change is a far-reaching and long-term issue that will affect the park, its resources, visitors, and management beyond the scope of this general management plan and its 15-20 year timeframe. Although some effects of climate change are considered known or likely to occur, many potential impacts are unknown. Much depends on the rate at which temperature will continue to rise and whether global emissions of greenhouse gases can be mitigated before serious ecological thresholds are reached.

Climate change science is a rapidly advancing field and new information is being collected and released continually. Because the drivers of climate change are largely outside park control, the National Park Service alone does not have the ability to prevent climate change from happening. The full extent of climate change impacts to resources and visitor experience is not known, nor do managers and policy makers yet agree on the most effective response mechanisms for minimizing impacts and adapting to change. Thus, unlike some other issues, this GMP does not provide definitive solutions or directions to resolving the issue of controlling impacts of climate change on Ross Lake National Recreation Area. Rather, the plan provides some general directions and strategies that can help minimize the park’s contribution to climate change. The plan also recognizes that management actions and facilities being proposed in the alternatives need to be adopted with future climate change and impacts in mind.

While climate change is a global phenomenon, it manifests differently depending on regional and local factors. A 2007 report by the Intergovernmental Panel on Climate Change (representing 39 countries and reporting on the greenhouse effect) projected that the average global temperature will increase by 1.8 to 4.0 degrees Celsius (3.2 to 7.2 degrees Fahrenheit) by the end of the 21st century, as compared to 1980-1999 temperatures. Mountain ecosystems are among those identified as likely to be especially affected by climate change. The Intergovernmental Panel on Climate Change projects that warming in western mountains will cause decreased snowpack, more winter flooding,

and decreased summer flows (Intergovernmental Panel on Climate Change, 2007).

Climate Change in National Parks

Within lands managed by the National Park Service nationwide, climate change has already had noticeable impacts on both natural and cultural resources. Conditions for sustaining the health and prosperity of animal and plant habitats, glacial, marine, and wetland ecosystems have been diminished and changing patterns of weather and natural hazards such as flooding and wildfires have damaged habitat areas and cultural resource sites. Invasive plants and animals and native and non-native pests and pathogens are expanding into areas where they had not previously survived, threatening ecosystem balances. A 2006 report by the Rocky Mountain Climate Organization and the Natural Resources Defense Council identified the North Cascades NPS Complex as one of the top 12 most at-risk units of the National Park System, citing climate threats such as loss of glaciers and snowfields, changes in vegetation, loss of fishing, and loss of winter recreation opportunities (Rocky Mountain Climate Organization and the Natural Resources Defense Council, 2006).

In response to the increasing need for understanding and action related to climate change impacts in the parks, the NPS is collaborating with the Environmental Protection Agency through an interagency agreement to create the Climate Friendly Parks Program. This program enables the NPS to educate its staff about climate change issues, assess the park’s contribution to greenhouse gas emissions, create short- and long-term strategies for reducing emissions, determine potential effects of climate change on park resources, and develop skills and strategies for communicating these effects to the public. The North Cascades NPS Complex, which includes Ross Lake NRA, is a participant in the Climate Friendly Parks program and completed a climate action plan in 2009.

Regional Projections

The University of Washington’s Climate Impacts Group has done extensive research on the potential impacts of climate change in the Pacific Northwest. The Climate Impacts Group computer modeling has modeled accelerated warming in Washington State beginning in the 1920s and projected through the 2080s. Climate models indicate an average increase in annual temperature of approximately 2.2 degrees Fahrenheit, on average, within the lifetime of the GMP (2020s). By the 2040s, that temperature increase

is anticipated to rise to 3.5 degrees. Increases in extreme high precipitation in Western Washington and reduction in snowpack in the Cascades mountain range are consistently predicted among regional climate models. High-elevation pine trees are likely to be more susceptible to pests. Snowpack is expected to decrease by nearly 30 percent statewide by the 2020s, and approximately 40 percent by the 2040s. This decrease has implications for altered streamflow timing. Streams are also projected to experience higher temperatures, causing stress to salmon populations because of their dependence on glacial meltwater during summertime. Summer months are expected to be hotter and drier, and regional areas burned by fire are projected to nearly double by the 2020s and nearly triple by the 2040s. Increased energy demand during the hot, dry summers will place stresses on hydropower, which is expected to decline in summer production due to reduced flows (University of Washington Climate Impacts Group, 2009).

Profile of Regional Emissions Sources

A 2002 inventory of industrial emission sites was conducted by NPS staff. This effort focused on sources in Island, Jefferson, Whatcom, Snohomish, and Whatcom counties, as well as sites in the lower mainland of British Columbia. This effort included 51 sites in the five counties, and another 377 sites in Canada thought to contribute to pollution in the park complex. Annual emission output for the U.S. sites in 2002 was approximately 73,000 tons, with nearly half the total coming from Intalco aluminum in Ferndale, Washington (34,500 tons). The majority of the rest is from the Texaco, Arco, and Tesoro refineries on Cherry Point and March Point (25,000 tons). Output data from sources in Canada was not available.

Climate Change in Ross Lake NRA

The climate of Ross Lake NRA is sensitive to change due to its proximity to the Pacific Ocean and location within the global westerly winds. Climate change is also natural, and evidence collected within Ross Lake NRA by geologists indicates that mean annual temperature during the last ice age 25,000 years ago was 7°C (12.6°F) below today. Within the current interglacial period, geologic evidence indicates that mean annual temperature has varied by about ±3°C (±5.4°F), although within the last 1,000 years before the 20th century mean annual temperature varied by ±0.4°C (±.72°F). Variation in precipitation over long time periods is more difficult to quantify.

Climate of Ross Lake NRA is currently warming rapidly; mean annual temperature has risen about 1°C (1.8°F) since the end of the 19th century, as illustrated by the loss of half the glacier area in the park complex. This change is beyond observed temperature variation over the past millennium. Projected future climate changes for the Pacific Northwest will be influenced by rising sea level warming sea surface temperatures, which may enhance El Niño conditions. Rapid warming will result in stronger coastal winds, less snowfall, continued rapid loss of glaciers, higher treeline, and intense periods of rainfall and associated flooding. A stronger Sonoran High pressure cell in summer could result in longer, more severe seasonal and interannual droughts. Average climate model projections of mean annual temperature increases in the coming decades for this region are 0.45°C (.81°F) per decade. Mean annual precipitation is expected to increase by as much as 14 percent by the 2040s (Climate Impacts Group).

Ross Lake NRA Carbon Emissions Inventory

Ross Lake NRA's 2007 carbon footprint was analyzed using the Climate Leadership In Parks (CLIP) tool, a greenhouse gas emissions inventory model jointly developed by the EPA and the NPS. Most of the data needed to perform the calculations was taken from existing reports and records. These items included the amount of electricity purchased, waste sent to the landfill, and fuels consumed. Additional motor vehicle data was derived from a combination of road counter data and visitor use surveys. The findings show that motor vehicle use is the largest contributor to greenhouse gases (approximately 87 percent of emissions). In comparison, emissions resulting from solid waste disposal, stationary combustion, purchased electricity, refrigeration, and other greenhouse gas (GHG) sources were negligible (5 percent or less). These findings provide a rough initial look at the carbon footprint of Ross Lake NRA. Further monitoring and analysis using the CLIP tool will be continued into the future and compared against the 2007 baseline. (See Table 5.2).

Air Quality

Air quality at Ross Lake NRA is strongly influenced by the region's climate and topography. Deep mountain valleys, downslope winds, and frequent summer temperature inversions in Ross Lake NRA can restrict air flow and exacerbate air quality problems. Westerly winds bring pollutants to the park complex from sources in the Puget Lowland, as well as Asia.

Table 5.2 2007 Baseline Emission Results for Ross Lake NRA - Metric Tons Carbon Dioxide Equivalent

Park Unit	Stationary Source	Purchased Electricity	Mobile Source	Refrigeration	Waste	Other GHG Sources	Gross Emissions	Net Emissions
Ross Lake NRA Operations	159	115	35	13	248	20	590	590
Visitors	1		4,578	80		0	4,659	4,659
Ross Lake Resort	0	0	120	0	0	0	120	120
Other Permitted Activities	16	0	0	1	0	81	97	97
Gross Emissions	176	115	4,732	94	248	101	5,466	5,466
Net Emissions*	176	115	4,732	94	248	101		
* Net Emissions = Gross Emissions - Carbon Sequestration								
Ross Lake NRA Operational Data Stationary Combustion: 24,943 gallons of propane; 100 cords of wood (Seattle City Light) Purchased Electricity: 247,999 kilowatt hours (purchased from Puget Sound Energy) Mobile Combustion: 618,476 vehicle miles traveled (Park Operations); 12,890,500 vehicle miles traveled (Visitors) Solid Waste: 159 short tons								

The Clean Air Act of 1977 established North Cascades National Park as a mandatory Class I area, along with adjacent Glacier Peak and Pasayten Wilderness areas, while Ross Lake NRA was designated as a Class II area. Class I areas are afforded the greatest protection under the act, which seeks to prevent significant deterioration of air quality, particularly in Class I areas. A formal process exists whereby the NPS can request the State of Washington to redesignate the Ross Lake NRA airshed from Class II to Class I.

Various metrics of air quality have been monitored in and near Ross Lake NRA since 1984 by several agencies and programs. The NPS Air Resources Division in Denver coordinates these activities, while sites are maintained by park complex staff. Review of applications for new point source permits is conducted by the Washington State Department of Ecology. Analysis is based on regional computer models that incorporate weather conditions from meso-scale climate models.

The North Cascades air quality monitoring program has included several data collection systems, including acid deposition, visibility, haze, ozone, and wet/dry deposition. An IMPROVE site (Interagency Monitoring of Protected Visual Environments) near the Ross Dam contains an aerosol sampler that continually samples and analyzes air every week for

substances such as sulfates, nitrates, organic carbon and particulates. A nephelometer provided by Washington State Department of Ecology was also installed at the Ross IMPROVE site, but due to a lack of funds its use was discontinued in 2006.

The objectives of IMPROVE are to establish current visibility and aerosol conditions in mandatory Class I areas, to identify chemical species and emission sources responsible for existing man-made visibility impairment, and to document long-term trends for assessing progress towards the national visibility goal. This monitoring is a response to the Regional Haze Rule, which dictates that regional haze monitoring shall be done in protected federal Class I locations. In addition to the IMPROVE monitoring, in 2003 a visibility web camera, which takes images hourly, was installed at the North Cascades Visitor center to monitor regional haze. Although IMPROVE data have been collected at Ross Dam since 2001, there is no apparent trend in visibility through 2007. While the period of record is short, and data from 2003 and 2004 substandard, data from the adjacent Pasayten Wilderness also show no trend. During periods of high forest fire activity the nephelometer at Ross Dam did record several week-long periods of reduced visibility.

Acid deposition has been monitored at Marblemount since 1984. Sensors monitor pH of precipitation,

as well as sulfate, nitrate, ammonium, calcium magnesium, sodium, chloride, and potassium, as part of the National Atmospheric Deposition Program. There were no apparent trends between 1996 and 2005 in sulphate and nitrate at Marblemount. Recent sampling of lichen detected increased levels of nitrate with higher elevations.

Dry deposition of sulfur dioxide, particulate sulfate, nitric acid, particulate nitrate and particulate ammonium was monitored, as part of the Clean Air Status and Trends Network, in Marblemount from 1996 – 2008. Dry deposition is relatively low for all compounds; the park complex ranks in the lowest 10th percentile of network sites nationwide. Data indicate that dry nitrogen deposition is about 10 percent of wet deposition, while dry sulfur deposition is about 8 percent of wet deposition (i.e. most loading during rain events).

Ozone was monitored at Marblemount from 1996-2008. Before measurements were discontinued, ozone monitoring showed diurnal cycles in low-level ozone production, with high concentrations in the range of 30-40 parts per billion that were not high

enough to exceed human health standards or harm sensitive vegetation. A recent research project involved installing passive ozone monitors at higher elevations in the Stephen Mather Wilderness, but no results have been reported.

Recent research has focused on atmospheric pollutants deposited in snow, from fog, and in surface water systems. Preliminary results from the Western Airborne Contaminants Project and other research indicate that we are receiving mercury and pesticide pollution from sources adjacent to the park complex as well as across the Pacific Ocean. Elevated levels of mercury and organochlorine compounds have been found in snow and fish tissues from high elevation lakes. The park complex was the only park in the western US where heptachlor was detected, while concentrations of polycyclic aromatic hydrocarbons, endosulfans, historic use pesticides and other chlordane compounds ranked above median values for 20 National Parks. A wide range of pollutants were also detected in vegetation samples, and an increasing concentration of polychlorinated biphenyls and pesticides in lichens with elevation.



Air Quality has been measured since 1984 for Ross Lake NRA.

Natural Soundscapes

A soundscape can be defined as the aggregate of all the sounds in an area, including sounds inaudible to the human ear. Soundscapes are typically composed of a variety of both natural ambient sounds and human-caused sounds. The NPS is required to preserve *natural* soundscapes, which are composed of the natural sound conditions in a park that exist in the absence of any human-produced noises (park units that possess cultural sounds are also required to preserve the cultural soundscape). Examples of natural sounds commonly heard in Ross Lake NRA include flowing water, bird songs, and wind. Examples of human-caused sounds commonly heard in some areas of Ross Lake NRA include human voices and sounds produced by vehicles, motorboats, and jet airplanes. Human-caused sounds and sound levels (or loudness) may be appropriate or inappropriate depending on the management zone of an area.

The NPS recognizes natural sounds as inherent components of the resources it is required to protect under the Organic Act. Natural sounds are vital to the natural functioning of ecosystems; birds, insects, mammals, and amphibians rely on sounds as part of complex communication networks. In habitats where wildlife vocalizations signify mating calls, danger from predators, or territorial claims, hearing these sounds is important to animal reproduction and survival. The natural soundscape is also a key element of the visitor experience in national parks. As was reported to the U.S. Congress in the “Report on the Effects of Aircraft Overflights on the National Park System,” (1994) a system-wide survey of park visitors revealed that nearly as many visitors come to national parks to enjoy the natural soundscape (91 percent) as come to view the scenery (93 percent).

There are three major sources of noise intrusions that occur within Ross Lake NRA: vehicles, motorboats, and aircraft. Because of the topography of the highway corridor (deep, narrow valleys surrounded by 7,000'+ peaks), sounds can be magnified within the valley. For example, a party climbing Colonial Peak at 7,444' can clearly hear motorcycles on the highway below, even though they are well within designated wilderness and what feels like a long distance from the highway. Noise intrusions from motorboats and occasional float plane landings occur most frequently on Ross Lake, where many visitors go to seek a more primitive lake recreation experience using self-propelled boats or on foot along the shoreline. Overflights by commercial jets, airplanes, propeller aircraft, helicopters, and

military aircraft can also be heard within Ross Lake NRA. Helicopter use for NPS administrative purposes occurs frequently within Ross Lake NRA during the summer.

Soundscape Monitoring

In 2006, NPS resource managers began collecting acoustic and sound source data as part of a complex-wide soundscape monitoring effort. Data was collected at four sites within Ross Lake NRA; from north to south, these sites were located at Hozomeen, just north of Rainbow Point along Ross Lake, along the north side of Ruby Arm, and near Colonial Creek Campground (See Figure 5.2). Monitoring locations were chosen primarily to characterize the soundscape associated with different human uses within Ross Lake NRA; accessibility to each site was also a key factor.

Data collected at the four sites includes sound pressure level (measured in decibels (dB)), continuous digital audio recordings, and on-site sound source listening. Sound pressure level data helps in determining how loud sound sources are, while digital audio recordings and on-site sound source listening assist in the identification of those sound sources. These measurements allow the calculation of a variety of metrics, including ambient sound levels, time of audibility, noise free intervals, and time above specific decibel levels. These metrics, described below in more detail, are used to characterize the soundscape at each of the sampling sites.

Median A-weighted existing ambient: describes normal daytime and nighttime sound levels audible by the human ear (in Decibels Audible (dBA)).

Median A-weighted natural ambient: describes normal daytime and nighttime sound levels audible by the human ear when all human-caused sounds are removed from the existing ambient (in dBA).

Mean percent time audible: indicates the average amount of the 24-hour day that is affected by human-caused sounds.

Noise free interval (NFI): indicates the amount of time between human caused sound events during the daytime. This is reported using maximum and average intervals.

Time above 35 dBA: indicates the percent of time above 35 dBA (level at which sound can have adverse effects on blood pressure while sleeping).

Time above 45 dBA: indicates the percent of time above 45 dBA (level below at which the World

Acoustic Monitoring Sites within Ross Lake NRA

Ross Lake National Recreation Area GMP/EIS

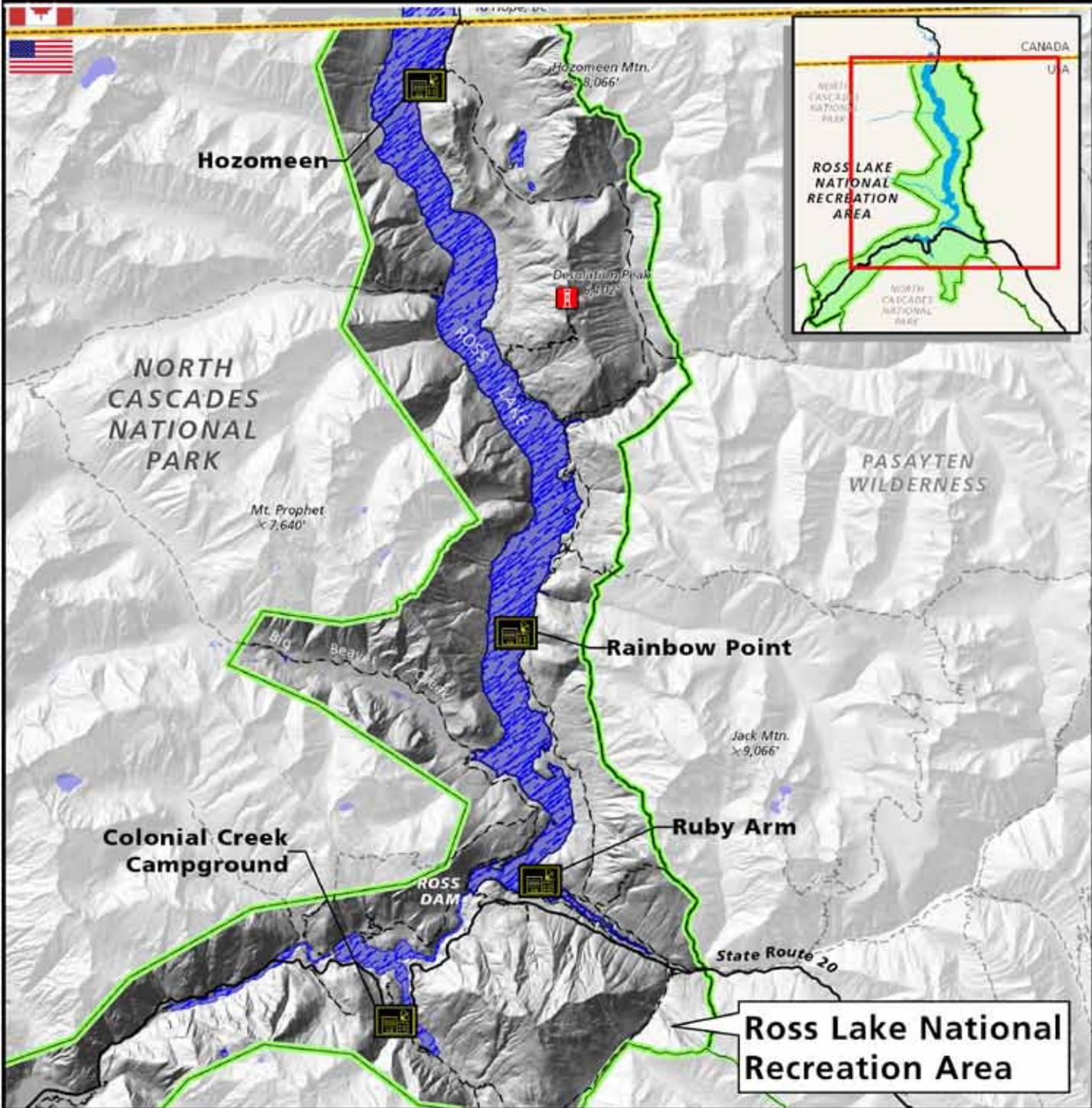
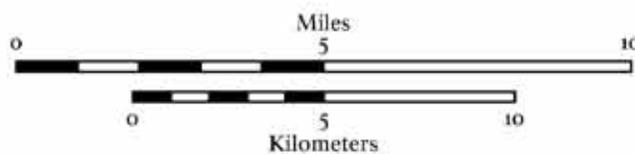


Figure 5.2

- Acoustic monitoring sites
- Desolation Fire Lookout
- Roads
- Trails

mapscale 1:81,250



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North Cascades National
Park Service Complex
12 May 2010
ah/ross_lake_gmp/draft_acoustics.mxd

Health Organization recommends noise levels should be inside bedrooms).

Time above 52 dBA: indicates the percent of time above 52 dBA (level at which speech interference would occur during an interpretative program; speaker talking in a “raised voice” is 10 meters away from audience).

Time above 60 dBA: indicates the percent of time above 60 dBA (level at which speech interference occurs between individuals speaking at normal level, one meter away from each other).

Preliminary Monitoring Results

Colonial Creek Campground

Results indicate that Colonial Creek Campground is the loudest of the four monitor sites (See Table 5.3). The daytime existing ambient is 39.4 dBA and the nighttime existing ambient is slightly quieter at 37.0 dBA. Both the daytime (37.6 dBA) and nighttime (36.8 dBA) natural ambient sound levels (with human sounds removed) are not significantly quieter than the existing ambient and they are also by far the loudest of the four monitored sites. The source of these natural sounds is likely running water of streams and drainages surrounding the campground. It is probable that the pervasive sound of running water masks some of the human-caused sounds, effectively lowering the amount of time that human-caused sounds are audible (37.4 percent of the time) in this location. Despite the likelihood that some human sounds are masked by natural sounds, the longest daytime period recorded without human sounds (maximum NFI) was still only one minute and 56 seconds (1:56), and the average NFI was a mere 0:20. A closer look at the sound sources reveals that vehicles, including cars, trucks, motorcycles, and RVs are largely the source of human-caused sounds in this location. Percent Time Above metrics (See Table 5.4) also show that this site is the loudest. Sounds are above 35 dBA 99.9 percent of the time during the day and 100 percent of the time during the night. These values are so high due to the constant sound of running water in the vicinity of the campground. The percent time that sounds are above 45 dBA, or the level below at which noise levels should be inside bedrooms, drops considerably to 8.8 percent during the day and 1.3 percent during the night. Sounds were greater than 52 dBA (day and night) and 60 dBA (day) less than one percent of the time, and never greater than 60 dBA during the night.

Ruby Arm

The monitor site along Ruby Arm is second loudest after Colonial Creek Campground with an existing ambient of 35.5 dBA during the day and 28.4 dBA during the night. This site holds the biggest difference between daytime and nighttime ambient sound levels; this can probably be attributed to the drop in traffic that occurs at night, which is more perceptible at this location due to lower natural ambient sound levels (32.5 dBA daytime and 27.8 dBA nighttime). This site is also a close second behind Colonial Creek Campground with human-caused sounds being audible 36.7 percent of the time, the maximum daytime NFI at 5:30, and the average daytime NFI at 0:45. The source of most of the human-caused sounds at Ruby Arm is highway traffic with a small amount of watercraft. Percent Time Above metrics show that sounds are above 35 dBA 55.9 percent of the time during the day and 24.1 percent of the time during the night. Daytime sound levels above 45 dBA are slightly higher (9.7 percent) at this site during the day than those at Colonial, whereas nighttime sound levels are slightly lower at 1.2 percent of the time. Sounds were greater than 52 dBA (day and night) less than one percent of the time and never greater than 60 dBA at any time.

Rainbow Point

The monitor site at Rainbow Point ranks third for daytime sound levels with an existing ambient of 32.6 dBA and a natural ambient of 30.9 dBA. Nighttime ambient levels are almost the same for existing (28.4 dBA) and natural (28.3 dBA), meaning that there are very few human-caused sounds that are audible at Rainbow Point during the night. This site has the lowest figure for percent time that human sounds are audible over a 24-hour period at 18.7 percent. Noise free intervals are by far the longest at this site, with a maximum NFI of 25:21 and a mean NFI of 3:07. The largest source of human-caused sounds in this location is watercraft, though aircraft noise also contributes. Percent Time Above metrics show that sounds are above 35 dBA 33.1 percent of the time during the day and 17.6 percent of the time during the night. Sounds above 45 dBA occur less than one percent of the time during both day and night, and never go above 52 dBA.

Hozomeen

The quietest of the four sites monitored is Hozomeen. The daytime existing ambient, 24.4 dBA, is over 15 dBA lower than what was recorded at Colonial. The

Table 5.3 Ambient Sound Levels, Percent Time Audible, and NFI

Site Location	Median A-weighted Existing Ambient (in dBA)		Median A-weighted Natural Ambient (in dBA)		Mean % time human sounds are audible	Noise Free Interval (NFI)	
	Day (7am – 6:59 pm)	Night (7pm - 6:59 am)	Day (7am – 6:59 pm)	Night (7pm - 6:59 am)		Max (min:sec)	Mean (min:sec)
Colonial Creek Campground	39.4	37.0	37.6	36.8	37.4%	1:56	0:20
Ruby Arm	35.0	28.8	32.5	27.8	36.7	5:30	0:45
Rainbow Point	31.8	28.6	30.9	28.3	18.7	25:21	3:07
Hozomeen	24.2	22.2	23.0	21.8	32.3	10:53	1:54

Table 5.4 Ambient Sound Levels, Percent Time Above dBA

Site Location	> 35 dBA		> 45 dBA		> 52 dBA		> 60 dBA	
	Day (7am – 6:59 pm)	Night (7pm - 6:59 am)	Day (7am – 6:59 pm)	Night (7pm - 6:59 am)	Day (7am – 6:59 pm)	Night (7pm - 6:59 am)	Day (7am – 6:59 pm)	Night (7pm - 6:59 am)
Colonial Creek Campground	99.9%	100.0%	8.8%	1.3%	0.8%	0.1%	0.1%	0.0%
Ruby Arm	55.9	24.1	9.7	1.2	0.7	0.1	0.0	0.0
Rainbow Point	33.1	17.6	0.9	0.5	0.0	0.0	NaN	0.0
Hozomeen	5.9	0.5	0.7	0.1	0.2	0.0	0.0	NaN

dBA: Decibels Audible NaN: no number was generated because no sounds were above this decibel level

nighttime existing ambient is 22.2 dBA. Removing human-caused sounds, the natural ambient becomes 23.0 during the day and 21.8 during the night. Although ambient sound levels at Hozomeen are much quieter than those at Colonial, human-caused sounds are still audible 32.3 percent of the time. In contrast to Colonial, where higher natural ambient sound levels are likely to mask some human-caused sounds, at Hozomeen lower natural ambient sound levels allow for most human-caused sounds to be heard and recorded. Hozomeen has the second-longest maximum daytime NFI at 10:53 and an average NFI of 1:54. The main source of human-caused sounds at this location is aircraft with a smaller amount attributed to watercraft. Percent Time Above metrics also show that this site is the quietest. Sounds are above 35 dBA 5.9 percent of the time during the day and 0.5 percent of the time during the night. Sounds above 45 dBA occur less than one percent of the time during both day and

night, and only go above 52 dBA 0.2 percent of the time during the day.

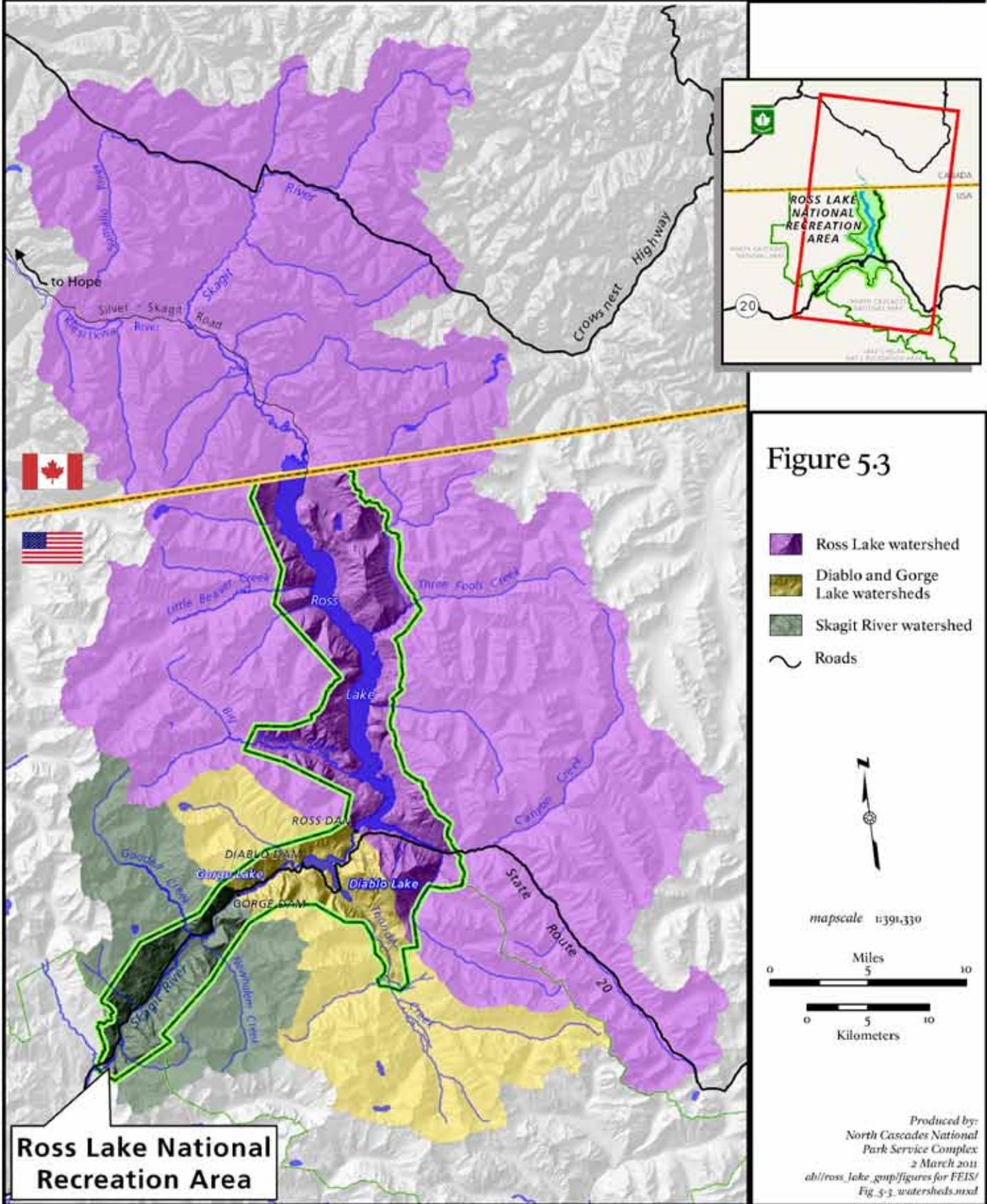
Water Resources

Watersheds

Ross Lake NRA straddles the Skagit River, which drains an area of 3,000 miles² before reaching Puget Sound, including parts of Canada, two national forests, and private and state lands in Whatcom and Skagit Counties in the United States. There are three primary watersheds within Ross Lake NRA above the three hydroelectric dams (See Figure 5.3). The Ross Lake watershed is the largest and encompasses 1,017 miles² (650,880 acres) that is drained by seven major tributaries including Big Beaver, Little Beaver, Lightning, Devils, and Ruby Creeks in the U.S. The NPS is a minority land owner in the Ross Lake

Watersheds draining into Ross Lake NRA

Ross Lake National Recreation Area GMP/EIS



watershed. The combined area of Diablo and Gorge Lake Watersheds is 174 miles² (111,400 acres), and includes two main tributaries, Thunder and Stetattle Creeks, which are managed mainly by the NPS with small in-holdings owned by Seattle City Light. The lowest point in Ross Lake NRA is 354 feet above sea level where the Skagit River meets Bacon Creek at the western edge of Ross Lake NRA.

The Skagit River is the only stream that crosses the Skagit hydrologic crest, a major hydrologic divide running from Cascades Pass to Mt. Redoubt. Geologic data indicates that the river used to flow in two directions from the crest; west to Puget Sound and north to the Fraser River (Riedel et al., 2007). The Ross Lake portion of the Skagit watershed lies between the Skagit Crest and the Pacific Crest to the east.

Glaciers are a significant resource within the Skagit watershed, with more than 300 glaciers identified in a recent inventory (Granshaw, 2001). Most of the glaciers are found along the Skagit Crest, with only a few small glaciers on the Pacific Crest. Nohokomeen Glacier at the headwaters of May Creek and Challenger Glacier in Little Beaver valley are the largest glaciers at 444 acres and 871 acres, respectively.

Floodplain and Channel Migration Zones

Geologic mapping indicates that only about 3 percent of the Skagit watershed is floodplain, but most of this area has been inundated by waters impounded by the three main hydroelectric dams. The largest remaining extensive floodplain along the Skagit River is found between the town of Newhalem and the western boundary of Ross Lake NRA. This floodplain has also been significantly impacted by the Skagit Hydroelectric Project. In general, flood storage behind Ross Dam has reduced extremes in discharge and virtually eliminated sediment supply from the upper portion of the valley. The elimination of large floods on the river below Newhalem has stabilized the position of the river on the floodplain. Only minor modification of in-stream bars and islands is evident since 1956. The primary effect of increased stability has been to decrease the movement of sediment from the river banks and upper watershed into the river. Changes in channel shape and elevation of the bed of the river have been minor since project construction. Degradation of the river bed by 0.6 ft. between 1943 and 1950 at the Alma Creek gauging station is related to closure of Ross Dam. A large 1967 flood, however, caused aggradation of the bed at the same site to within 0.2 ft. of its pre-Ross level. Stable bed elevations at a gauging station farther upstream may be due to armoring of the bed with

coarse clasts. Changes in bed material size and sediment movement were not addressed.

Reservoirs

Ross Lake, Diablo Lake and Gorge Lake compose the three impoundments of the Skagit River created by the Seattle City Light hydroelectric project. Ross Lake, the largest of the three reservoirs, is located in the northeastern part of Ross Lake NRA. At full pool Ross Lake has a surface area of 11,700 acres, with 1186 acres (480 hectares) located in British Columbia. It is 22 miles long and extends one mile into British Columbia at full pool. The northern portion of Ross Lake is shallow with an average depth of 49 feet and the lake has a maximum depth of 400 feet at the base of the dam. Water level fluctuations in Ross Lake vary annually and may range from 1,602.5 feet above mean sea level to 1,475 feet mean sea level, a range of 127 feet. The volume is 770,000 acre-feet (Looff 1995).

Diablo Lake lies below the Ross Lake reservoir and receives 86 percent of its inflow from Ross Lake and 14 percent from Thunder Creek. Diablo Lake has a surface area of 910 acres making it the second largest reservoir in Ross Lake NRA. Its maximum depth is 207 feet near the base of the dam and stores 89,880 acre-feet of water at full pool (Burgner 1977). Full pool elevation is 1,205 feet mean sea level and annual water level fluctuations range from 10 to 12 feet.

Gorge Lake, the farthest downstream reservoir, is also the smallest. Gorge Lake has a surface area of 240 acres, a maximum depth of 118 feet and stores 9,758 acre-feet of water (Burgner 1977). It fluctuates only a few feet from its full pool elevation of 875 feet mean sea level.

Manipulation of reservoir level contributes to erosion by seasonally focusing wave energy on different parts of the bank. During pool drawdown and filling, material previously eroded is transported downslope, preventing the establishment of beaches or equilibrium shore profiles. As a result wave energy at full pool is dissipated directly on bluffs. Shorelines on Ross Lake have receded as much as 135 feet above full pool over the life of the reservoir. Bank recession rates estimated by two methods vary for individual stretches of shore and vary with time. Measurements of bank recession rates range from 2.4 inches per year to over 6 inches per year. These rates are within the range of those reported for other reservoirs in North America. Assuming an average recession rate of 30 cm (4.8 inches) per year for all eroding shorelines on Ross Lake, approximately 1.7 acres per year are lost to

erosion along the entire 60 miles of shoreline. Similar rates of recession were measured on Diablo and Gorge lakes.

Erosion of areas below full pool on Ross Lake has removed as much as 9 feet vertically of sediment on steeper slopes. In most areas erosion has completely removed pre-reservoir soils leaving behind a lag deposit of coarse gravel and cobbles. The lag deposits protect the bank from further recession, but are prone to downslope movement as the reservoir level falls.

Lakes and Ponds

Ross Lake NRA contains 68 small lakes and ponds. These water bodies range in size from 0.1 to 39 hectares (.25 to 96.4 acres) in size (See Table 5.5). Lake origin is variable, however almost 60 percent of the lakes are maintained or strongly associated with beaver activity. Eleven of the ponds are old gravel pits, created during the construction of Skagit Hydroelectric Project as a source for aggregate for the concrete used to build the dams. The aggregate ponds are not fed by significant surface runoff, and their water levels are tied to the ground water table.

Wetlands

Wetlands are important resources to both Ross Lake NRA and the communities downstream. These systems provide many ecosystem services by moderating flood events, controlling erosion, filtering fine sediments and nutrients, storing water during seasonal low flow periods and episodic droughts, providing fish and wildlife habitat, as well as opportunities for education and research.



Diablo Lake is a reservoir in Ross Lake NRA.

The National Wetlands Inventory generated by the US. Fish and Wild Service identified 643 acres of paulustrine wetlands in Ross Lake NRA at 1:24,000 scale. This information should be considered a baseline measure for wetlands in Ross Lake NRA as on-the-ground surveys often reveal more extensive wetland complexes. Nonetheless, it does indicate the significance of this area regarding wetland conservation. These wetlands are predominantly located in four general areas: Big Beaver Creek; the mouth of Thunder Creek; Lightning Creek above the Three Fools Creek confluence; and riparian areas adjacent to the Skagit River downstream of the Goodell Creek confluence. Riparian wetlands constructed on the floodplain of the Skagit River provide essential habitat for rearing Coho salmon.

Hydrologic Processes

In Ross Lake NRA area, both spring and fall floods significantly contribute to the level of Ross Lake and the amount of sediment delivered into it from tributary systems. Major flooding in the North Cascades can occur at two times per year. During fall (late October through December) rain-on-snow

Table 5.5 Well Known and Prominent Lakes and Ponds in Ross Lake NRA

Water Body	Size (Acres)
Bouck Lake	10.9
Colonial Ridge Pond	0.0
County Line Pond	2.5
County Line Pond	1.2
County Line Pond	0.7
County Line Pond	0.5
Hozomeen Lake	97.4
Miner's Pond	0.2
Newhalem Ponds	14.6
Newhalem Ponds	4.9
Panther Potholes Lower	0.5
Panther Potholes Upper	0.2
Pyramid Lake	0.5
Ridley Lake	10.9
Ross Resort Pond	0.7
Ruby Mtn Lake	0.5
Thunder Lake	6.7
Unnamed beaver pond	13.6
Willow Lake	16.8

events, heavy warm rainfall exceeding 10 cm (3.9 inches)/day over several days triggers the largest magnitude floods. These floods rise and fall rapidly, with flood peaks often occurring in a day or less. This type of flooding dominates lower elevation west-side streams, including the Skagit River and its tributaries.

Flooding also occurs in the mountains due to rapid melt of heavy winter snowpack in May and June. Larger spring floods occur later in spring and can extend over several weeks into early summer. Peak flows for spring floods at lower elevations are lower than fall rain-on-snow events. At higher elevations above the rain-on-snow zone, and in colder east tributaries such as Ruby and Devil's creeks, spring flooding is dominant. Occasionally, summer floods occur as a result of intense convection and downpours associated with thunderstorm activity. The intensity and magnitude of these floods is greatest in small first- and second-order watersheds.

The NPS has monitored the mass balance of Silver and North Klawatti glaciers since 1993. These data are used to estimate glacial changes as well as glacial melt water contribution to summer streamflow. For the Ross Lake watershed, glaciers contribute from 3-14 percent of summer runoff, with an average of 5

percent (91,500 yards³). Thunder Creek watershed, which is the main stream draining into Diablo Lake, receives on average 33 percent of its summer runoff from glaciers, which equals about 143,800 yards³/year. Stream flow is monitored at a number of locations within the Skagit watershed by the U.S. Geological Survey and Seattle City Light. Main stem Skagit gages are located in the town of Newhalem and at Marblemount, while there are gages on tributaries Thunder Creek and Newhalem Creek. Records at these sites extend to the early 20th century. At several other sites temporary gages were placed on several Skagit tributaries in the mid 20th century and operated for three to four years to characterize the timing, magnitude, and annual variability of runoff into the reservoirs.

Water Quality

The water quality of the lakes, streams and rivers in Ross Lake NRA is generally in excellent condition and supports the beneficial uses identified by the Washington State Department of Ecology. However, several specific areas of concern currently exist within Ross Lake NRA that have either been listed as impaired under the Clean Water Act in the past or are at an elevated risk of impairment:



Newhalem Creek.

A watershed scale risk assessment was conducted for the park complex as part of a water quality monitoring effort for the North Coast and Cascades Network of National Parks (Rawhouser in prep). This assessment evaluated land-use, road development, recreational use and both historic and active mining activities for 122 catchments that drain into the Ross NRA (See Figure 5.4). The results of the risk assessment identified 27 catchments that are believed to be at an elevated level of risk for water quality impairment in the Ross NRA.

Water quality assessments of several tributary streams to the Skagit River in British Columbia have indicated these streams are potentially impaired due to urban development, cattle grazing and mining activity (Perrin 2008, 2009). Currently, no water quality assessments have been conducted to determine if these impairments are affecting the water quality of the main-stem of the Skagit River where it enters Ross Lake. However, the Skagit River, which is one of the major tributaries draining into Ross Lake, could become a primary source of environmental stress with increasing population growth in the town of Sunshine Valley, BC and if the Copper Giant, BC mine is expanded as currently planned.

Mill Creek, a tributary to Ruby Creek, has exceeded EPA water quality criteria for sulfides, arsenic, zinc, copper, lead and cadmium. Mine tailings, waste rock and contaminated soil from the Azurite Mine and mill site located adjacent to Mill Creek are the sources of this contamination. This site has been identified as a potential EPA Super Fund Clean-up site under the Comprehensive Environmental Response, Compensation, and Liability Act and negotiations are currently being undertaken by the USFS (the land owner) and ASARCO Inc. (operator of the Azurite Mine) for the removal or capping of the contaminated materials.

An assessment of the benthic invertebrate communities of Ruby Creek indicated these communities may be responding to environmental stress from a combination of mining activity and the effects of the North Cascades Highway (Rawhouser 2008).

Two dump sites immediately adjacent to Gorge Lake and Goodell Creek are potential contaminant sources into these waterbodies. The Gorge Lake dump site is currently covered with soil and functions as the Gorge Campground. The exact contents of this dump are unknown, however, it is believed that this site

was primarily used to hold refuse from the town of Diablo and it could potentially hold industrial waste from Diablo Powerhouse. During the construction of the Gorge Campground household refuse, medical waste and construction debris was uncovered. The Goodell Creek dump currently functions as a levee constraining Goodell Creek and was filled in by the mid 1980's. The exact contents of this site are also unknown, however it has been reported that this site holds industrial waste and is probably contaminated with arsenic and lead from sand blasting waste.

Three sites (Ross Lake adjacent to Ross Lake Resort, Gorge Lake Campground and the Skagit River near Diablo Townsite) have exceeded DOE fecal coliform criteria for water quality in the past (Kuntz, in prep). While it is believed that the sources of this impairment have been eliminated, continued monitoring is recommended since these areas were last monitored in 2000.

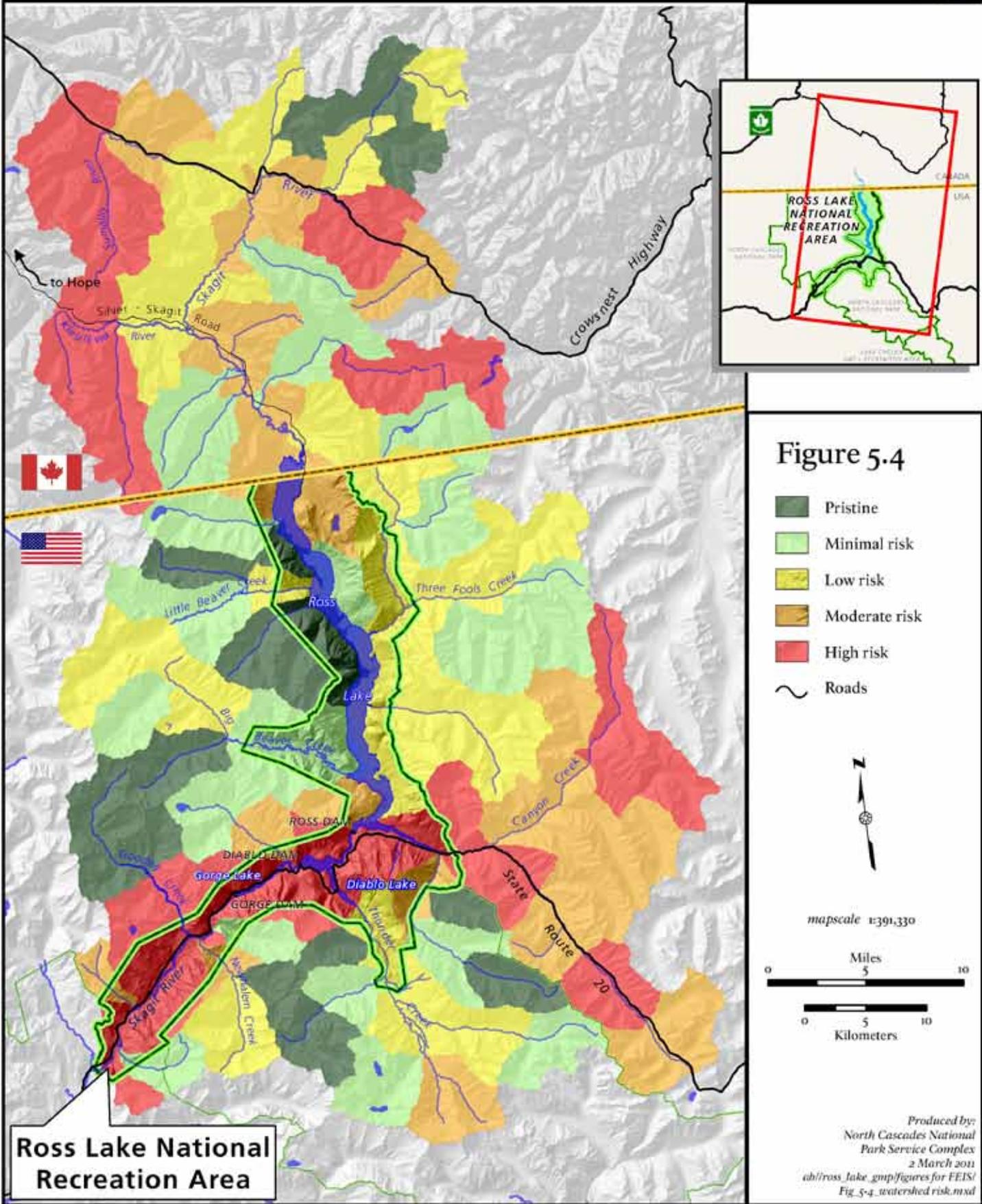
Seattle City Light operates three hydropower projects in the Ross NRA and each of these projects is a large scale industrial operation that increases the risk of water quality impairment. The characteristics of the environmental stressors from these projects is highly variable and projecting future SCL operational activity also adds to the uncertainty on setting the best course for protecting water quality. For example, on June 19, 2008 approximately 150 gallons of transformer cooling oil leaked from a heat exchange unit at the Ross Powerhouse into Diablo Lake. This oil contained traces of PCBs which bioaccumulate and are persistent in the environment. Since this event SCL has taken measures to prevent future discharges into Ross Lake NRA waters, however the possibility for such leaks still exist due to the large scale hydropower operations in the area. Seattle City Light is also planning on drilling a second tunnel for the Gorge powerhouse which will involve removing 130,000 cubic yards of material, adding another industrial operation to the Ross NRA for several years.

Flow alteration at Newhalem Creek due to the operation of the Newhalem Creek hydropower project caused this water body to be listed under section 303(d) of the Clean Water Act for lack of flow. Since the listing, SCL has implemented new management strategies to mitigate flow concerns and improve habitat for fish.

Studies involving high elevation lakes within North Cascades National Park have been particularly useful in proving a link between air pollution and

Water Quality Risk of Watersheds Draining into Ross Lake NRA

Ross Lake National Recreation Area GMP/EIS



water quality. Recent research by the US Geological Survey has documented elevated levels of mercury and organochlorine compounds in fish tissues from the park complex's high elevation lakes. In addition, giardia has been found in some surface waters.

The Washington Dept. of Ecology just released a summary of fish tissue toxicity for 16 sites across Washington State from collections made in 2007. Ross Lake was included in this survey, and reported high concentrations of mercury and PCB. While Ross Lake is below any 303(d) criteria for persistent toxic compounds, there are some reasons to be concerned (Seiders and Deligeannis 2009).

The Pacific Northwest snow component of the Western Airborne Contaminants Assessment Project sampled for a range of pollutants in the air, snowpack, and in vegetation. Results for the park complex indicate the presence of a host of semi-volatile organic compounds, including hexachlorobenzene, endosulfans, chlorpyrifos, hexachlorocyclohexane, polyaromatic hydrocarbons, heptachlor, and chlordanes. Vegetation samples from the park complex were above median values for all of the other 20 parks studied.

A study of surface water chemistry on Thornton and Newhalem creeks was conducted from 2005 to 2006 by the U.S. Geological Survey. Inorganic nitrogen was found to be high due to Puget Sound emissions, while wet sulphur deposition tended to increase with precipitation (Clow and Campbell, 2008).

Geologic Resources

The bedrock geology of the Ross Lake NRA is some of the most complicated in the world. The North Cascades mountains are located at a geologic crossroads that is the overlap between the older Coast Mountains to the northwest and the younger Cascade Mountains to the south. The region's geologic history is summarized into five major events, which included numerous periods of uplift, faulting, granitic intrusion, and mountain building. These events are driven by the continuing collision of the North American continental plate with oceanic plates, and have created a diverse mosaic of bedrock types, all of which respond differently to surficial processes.

The geology of Ross Lake NRA is divided into three major crustal blocks bounded by deep, high angle faults including the Straight Creek, Easton, Ross Lake, and Hozomeen fault zones. Topographic expression of

these faults is strong, and includes saddles on ridges, depressions, and deep canyons where streams have exploited weak rocks along the faults.

Between the Easton fault at Damnation Creek and the western Ross Lake NRA boundary are rocks metamorphosed by high temperature and low pressure such as Cascade River Schist and soapstone. Several inactive soapstone quarries are located within this area (Tabor and Haugerud, 1999). Bedrock east from Damnation Creek to the Ross Lake Fault near Ross Dam is composed of Skagit Gneiss and Chilliwack granite, which is known as the crystalline core of the North Cascades. East of the Ross Lake fault zone is the Hozomeen Group, which includes greenstone, radiolarian chert, and minor limestone (Tabor et al, 2003). The east half of Desolation Peak is composed of sandstone and argillite deposited 150 million years ago as part of the Methow terrane.

Despite the occurrence of several major faults in Ross Lake NRA, there has been little seismic activity in the last century. In fact, several of these faults may not have been active for many millions of years. The largest recorded earthquake in the region occurred in 1872 and had a magnitude of 7.2. Although the exact epicenter of this fault is not known, it is believed to have occurred somewhere between the south end of Ross Lake and the north end of Lake Chelan. The most recent earthquakes to have shaken Ross Lake NRA have had epicenters located to the west of the park, and relatively small magnitudes in the 3-4 range.

Topography

Several important topographic features dominate Ross Lake NRA, including glaciated summits, deep glacial valleys, Skagit Gorge, and the asymmetry in shape of the valleys on either side of Ross Lake. Local relief in Skagit valley is 7875 feet from the floor of Skagit Gorge to the summit of Jack Mountain just outside the Ross Lake NRA boundary, which is some of the most extreme vertical topography in the lower 48 states.

These topographic features were created primarily by multiple ice age glaciations that included both alpine and continental ice sheet styles of glaciation. Alpine glaciers flowing off of adjacent mountains cut deep, straight U-shaped canyons, while the ice sheets flowed out of Canada to the south. The primary effects of ice sheet glaciations were to enlarge valleys like the upper Skagit that trend north-south, round-off low summits and ridges, and to create the Skagit Gorge. These two types of glaciers had dramatically different sizes. Alpine glaciers filled valleys to depths of several

hundred yards, but the Cordilleran Ice Sheet was greater than 1.5 km (a mile) thick at the latitude of Ross Lake.

Along with Ross Lake, the Skagit Gorge is the other primary feature of Ross Lake NRA. The Skagit is the only stream that runs across, or perpendicular to the northwest-southeast structural and topographic grain of the region. Continental glaciation by the Cordilleran Ice Sheet caused the drainage throughout this region to be rearranged. Valleys that used to drain north, like the Skagit, were blocked by the advancing ice. These ice dams created several lakes which in turn drained south, cutting deep canyons in several watersheds. As a result, when the ice sheet retreated, major rivers and creeks were re-directed to drain south. The Skagit is the most prominent example of this stream piracy; another is Lightning Creek.

The difference in the shape of valleys on either side of Ross Lake is a dramatic illustration of the effect of climate on processes like glaciation that form valleys. Major tributaries on the west-side of Ross Lake have wetter climates than those entering from the drier east side. As a result, glaciers west of Ross Lake were large and cut deep, broad, U-shaped canyons from valley heads to the Skagit. In contrast, alpine glaciers on the drier east side of Ross Lake were much smaller and confined to the upper 12.4 miles of Three Fools, Devils and Ruby creeks. As a result, these streams enter Ross Lake as deep, narrow, winding, water-cut canyons.

Landforms and Surficial Geologic Processes

Several geologic processes continue to shape the topography of Ross Lake NRA, including glaciation, mass wasting, and erosion and deposition by rivers. Surficial geology of the area has been mapped by the NPS as part of the North Cascades landform inventory, which is focused at the 1:24,000 scale and is linked to the National Hierarchical Framework of Ecological Units (See Figure 5.5, Table 5.6, and Table 5.7). There are 37 distinct landforms mapped in Ross Lake NRA, which represent geologic events that occurred millions of years ago, or as recently as the last season.

Nearly 1/2 of the upper Skagit valley is classified as valley wall consisting of steep bedrock slopes with discontinuous cover of hillslope and glacial sediment. Valley walls are the source area for most major landslides, and the inventory identified a total of 189 mass movements classified into one of six categories based on failure type and material. These include debris avalanches, rock falls/topples, debris torrents,

sackings, slumps, and snow-avalanche impact landforms.

Debris avalanches have garnered the most interest since they are significant sources of sediment and capable of blocking the largest streams for extended periods. Several large landslides have been mapped along the main stem Skagit River. Hummocky deposits from two massive landslides, one off of the west face of Desolation Peak and another from the west valley wall across from Devils Creek, are submerged beneath the waters of Ross Lake. Big Beaver, Little Beaver and Lightning creeks also have been impacted by large landslides. The Damnation Creek landslide blocked the Skagit River from about 8,000 to 6,000 years ago, creating Lake Ksnea (Riedel and others, 2001). The largest rapids on the Skagit River (a.k.a. the S curves, or Portage) below Newhalem occur where the river cuts through the landslide dam.

Heavy precipitation in December 2003 triggered two large debris avalanches that are impacting the North Cascades Highway. A debris avalanche in Skagit Gorge released several hundred thousand cubic yards of rocky debris that remain perched above the highway in the headwaters of Afternoon Creek. In November of 2003, the Goodell Creek landslide delivered approximately 3.8 million cubic yards of debris that temporarily blocked Goodell Creek and formed a large lake. As this material is carried by the river downstream two miles, it is causing aggradation of lower Goodell Creek which is resulting in increased flooding and erosion that threatens the North Cascades Highway bridge over Goodell Creek and the Lower Goodell Group Camp and Goodell Creek Campground.

Debris torrents are another class of mass movement that occur in steep first and second order stream channels on valley walls. Two of the most active debris torrent systems in Ross Lake NRA are Rhode and Sourdough creeks. Both of these streams faithfully follow the Thunder Lake Fault, which provides abundant sediment that, under natural conditions, is flushed out of canyons every 25 years or so. Removal of sediment from the debris cones at the bottom of these streams has triggered instability.

Soils

The National Resource Conservation Service is in the process of producing a soils map for the entire complex. Since the terrain of the complex is inherently difficult to map as a traditional soil survey, the National Resource Conservation Service is using a GIS-based

Landform Map of Ross Lake NRA and Associated Watersheds

Ross Lake National Recreation Area GMP/EIS

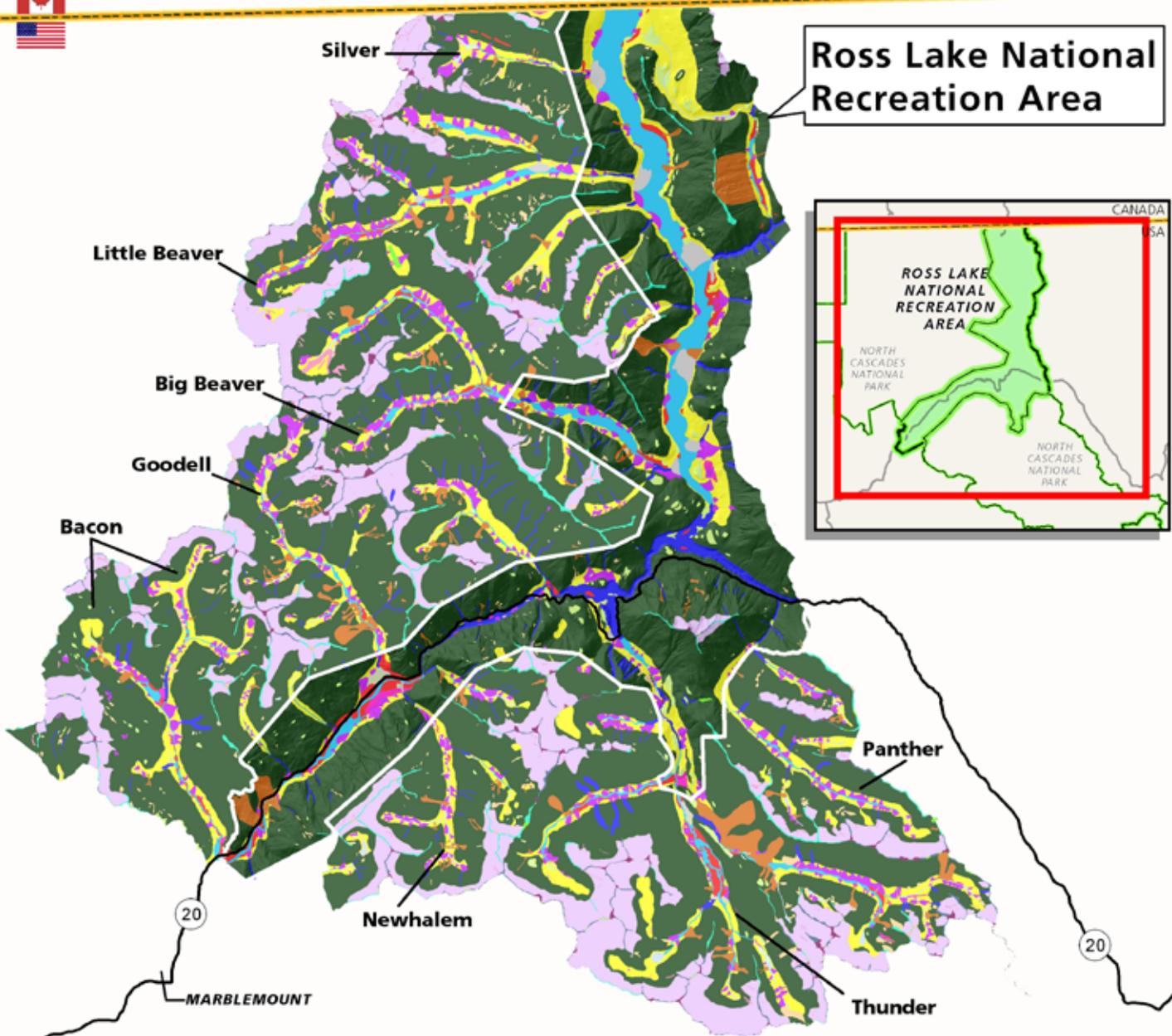
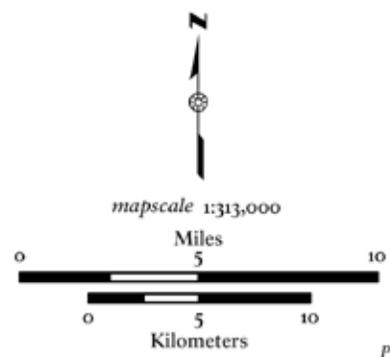


Figure 5.5

- | | | |
|---------------|----------------------------------|---------------------|
| Alluvial fan | Horn | Pass |
| Arete | Little Ice Age Moraine | Pleistocene moraine |
| Bedrock bench | Mass movement - debris avalanche | Ridge |
| Cirque | Mass movement - debris torrent | River canyon |
| Debris apron | Mass movement - fall/topple | Terrace |
| Debris cone | Mass movement - sackung | Undifferentiated |
| Delta | Mass movement - sail | Valley bottom |
| Fan terrace | Mass movement - slump/creep | Valley wall |
| Floodplain | Other mountain | |



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1 March 2011

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model that incorporates vegetation, surficial geology, hydrology, and topographic data to map soils. The model is verified by soils test pits dug at dozens of locations within a given watershed. Known as RASP (Remote Area Sensory Proxy), this model has already been applied to the 29,000 ha (71,661 acres) Thunder Creek Watershed (Briggs, 2004). In that study, 120 pedons were observed and described to represent the major combinations of soil-forming factors. The authors of the study found that the surficial geology layer was beneficial in predicting the soil properties because it summarizes parent material, landform age and slope stability. Four main soil orders have been identified, including entisols, spodosols, inceptisols, and andisols. Most floodplain and recent mass movement deposits are entisols and inceptisols. Andisols form on older landforms and in debris accumulation zones at the toe of valleys walls where volcanic ash deposits are concentrated. Spodosols are found on the oldest surfaces that date to the end of the last ice age beneath conifer vegetation. Preliminary

application of these results in other watersheds is revealing a similar pattern.

Geologic Hazards

Steep topography, narrow valleys, and heavy precipitation combine to produce the primary geologic hazards within Ross Lake NRA. Valley walls produce snow avalanches, rock falls, debris avalanches, and debris torrents. Canyons such as Skagit Gorge are particularly hazardous locations due to the frequency and size of these events. As a result, the North Cascades Highway through Skagit Gorge is often closed in winter due to hazards from rock falls, debris avalanches, and snow slides. A 1999 snow avalanche at Afternoon Creek in Skagit Gorge deposited snow 33 feet deep across a 328-foot swath of the North Cascades Highway.

Flooding in narrow canyons also presents a hazard to park staff and visitors. Steep valley walls and small streams deliver water quickly to larger streams, which

Table 5.6 Landform Information for Ross Lake NRA

Landform Type	Count	Acres	% of Watershed
Alluvial Fan	14	1,575.337	1.41
Arete	15	78.08285	0.07
Bedrock Bench	129	1,997.552	1.79
Cirque	13	712.2219	0.64
Debris Apron	154	12,323.2	11.02
Debris Cone	153	3,220.263	2.88
Fan Terrace	15	168.3011	0.15
Floodplain	16	8,765.861	7.84
Horn	6	45.09699	0.04
Little Ice Age Moraine	3	4.410049	0
Mass Movement_debris Avalanche	31	3,050.276	2.73
Mass Movement_fall/topple	139	491.1332	0.03
Mass Movement_slump/creep	10	9.021201	0.44
Mass Movement_debris Torrent	9	32.19498	0.01
Other Mountain	1	9.424371	0.01
Pass	5	29.98753	0.03
Pleistocene Moraine	10	417.5375	0.37
Ridge	28	654.0554	0.58
River Canyon	86	4,165.02	3.72
Terrace	104	2,083.313	1.86
Valley Bottom	6	217.2307	0.19
Valley Wall	60	71,803.74	64.19
Totals	1007	11,323.25	100.00

Table 5.7 Landform Information for Ross Lake NRA and the Tributaries within the North Cascades NPS Complex that Drain into Ross Lake NRA

Landform Type	Count	Acres	% of WS
Alluvial Fan	20	1,813.413	0.48
Arete	182	3,014.94	0.80
Bedrock Bench	228	2,767.581	0.74
Cirque	366	48,400.3	12.91
Debris Apron	681	33,307.59	8.89
Debris Cone	641	12,795.94	3.41
Delta	2	2.93418	0
Fan Terrace	23	276.4056	0.07
Floodplain	41	12,365.18	3.30
Horn	84	1,101.052	0.29
Little Ice Age Moraine	209	989.3603	0.26
Mass Movement_debris Avalanche	150	8,952.748	2.39
Mass Movement_fall/topple	486	3,410.099	0.91
Mass Movement_sackung	1	2.883965	0
Mass Movement_sail	2	1.935	0
Mass Movement_slump/creep	34	23.73603	0
Mass Movement_debris Torrent	76	291.5944	0.08
Other Mountain	53	445.4589	0.12
Pass	92	355.8845	0.09
Pleistocene Moraine	31	675.8117	0.18
Ridge	147	4,023.645	1.07
River Canyon	264	6,640.779	1.78
Terrace	256	3,519.66	0.94
Undifferentiated	20	180.4859	0.05
Valley Bottom	49	1,601.479	0.43
Valley Wall	88	22,7901.2	60.81
Totals	4226	37,4862.1	100

in turn rise fast and have high velocities. Crossing of mountain streams during periods of rapid spring snowmelt or heavy rainfall are particularly hazardous.

Vegetation

Terrestrial Communities

Ross Lake NRA has some of the most unique and diverse plant communities that can be found within a relatively small area in the Pacific Northwest. This diversity is a result of several factors such as topography, precipitation, disturbance, parent material, and aspect. Elevation ranges from approximately 400 feet near the Ross Lake NRA

western boundary to 6000 feet on Desolation Peak. Precipitation amounts range from approximately 79 inches/year in Newhalem to a low of 30 inches on Desolation Peak. These extreme elevation and precipitation gradients within a narrow distance result in a high diversity of vegetation. Four major forest cover types or zones are found in Ross Lake NRA (See Table 5.8) and are discussed below.

Lowland Forest Zone: These forests dominate the low elevation areas within Ross Lake NRA. They are dominated by western hemlock (*Tsuga heterophylla*), Douglas fir (*Pseudotsuga mertensiana*), and western red cedar (*Thuja plicata*). This type, commonly referred to as the Douglas fir or western hemlock forest type,

Table 5.8 Vegetation Zones of Ross Lake NRA

Vegetation zone	Dominant Tree Species	Elevation
Low forest zone -Western Hemlock/ Douglas Fir	<i>Tsuga heterophylla/ Psuedotsuga mertensiana</i>	1200' on wet sites to 4200' on drier sites
Montane forest zone-Silver Fir	<i>Abies amabilis</i>	2800' on wet sites to 6200' on dry sites
Mountain Hemlock	<i>Tsuga mertensiana</i>	2800' on wet sites and 4000' on dry sites
Subalpine Fir	<i>Abies lasiocarpa</i>	Occurs mostly above 5000'

is the widest spread cover type in Ross Lake NRA and Douglas fir and western hemlock are the dominate trees. Tree species occurring less frequently include lodgepole pine, ponderosa pine, and silver fir.

Montane Zone: This zone is found above the lowland forest zone and below the mountain hemlock zone. It is dominated by Pacific silver fir (*Abies amabilis*). The Pacific silver fir forest type is found in cooler and wetter sites than those of the western hemlock type. This type occurs where winter snow peak ranges from 4' -6'. In Ross Lake NRA, Pacific silver fir is found at relatively low elevations at Colonial Creek as a result of cold air drainage. Common associates of this dominate are western red cedar, Douglas fir and Engelman spruce (*Picea engelmannii*).

Mountain Hemlock Zone: This zone occurs between the Pacific silver fir zone and the subalpine fir zone. This type is dominated by mountain hemlock (*Tsuga mertensiana*). This zone has cold winter and cool summer temperatures. Winter snow accumulations may reach 10 feet. Common associated tree species are Pacific silver fir and subalpine fir.

Subalpine Zone: The subalpine zone is dominated by subalpine fir (*Abies lasiocarpa*) and mountain hemlock (*Tsuga mertensiana*). This zone occurs at the highest elevations of any forest type and is characterized by cold winters, with significant snow accumulation, and relatively warm, dry summers. This forest type also occurs with larch (*Larix lyallii*) and whitebark pine (*Pinus albicaulis*) which are relatively rare in Ross Lake NRA.

Unique Vegetation Types

Ponderosa pine

Ponderosa pine (*Pinus ponderosa*) occurs outside the normal range of the species on the east side of Ross Lake in areas of low rain fall, such as on the west facing slopes of Desolation Peak near Lightning Creek. These stands are open woodlands with a grass and herbaceous understory. This type also occurs with species thought of as “east side species” such as Rocky mountain juniper (*Juniperus scopulorum*), balsamroot (*Balsamorhiza sagittata*), and pine grass (*Calamagrostis rubescens*)

Lodgepole pine

Several lodgepole (*Pinus contorta* var. *latifolia*) stands are found within Ross Lake NRA. These stands occur on bedrock benches in areas surrounding Ross Lake, west to Sourdough Mountain, and as far west as Newhalem. This forest type is relatively restricted on the east side of the Cascade Crest. Recently, these stands have been infested with mountain pine beetle (*Dendroctonus ponderosae*). These infestations have caused widespread mortality throughout these stands.

Whitebark pine

Whitebark pine (*Pinus albicaulis*) is found on the high ridges surrounding Ross Lake NRA, such as Desolation Peak. This is an important species to Ross Lake NRA as it is considered a keystone species throughout its range due to its importance as a food source for such vertebrate species as the Clark’s Nutcracker and the red squirrel. Whitebark pine is being threatened throughout the west by a non-native pathogen.

Cedar forest

These forests are associated with the wetlands in the Big Beaver drainage where several stands of large old growth cedar are found on the valley floor. Some trees measure up to 80 inches in diameter (DBH, or as measured at 4.5 feet from the ground). These cedar forests, and their potential destruction, became a focal point of public outcry against the proposal to raise Ross Dam in the 1970's.

Wetlands

Several low elevation wetlands occur in Ross Lake NRA. The most notable is the Big Beaver wetland system. Wetlands are also found at the mouth of Thunder Creek and along the shoreline of Thunder Lake. These wetland communities are a rare habitat within Ross Lake NRA and within the North Cascades NPS Complex. These wetlands are very important fish, amphibian, and bird habitats as well as habitats for several rare vascular and nonvascular plant species.

Quaking aspen

A few small stands of quaking aspen (*Populus tremuloides*) occur on the east side of Ross Lake as well as a short distance up the Little Beaver drainage. This species is rarely found west of the Cascade Crest.

Riparian and avalanche tracks

Throughout Ross Lake NRA there are extensive forests dominated by deciduous tree species which are most frequently associated with rivers, streams, and avalanche tracks. These forests are dominated by alders (*Alnus rubra* or *Alnus viridis* ssp. *sinuata*), maple (*Acer macrophyllum* and *Acer circinatum*), cottonwood (*Populus balsamifera* ssp. *trichocarpa*), and have an understory of willow species (*Salix* sp.).

Non-Native Plant Species

Within the entire North Cascades NPS Complex there are over 200 known species of non-native plants, but the total number of non-native species within Ross Lake NRA is unknown. The most common and widespread species within Ross Lake NRA are reed canarygrass (*Phalaris arundinaceae*), common tansy (*Tanacetum vulgare*), cheatgrass (*Bromus tectorum*), knapweed species (*Centaurea* spp.), scotch broom (*Cytisus scoparius*), orange hawkweed (*Hieracium aurantiacum*), herb Robert (*Geranium robertianum*), St. John's wort (*Hypericum perforatum*), knotweed species (*Polygonum* spp.) and oxeye daisy

(*Luecanthumum vulgare*). These species are associated with the perimeter of Ross Lake, the North Cascades Highway corridor, and other disturbed areas.

Invasive plant control in Ross Lake NRA continues to be an on-going activity. Prior to 2002 most control was accomplished through manual techniques. Chemical control of specific species has been used on the North Cascades highway road edge, along the perimeter of Ross Lake, and along the Skagit River. The extent and distribution of weed species is unknown for Ross Lake NRA. Some mapping and inventory efforts have included cheatgrass mapping in the Desolation/Lightning Creek area, mapping of weeds in the trail corridors and backcountry camps, mapping of knotweed along the Skagit River, surveys along Diablo and Ross lakes, and mapping of reed canarygrass along Ross Lake. In October of 2008 reed canarygrass was identified within the Big Beaver wetland. The extent of this species is still unknown.

Disturbance

Disturbance via windthrow, fire, avalanche, and floods causes major vegetation changes within Ross Lake NRA. Fire and avalanches cause the largest and most frequent disturbances within Ross Lake NRA. Windthrow events tend to be small and localized. Floods on the Skagit, although they do occur, are mitigated by the presence of dams. Floods on the tributaries can cause localized vegetation removal and sedimentation can cause tree death and a reduction in shrub cover. These disturbed areas are places where non-native invasive weeds may become established.

Hazard Trees

A hazard tree is any tree, either alive or dead, which, due to detectable defects, has potential to fail (in part or in its entirety) and strike a person or property within a developed area. Developed areas include; campgrounds, buildings and other infrastructure, parking areas, picnic sites, and designated campsites such as backcountry camps. Persons or properties that could be damaged by hazard trees are referred to as targets. For a tree to be deemed hazardous, a tree must have a potential to fail and a target. Roads and trails are not considered targets due to the transitory nature of people in these sites. If there is no identifiable target then a tree is not considered hazardous.

Developed sites are surveyed yearly by qualified park staff. Trees are monitored and when necessary the hazard is mitigated. Backcountry sites are monitored in a five year rotating schedule or more frequently if

resources allow. These surveys are generally completed by the trail crew.

Trees with a high or very high hazard rating (as defined by the park's *Hazard Tree Management Plan*) will require some type of abatement/mitigation. Abatement/mitigation options include: removing the target, permanent site closure, temporary site closure (the site is closed until the hazard tree fails or until the hazard is mitigated), pruning the defective parts of the tree, reducing the height of the tree below striking distance of the target, or tree removal.

Wildlife Habitat

Surrounded by several million acres of designated wilderness, Ross Lake NRA provides essential habitat for a diverse array of wildlife species that require large tracks of remote, mountainous land to survive. Species represented by these attributes include grizzly bear, gray wolf, wolverine, mountain goat, white-tailed ptarmigan and Clark's nutcracker. Ross Lake NRA is inhabited by 265 species of mammals, birds, reptiles, and amphibians (NPS files 2008).

The Skagit River watershed is one of the few remaining major watersheds in the Cascades that supports significant and pristine wildlife habitat. Within the watershed, habitats range from low elevation western hemlock / Douglas-fir old-growth forest to high elevation, treeless, alpine meadows with snowfields and rocky ridges. Other significant habitats found within the Skagit River watershed include western Washington's largest cottonwood overstory riparian area along the lower Skagit River within and near Ross Lake NRA (See the Vegetation section of this chapter, above).

Alpine/Subalpine

There are significant amounts of alpine/subalpine habitat within Ross Lake NRA. Alpine habitat includes all vegetated areas above treeline and many open areas just below treeline. Alpine areas are dominated by sedges, grasses, hardy forbs and dwarf shrubs such as heathers. They have low mean temperatures, high winds, prolonged snow cover, and intense ultraviolet radiation. Subalpine habitat is characterized by patchy mosaics of herbaceous and dwarf shrub meadows and tree islands or scattered trees with 10-30



Indian paintbrush is a common wildflower found in Ross Lake NRA.

percent canopy cover. Tree species most common to this habitat type are mountain hemlock, Englemann spruce, and subalpine fir. Wildlife species have adapted to these environments by migrating to warmer areas during the most extreme times of the year (such as winter) or hibernating for long periods of the year. Common species found in these habitats include mountain goats, hoary marmots, pikas, white-tailed ptarmigans, Clark's nutcrackers, American pipits, and gray-crown rosy finches.

Coniferous and Deciduous Forest

Coniferous/deciduous forest habitats are characterized by a diverse set of structural attributes with complexity increasing with stand age. Older forests typically have multi-storied canopies with developed mid-story vegetation, plentiful standing dead wood, and an abundance of down, decaying wood. Within Ross Lake NRA, common forest cover types include Douglas-fir, western hemlock, western red cedar, Pacific silver fir, red alder, and bigleaf maple.

Riparian

Riparian zones along the Skagit River, its tributaries, and along lakes are numerous in Ross Lake NRA. These riparian habitats have the greatest diversity of wildlife species of any habitat type within the complex. They are characterized by high plant species diversity and vegetation structure. Their linear shape creates a high degree of edge, the boundary between two or more habitat types, which increases species diversity. Riparian corridors serve as migration routes, and they include many habitat features necessary for foraging, nesting/breeding, and cover for terrestrial wildlife.

Open Water (Reservoirs)

Open water habitats greatly increased with the development of the three hydro-electric projects. Large expanses of riparian habitat along the mainstem Skagit River were lost with the creation of these reservoirs. While these reservoirs do provide habitat for some wildlife, most of these species are rare and transient, or were not found in Ross Lake NRA before the existence of the reservoirs. Extreme changes in water levels results in un-vegetated shorelines during much of the year. This open zone between water and vegetation does not provide the necessary cover for secretive species or nesting waterfowl at the time they need it. Ross Lake Reservoir now presents a major barrier to east/west mammal movements due to the length and width of the reservoir.

Grizzly Bear Core Area

The North Cascades ecosystem is one of six grizzly bear recovery zones in the coterminous states. The North Cascades ecosystem is comprised primarily of the North Cascades NPS Complex and; the Mt. Baker – Snoqualmie and Okanogan-Wenatchee National Forests, between Interstate 90 in the south, north to the international border, and roughly following national forest boundaries on both sides of the Cascade Range (see Figure 5.6).

Grizzly bears are not territorial but occupy large, and usually overlapping, home ranges. They are long-lived omnivores with very low reproductive rates. Grizzly bears' requirements for food and space vary depending on a multitude of environmental and behavioral factors, and on the experience and knowledge of each individual bear (US Fish and Wildlife Service 2007). Basic needs are for seasonal foraging and denning habitats secure from human disturbance. What this comprises varies widely in relation to food resource availability both across and within foraging seasons and years; the density of the bear population; reproductive status (females); sources of mortality and other stressors (e.g. Smith et al. 2005, Weaver et al. 2002, Hood and Parker 2001, Olson et al. 1997).

As explained in CEM – a Model for Assessing Effects on Grizzly Bears (USFS 1990), “in an area as large as a grizzly bear ecosystem it is necessary to divide the area into smaller units referred to as Bear Management Units (BMU) in order to: (1) assess the effects of existing and proposed activities on grizzly bear habitat without having the effects diluted by consideration of too large [or too small] an area; (2) address unique habitat characteristics and bear activity/use patterns; (3) identify contiguous complexes of habitat which meet [grizzly bears' yearlong needs] and (4) establish priorities for areas where land use management needs would require a cumulative effects assessment”. Each BMU is an approximation of what could be a home range for a female grizzly bear accompanied by young. The North Cascades ecosystem has been divided into 42 Bear Management Units (BMU), each an approximation of homerange of a female grizzly bear accompanied by young. The BMUs include entire drainages/ sub-drainages, encompassing a complete array of elevations and seasonal habitats to meet a grizzly bear family's annual requirements for feeding, cover and denning. BMU boundaries follow natural features rather than administrative lines. The North Cascades ecosystem has been divided into 42 BMUs. No grizzly bear habitat use data exist for the North

Grizzly Bear Management Units overlapping the North Cascades National Park Service Complex

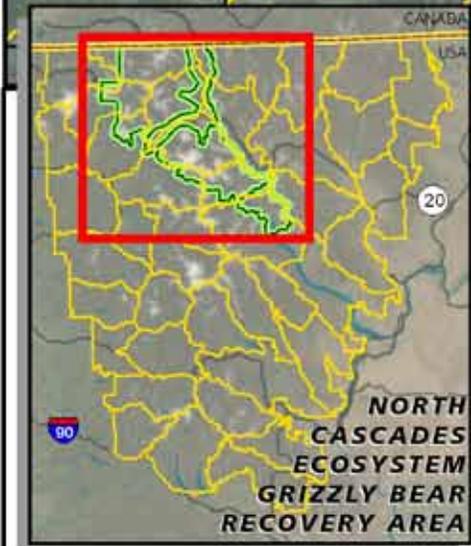
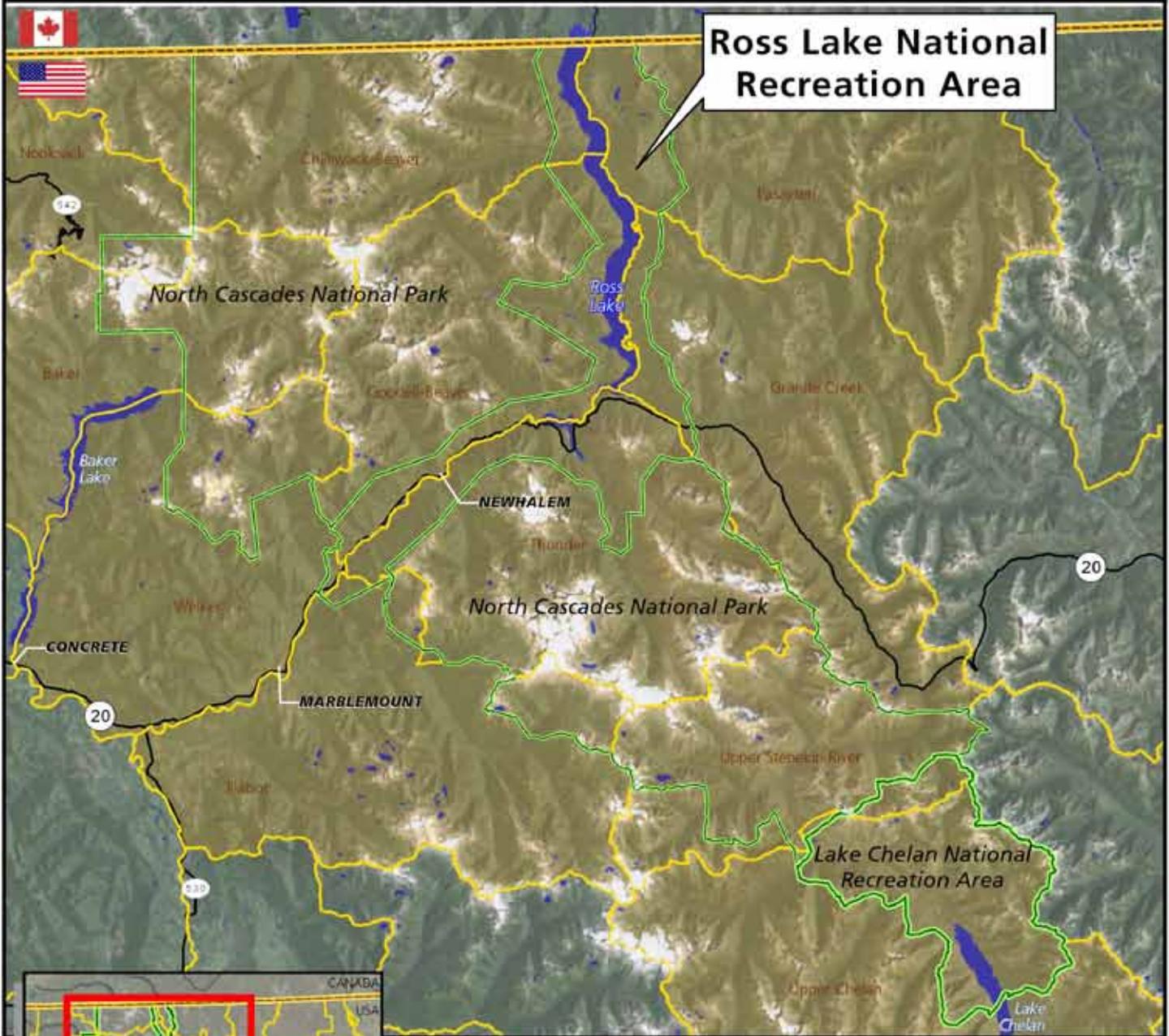
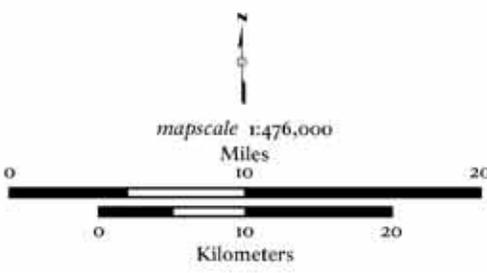


Figure 5.6

 BMU boundaries  BMUs overlapping the Complex



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2 February 2011

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Cascades ecosystem, so the units were delineated based on local habitat characteristics compared with habitat use data from similar ecosystems (such as McLellan and Hovey 1995 and, 2001, Jacoby et al. 1999, Almack et al. 1993). The North Cascades NPS Complex Ross Lake NRA falls within 11 seven BMUs (See Figure 5.6).

The BMUs overlapping the North Cascades NPS Complex Ross Lake NRA have some of the highest percentages of Core Area within the North Cascades ecosystem, during both early and late seasons. The taskforce identified Core Areas for grizzly bears as being free of motorized traffic and high levels of human use. Core Area within this ecosystem is defined as any area more than 0.3 miles (500 meters) from a road or high use trail. These BMUs are largely within designated wilderness (Stephen Mather and Pasayten), with large, contiguous areas of relatively low human use. Habitat within and immediately surrounding the North Cascades NPS Complex Ross Lake NRA is highly diverse with regards to elevation, aspect, ecotype and available cover. Excellent denning habitat occurs upslope of critical low elevation spring habitat; high meadows provide isolation and predictable food resources. Several valleys within the Complex Ross Lake NRA, the Big Beaver and Thunder valleys provide superb low elevation spring bear habitat, at a premium in an ecosystem in which most valleys are developed to some degree. The inundation of the upper Skagit River Valley by the Ross Lake reservoir makes the preservation of habitat such as found in these Big Beaver and Thunder Creek valleys all the more essential to grizzly bears, as well as many other species. Abundant avalanche chutes and meadows throughout the Complex on the slopes above Ross Lake provide important grizzly bear habitat for both during the spring ("early season") and summer/fall ("late season") foraging periods.

History has demonstrated, and research has shown, that grizzly bear populations have survived where frequencies of contact with humans were relatively low (Ciarniello et al. 2007, Schwartz et al. 2006, Suring et al. 2006, Boyce & Waller 2003, Mace et al. 1996, Kasworm and Manley 1990, McLellan and Shackleton 1988, Mattson et al. 1987). Reported responses of large carnivores to roads and trails have included spatial avoidance, decreased survival, and altered temporal activity patterns. Grizzly bear females with young generally avoid areas with high levels of human use when feasible, or potentially spend less time foraging within visual proximity of high human use (Gibeau et al. 2001, White et al. 1999, Wakkinen

and Kasworm 1997, Mace and Waller 1996, Purves et al. 1992, Gunther 1990, Kasworm and Manley 1990, McLellan and Shackleton 1988). In addition, road and trail access has been directly attributed to mortality of bears as a result of legal and illegal shooting (Ciarniello 2007, Garshelis et al. 2005, Benn and Herrero 2002, Mace and Waller 1996, Knick and Kasworm 1989). By managing human access in grizzly bear habitat, the following objectives can be met: minimize human interaction and potential grizzly bear mortality, minimize displacement from important habitats, minimize bear-human conflicts developing over competition for food resources (improperly stored food and garbage, etc.), and provide relatively secure habitat where energetic requirements of bears can be met (IGBC 1998).

In 1994, the Interagency Grizzly Bear Committee (IGBC) identified a task force to develop a consistent analysis process for determining the existing level of human access and defining the area within which road and trail density should be measured (IGBC 1994/1998). The basis upon which habitat effectiveness for grizzly bears would be determined was the amount and quality of "core areas" within a BMU. Core areas were defined as areas with the following characteristics: (1) No motorized use of roads and trails during the non-denning period. (2) No roads or trails that receive non-motorized, high-intensity use. "High intensity use" was defined by the US Forest Service (1990, under the purview of the IGBC) as trails receiving an average of 20 or more parties per week. (3) A minimum of 0.3 miles (500 meters) from any open road, motorized trail, or high use trail. The 0.3 mile buffer was determined from a review of available research on the relationships among grizzly bears, roads, trails and habitat use (Mattson et al. 1987, McLellan and Shackleton 1988, Aune and Kasworm 1989, Kasworm and Manley 1990, Mace et al. 1996, Mace and Waller 1996).

The importance of managing motorized access, one of the most influential parameters affecting habitat security, has been well documented for grizzly bears. This research has demonstrated that when it is feasible, grizzly bears avoid areas within at least .3 miles of motorized roads/trails (Proctor et al. 2005, Graves et al. 2004, Mueller et al. 2004, Gibeau et al. 2001a, Interagency Grizzly Bear Committee 1998, Mace and Waller 1996, Mace et al. 1996, Aune and Kasworm 1989, McLellan and Shackleton 1988, Mattson et al. 1987) and that motorized road access in particular is positively correlated with higher grizzly bear mortality rates (Ciarniello et al. 2007, Ciarniello

et al. 2004, Benn and Herrero 2002, Aune and Kasworm 1989, Knick and Kasworm 1989). Grizzly bears, particularly females with young, generally also avoid areas with high levels of human use when feasible, or potentially spend less time foraging within visual proximity of high human use (Proctor et al. 2005, Gibeau et al. 2001b, White et al. 1999, Wakkinen and Kasworm 1997, Mace and Waller 1996, Purves et al. 1992, Kasworm and Manley 1990, McLellan and Shackleton 1988).

The *Interagency Grizzly Bear Committee Taskforce Report on Grizzly Bear/Motorized Access Management* (IGBC 1998) contains recommendations in order to provide a consistent approach to access management within and between grizzly bear ecosystems. The taskforce report identified “Core Areas” for grizzly bears as being free of motorized traffic and high levels of human use.

Given the particular challenges of addressing low Core Area availability in heavily roaded areas of the national forests and other lands within the North Cascades ecosystem, the subcommittee’s technical team has recommended that the highest possible percentage of Core Area be maintained or increased within the BMUs dominated by designated wilderness.

The BMUs overlapping the Complex have some of the highest core area values within the North Cascades ecosystem during both early and late seasons. Habitat quality is also high, as summarized above. While the restoration of a sustainable grizzly bear population will require all of the North Cascades ecosystem as a whole, maintaining existing, large, contiguous blocks high quality core area of Core Area will be essential to grizzly bear recovery in both the short and long-term.

Wildlife

Mammals

Sixty-one mammal species have been documented in Ross Lake NRA. Common mammal species include pika, Townsend’s chipmunk, hoary marmot, Douglas squirrel, beaver, black bear, and black-tailed deer. More elusive mammals found in the park complex include snowshoe hare, northern flying squirrel, coyote, martin, spotted skunk, river otter, mountain lion, bobcat, and elk. Nine species of bats are known to occur within park complex boundaries. A small herd of mountain goats, numbering less than 25 individuals, resides on Jack Mountain.

Park staff conducted forest carnivore studies in 2003 and 2004. A total of 78 camera stations were sampled over the 2-year period. More than 1,700 automatic photographs were taken. These photographs documented 13 mammal and 5 bird species. The most common mammal photographed was the American marten (34 stations). Other mammal species detected included black-tailed deer, spotted skunk, Douglas squirrel, forest mouse, coyote, and ermine. Targeted species, fisher and lynx, were not detected.

Special status mammal species are discussed in the Sensitive Species section of this chapter. Special status mammal species associated with Ross Lake NRA include gray wolf, grizzly bear, Canada lynx, Pacific fisher and California wolverine.

Birds

One hundred ninety-two bird species occur within Ross Lake NRA. Just over half of these species live year-round in Ross Lake NRA and/or come to habitats within Ross Lake NRA to breed and raise offspring. Approximately 80 species (42 percent) are neotropical migrants that winter south of the U.S. border. Birds that are prevalent in Ross Lake NRA include common merganser, bald eagle, rufous hummingbird, Steller’s jay, American dipper, and an assortment of flycatchers, thrushes, warblers, and sparrows. Up to eight pairs of osprey nest along the Skagit River and three reservoirs. Along the Skagit River, deciduous forests of black cottonwood, red alder, bigleaf maple and several species of willow support small breeding populations of several bird species that are rare elsewhere in western Washington, such as veery, Nashville warbler, American redstart, and lazuli bunting (Wahl 1995; Smith et al. 1997).



Hoary Marmot near Desolation Lookout.

The largest concentration of bald eagles in Washington over-winter along the Skagit River due to its abundance of spawning anadromous fish and mild climate. Eagles arrive in November to gorge on spawning salmon and depart in March to return to their breeding grounds. Park biologists have monitored winter bald eagle populations from 1982 to present. Eagle counts peaked during the winter of 1991-1992; the peak one-day count was 510 birds. Since then most peak counts per year have averaged about 350 birds.

Reptiles

Only four reptile species inhabit Ross Lake NRA. These include the northern alligator lizard and three snakes: the rubber boa, western terrestrial garter snake, and common garter snake.

Amphibians

All 12 species of amphibians known to occur in the park complex have been found in Ross Lake NRA and currently three of these species are listed for special management status by either the Washington Department of Fish and Wildlife or the U.S. Fish and Wildlife Service (See Table 5.9).

Because amphibians occupy both aquatic and terrestrial environments and possess permeable skin, they are potentially at an increased risk from exposure to a wide range of stressors found in both of these environments. Reported declines have been attributed to disease, non-native predator populations, ultra-violet radiation, pollution, changing hydrologic regimes, and habitat alteration.

Fish and Fish Habitat

The Skagit River system is one of the few remaining systems in America which supports significant numbers of five native salmon species, two species of trout, and two species of char. These include six Chinook stocks (spring, summer, and fall), pink salmon, chum salmon, sockeye salmon, summer and winter run steelhead, sea run cutthroat trout, and Dolly Varden and bull trout. Of these stocks, all season-specific Chinook, sockeye, coho, and steelhead species are under review by state and federal agencies for potential listing under the Endangered Species Act. The system's fishery produces an average of 2,210,000 anadromous fish each year. Of this number, about a half-million return to spawn; the balance is harvested by commercial and sport fishermen or by natural predators at sea. These numbers of fish represent a

Table 5.9 Amphibian Species Found in Ross Lake NRA and Their Conservation Status

Common Name	Scientific Name	Documented in NOCA	Federal Status	State Status
Tailed Frog	<i>Ascaphus truei</i>	Yes	None	None
Pacific Chorus Frog	<i>Pseudacris (Hyla) regilla</i>	Yes	None	None
Red-legged Frog	<i>Rana aurora</i>	Yes	Species of Concern	None
Cascades Frog	<i>Rana cascadae</i>	Yes	None	None
Columbia Spotted Frog	<i>Rana luteiventris</i>	Yes	Species of Concern	Candidate
Western Toad	<i>Bufo boreas</i>	Yes	Species of Concern	Candidate
Northwestern Salamander	<i>Ambystoma gracile</i>	Yes	None	None
Long-Toed Salamander	<i>Ambystoma macrodactylum</i>	Yes	None	None
Pacific Giant Salamander	<i>Dicamptodon tenebrosus</i>	Yes	None	None
Ensatina	<i>Ensatina eschscholtzii</i>	Yes	None	None
Roughskin Newt	<i>Taricha granulosa</i>	Yes	None	None
Western Redback Salamander	<i>Plethodon vehiculum</i>	Yes	None	None

significant percentage of the Puget Sound anadromous fish harvest (somewhere between 20 percent and 30 percent).

The upper Skagit River within the Ross Lake NRA provides some of the most important salmon and steelhead spawning habitat in the Skagit River basin. This section of the Skagit system is highly conducive to the migration, spawning and rearing of both anadromous and resident fish. Factors contributing to the high-quality water in the upper Skagit include high dissolved oxygen content, relatively low nutrient level, and low bacterial content and relatively cool temperatures.

In addition, at least 13 other native fish species inhabit the streams and reservoirs of Ross Lake NRA. These include: mountain whitefish; minnows and dace; suckers; sculpins; and lampreys.

The reservoirs in Ross Lake NRA have altered and extended habitat, allowing fish migration above natural stream barriers. Prior to 1900, native anadromous and resident fish occupied primarily the low-gradient mainstream rivers and floodplain portions of tributary streams in Ross Lake NRA. Native salmonid fish became established in naturally isolated tributary streams when reservoirs were constructed and filled.

Non-native fish were introduced into the lakes of the Ross Lake National Recreation Area through stocking. Stocking of trout species in high mountain lakes within the tributaries of Ross Lake is well documented. These included California golden trout, coastal cutthroat trout, west slope cutthroat trout, rainbow trout, and brook trout. These fish have invaded naturally fishless streams through downstream dispersal from planted lakes. Stocked fish populations have developed in Thunder, Fisher, Big Beaver, Newhalem, and Ruby

creeks. The expansion of nonnative hatchery strains may be impacting native fish populations through interbreeding or by competition and predation.

In recent years a substantial population of red sided shiners (native to area but possibly introduced) have been observed in Ross Lake. The red sided shiner is a small minnow (2 to 4 inches) and a prolific breeder. The shiners eat the same food as trout (algae and insect larva) and easily adapt to a variety of water and habitat conditions. At this time the effects of this population explosion on the native rainbow trout and char in Ross Lake are unknown.

Ross Lake Reservoir Tributary Trout Habitat

The tributaries to Ross Lake which had the potential to support trout spawning were surveyed during the spring and summer of 1989 by the Seattle City Light Environmental Affairs Division. These surveys were designed to evaluate the quantity and quality of spawning habitat as well as identify barriers to fish passage from the lowest level of the draw down zone (1500') to the first migration barrier above full pool elevation (1602'). Much of the following stream habitat information was taken from the 1989 Seattle City Light Report. To date, no other comprehensive survey of fish distribution has occurred in the stream reaches located above these barriers identified in the 1989 Seattle City Light surveys.

Arctic Creek

Within the drawdown reach of Arctic Creek, from an elevation of 1500' to 1558', a few small pockets of suitable spawning habitat exist for trout species. Most of the streambed substrate is too large and the stream gradient too steep to provide substantial spawning habitat. A total barrier to fish passage occurs in Arctic Creek at an elevation of 1558'. The barrier is a waterfall that has a vertical drop of approximately one hundred feet and acts as a barrier to trout migration, even at Ross Lake's full pool elevation. Above the barrier to the boundary of Ross Lake NRA there is approximately 1.8 miles of stream habitat. This habitat is overall too steep to allow for significant resident trout populations and would likely have been historically fishless.

Big Beaver Creek

No suitable spawning habitat exists within the drawdown reach of Big Beaver Creek. The streambed within the drawdown reach is primarily boulder and bedrock substrates with multiple falls and high velocity



Pink salmon in Goodell Creek.

riffles. At full pool the first migration barrier to trout occurs at an elevation of 1725' near the confluence of Big Beaver Creek and McMillan Creeks. The 1989 Seattle City Light survey indicated a long series of cascades and whitewater at this point with multiple barriers to migration. From the full pool elevation at Ross Lake to the boundary of Ross Lake NRA there are 7.6 miles of stream habitat. This stream reach offers excellent fish habitat with low stream gradients and abundant off channel habitat. Historically fish were prevented from accessing Big Beaver Creek by a barrier falls that occurs within the current draw down zone of Ross Lake.

Devils Creek

There is almost no spawning habitat available within the draw down reach of Devils Creek due to numerous barriers and large streambed substrate. Above the full pool elevation of 1602' the streambed gradient of Devils Creek is 4-5 percent and the stream is confined to a narrow bedrock canyon. Several barriers to trout migration occur within the first 500 feet of Devils Creek. The first barrier occurs about 300 feet upstream from the full pool elevation and consists of a 12 foot high chute/ waterfall formed by bedrock. Below the first barrier a limited amount of spawning habitat exists. About one hundred feet above the first barrier there is an 8 foot high bedrock chute, and another 7 foot barrier waterfall occurs an additional one hundred feet upstream. All these waterfalls were determined to be barriers at all flows. Resident rainbow trout were present in Devils Creek above the migration barriers at the time of this survey. From the full pool elevation at Ross Lake to the boundary of Ross Lake NRA there are 1.3 miles of stream habitat within Devils Creek. This stream reach offers poor quality fish habitat due to its steep gradient.

Dry Creek

Most of the high quality spawning habitat in Dry Creek is within the draw down reach. Stream gradient with this zone varies between 2 percent and 7 percent and provides many areas of spawning habitat. Above Ross Lake full pool elevation the first potential barrier to fish passage occurs upstream 500 feet. At this point the stream gradient increases to 14 percent and the stream is primarily whitewater and cascades. About 1200 feet upstream from Ross Lake full pool a 6 foot high chute and a 10 foot high boulder cascade form an impassable barrier to upstream trout passage. Resident rainbow trout were documented above this barrier. The only spawning habitat available above the full pool elevation occurs in the first 500 feet of Dry

Creek. From the full pool elevation at Ross Lake to the boundary of Ross Lake NRA there are 1.2 miles of stream habitat within Dry Creek. This stream reach offers poor quality fish habitat due to its steep gradient and small size.

Hozomeen Creek

The majority of the spawning habitat in Hozomeen Creek occurs within the draw down reach below full pool elevation. From elevation 1573' to 1595' the streambed gradient is 1 – 3 percent and substrate is dominated by gravels suitable for spawning. Below 1570 ft elevation substrate is dominated by sand and silt. Above the full pool elevation of 1602' the gradient of Hozomeen Creek precludes good spawning habitat and at 1625' an impassable barrier exists consisting of steep bedrock chutes. From the full pool elevation at Ross Lake to the boundary of Ross Lake NRA there are 2.7 miles of stream habitat within Hozomeen Creek. This stream reach offers good quality fish habitat due to its moderate gradient. This stream reach was historically fishless due to the barrier falls located just upstream from the full pool elevation. Hozomeen Lake was stocked with Brook Trout and this population has dispersed downstream throughout Hozomeen Creek to Ross Lake.

Lightning Creek

The stream gradient within the drawn down of Lightning Creek ranges from 0.5 percent to 3 percent and provides good spawning habitat. Above the full pool elevation there is 1400 feet of habitat accessible to trout in Lightning Creek. A landslide of large boulders creates an impassable 13 foot waterfall above this point. Nine hundred feet above this barrier, large boulders create another 6 foot high cascade which would be a barrier to most fish. Above these barriers Lightning Creek has a gradient of approximately 3 percent and offers excellent trout habitat. The lower quarter mile of Lightning Creek, including its mouth, are important spawning areas for Ross Lake trout. From the full pool elevation at Ross Lake to the boundary of Ross Lake National Recreation Area (Ross Lake NRA) there are 7.2 miles of stream habitat within Lightning Creek. This stream reach offers good quality habitat to resident trout. In the reaches above the barrier falls the populations consist of Dolly Varden/Bull Trout and Rainbow Trout that have existed since before human stocking efforts of this past century.

Little Beaver Creek

Little Beaver Creek has very little spawning habitat in the draw down reach. Most of this reach consists of a long, fast, deep riffle; however, isolated pockets of suitable spawning habitat do occur in some locations. From the full pool elevation at Ross Lake to the boundary of Ross Lake NRA there are 2.0 miles of stream habitat within Little Beaver Creek. From the full pool line upstream approximately 1 mile, a number of bedrock chutes and waterfalls create a barrier to fish migration and provide no spawning habitat. Above this reach the gradient decreases and offers good quality fish habitat due to its low gradient and abundant off channel habitat. It is highly likely that Little Beaver Creek was fishless due to the barrier falls near full pool elevation. Fish populations within Little Beaver Creek were likely introduced by humans.

No Name Creek

The only suitable spawning habitat in No Name Creek occurs in the alluvial fan within the draw down reach below an elevation of 1543'. The stream gradient is 1.5 percent here and substrate is dominated by gravels. A barrier falls occur on No Name Creek immediately above full pool. From the full pool elevation at Ross Lake to the boundary of Ross Lake NRA there are 1.9 miles of stream habitat within No Name Creek. This area offers poor quality fish habitat due to its steep gradient. At this time, it is unlikely that fish populations exist in this reach. This stream reach was historically fishless due to numerous upstream migration barriers.

Pierce Creek

Within the draw down reach of Pierce Creek there are small isolated patches of suitable spawning habitat but overall the creek velocities are too high. Streambed gradient above full pool elevation in Pierce Creek is 33 percent, and no suitable trout spawning habitat is available, high gradient and a series of bedrock falls precludes trout migration. From the full pool elevation to the boundary of Ross Lake NRA there are 0.9 miles of stream habitat within Pierce Creek. This stream reach offers poor quality fish habitat due to its steep gradient and was historically a fishless stream reach. Current isolated populations of trout species may exist in this reach through dispersal downstream from stocked lakes.

Roland Creek

The majority of suitable spawning habitat on Roland Creek is within the draw down reach though this

habitat is of marginal quality. Streambed substrates are somewhat angular and cemented by fine sediments. Above the full pool elevation Roland Creek is a small steep gradient stream with an estimated spawning area of 350 feet² accessible to Ross Lake trout. The first barrier to upstream trout migration occurs 1400 feet upstream from the full pool elevation. This barrier consists of a 6 foot high chute cascading over instream logs. Upstream from this point the gradient increases further and a bedrock chute creates another barrier to trout. From the full pool elevation at Ross Lake to the boundary of Ross Lake NRA there are 1.1 miles of stream habitat within Roland Creek. This stream reach offers poor quality fish habitat due to its steep gradient and small size.

Ruby Creek

Within the draw down reach of Ruby Creek some small pockets of good spawning habitat exist along the margins of the channel. In general the stream depths were too deep and substrate too large to provide suitable spawning habitat. The reaches of Ruby creek above full pool elevation provide abundant spawning habitat for native fish. Tributaries to Ruby creek including Canyon Creek and Granite creek have particularly good spawning habitat. There are no identified barriers to trout migration within these creeks until reaching the increased gradient of headwater streams. There are about 21 miles of accessible habitat in the Ruby drainage. From the full pool elevation at Ross Lake to the boundary of Ross Lake NRA there are 1.4 miles of stream habitat within Ruby Creek. This stream reach offers good quality fish habitat due to its moderate gradient and large size. This reach contains native populations of Rainbow Trout and Dolly Varden/Bull Trout.

Silver Creek

Within the draw down reach there are areas of suitable spawning habitat near the mouth of Silver Creek and along the margins of the channel. Gradients range from 1 – 3.5 percent and the substrate is composed of gravels and cobbles. Above full pool there is virtually no suitable spawning habitat for trout as the gradient approaches 11 percent. The gradient continues to increase upstream where it forms a nearly continuous series of cascades and waterfalls. Above full pool to the Ross Lake NRA boundary 1.1 miles of stream exists.

Canadian Reach of the Skagit River

According to Johnson (1989) the Canadian Skagit River and its tributaries have more fish spawning

habitat than all the U.S. tributaries to Ross Lake. Stream gradients are generally lower and substrate more appropriate for trout spawning in the Canadian Skagit River System.

Diablo Lake Tributary Trout Habitat

Diablo Lake tributaries believed to support trout spawning were surveyed during spring and summer 1989 by the Seattle City Light Environmental Affairs Division. Surveys were designed to evaluate the quantity and quality of spawning habitat as well as identify barriers to fish passage. Much of the following stream habitat information was taken from this report.

Similar to the Ross Lake tributaries, it is likely that fish are now present in streams which were historically fishless due to widespread stocking efforts within the past century. Stocking of trout species in high mountain lakes within the tributaries of Diablo and Gorge reservoirs is well documented. These introduced fish are capable of dispersing downstream into water bodies below. To date no comprehensive survey of fish distribution has occurred in the stream reaches located above the identified barriers.

Colonial Creek

Small isolated patches of suitable spawning habitat for trout occur in Colonial Creek in the tail-outs of small pools and along the stream margins from the full pool elevation of Diablo Reservoir upstream 1100 feet. From 1100 feet to 1700 feet upstream the gradient increases to 8 percent and stream substrate size increases. A barrier falls occurs 1700 feet upstream from full pool elevation which prevents fish passage. This waterfall has a 7 foot vertical drop which is a barrier to fish at all flows. From the mouth of Colonial Creek to the Ross Lake NRA boundary there are 1.3 miles of stream habitat.

Deer Creek

Within the lower 120 feet of Deer Creek contain numerous small chutes, cascades and waterfall barriers which would prevent upstream fish passage. From the mouth of Deer Creek to the Ross Lake NRA boundary there is 1.2 miles of stream habitat. This habitat is not suitable for trout due to the high gradient and small size of the stream.

Rhode Creek

Rhode Creek has a very small amount of spawning habitat (100 feet²) in the lower 200 feet of stream.

However the spawning habitat is considered poor quality due to the lack of cover, proximity to a road and campground and unstable stream banks. The stream gradient is 4 percent in the lower 200 feet of channel. A concrete culvert forms a total barrier to fish passage about 250 feet from the mouth of Rhode Creek. Above the barrier the streambed gradient increases to 15 percent and there is no habitat available for trout spawning. From the mouth of Rhode Creek to the Ross Lake NRA boundary there is 1.6 miles of stream habitat. This habitat is not suitable for trout due to the high gradient and small size of the stream.

Thunder Creek

Thunder Creek is the largest tributary to Diablo Lake (not counting the Skagit River) and provides the most important trout spawning for Diablo Lake. In the lower 1.5 miles of stream the substrate consists of cobble and boulders and habitat is primarily large deep runs, pools and riffles. Depths range from 3-8 feet and widths range from 70-90 feet. Good spawning habitat is common along the edges of Thunder Creek, especially in the lower ½ mile of stream. There are no barriers to fish passage in Thunder Creek, however, tributaries to Thunder Creek were typically steep and unsuitable for trout spawning or rearing. From the mouth of Thunder Creek to the Ross Lake NRA boundary there is 5.3 miles of stream habitat. The first 3.1 miles of stream habitat is accessible to trout migrating upstream from Diablo Lake. A barrier falls at this point precludes fish passage into the upper 2.2 miles of stream habitat within Ross Lake NRA. Fish presence in the reach from the barrier falls upstream to the Ross Lake NRA boundary is of uncertain origin.

Gorge Lake Tributary Trout Habitat

Gorge Lake tributaries believed to support trout spawning were surveyed during spring and summer 1989 by the Seattle City Light Environmental Affairs Division. Surveys were designed to evaluate the quantity and quality of spawning habitat as well as identify barriers to fish passage. Much of the following stream habitat information was taken from this report.

Similar to the Ross Lake tributaries, it is likely that fish are now present in streams which were historically fishless due to widespread stocking efforts within the past century. Stocking of trout species in high mountain lakes within the tributaries of Diablo and Gorge lakes is well documented. These introduced fish are capable of dispersing downstream into water bodies below. To date no comprehensive survey of

fish distribution has occurred in the stream reaches located above the identified barriers.

Pyramid Creek

The lowermost 400 feet of Pyramid Creek contains about 500 feet² of spawning habitat. A series of falls shortly above this reach precludes all fish passage. From the mouth of Pyramid Creek to the Ross Lake National Recreation Area (Ross Lake NRA) boundary there is 2.6 miles of stream habitat. This habitat is not suitable for trout due to the high gradient and small size of the stream.

Stetattle Creek

Stetattle Creek is the largest tributary to Gorge Lake, besides the Skagit River, and subsequently contains the most spawning habitat for trout and char. The lower 1.5 miles contain an estimated 1800 feet² of spawning habitat. Most of this habitat occurs along the stream margin or in pool tail-outs. Stream gradient in this reach is 3-5 percent. A 100 foot falls occur about 1.5 miles upstream from Gorge Lake creating a barrier to fish passage. From the mouth of Stetattle Creek to the Ross Lake NRA boundary there are 1.1 miles of stream habitat. This habitat is suitable for trout due to the low gradient and large size of the stream. This reach is entirely below the barrier falls described above. Fish presence above the barrier and upstream of the Ross Lake NRA boundary has been documented and is likely due to stocking.

Sensitive Species

Special Status Wildlife

Three mammal species are listed under the federal Endangered Species Act. These include the “endangered” gray wolf (*Canis lupus*) and the “threatened” grizzly bear (*Ursus arctos*) and Canada lynx (*Lynx Canadensis*). Two bird species, marbled murrelet (*Brachyramphus marmoratus marmoratus*) and northern spotted owl (*Strix occidentalis caurina*), are both listed as “threatened”. There are also two federal “candidate” species, the fisher (*Martes pennanti*) and Columbia spotted frog (*Rana luteiventris*). Additionally, two “monitor” species, both recently delisted, include bald eagle (*Haliaeetus leucocephalus*) and peregrine falcon (*Falco peregrinus*). There are six state endangered, two state threatened, and eleven state candidate wildlife species found in Ross Lake NRA (Table 5.10).

Gray Wolf (federal – endangered, state – endangered)

Wolves are highly social animals with large home ranges that include a variety of habitat types. Key components of wolf habitat include: (1) sufficient, year-round prey base of ungulates and alternate prey (i.e., beaver and smaller mammals), (2) suitable and somewhat secluded denning and rendezvous sites, and (3) sufficient space with minimal exposure to humans. Wolf distribution is largely influenced by distance from human activity and wolves are highly susceptible to human-caused mortality.

Small numbers of gray wolves persist within the North Cascades, as evidenced by annual observations (NPS files). Recent confirmed sightings include areas just east of Ross Lake NRA and provide evidence that wolves are successfully reproducing. There is currently no U.S. Fish and Wildlife Service recovery plan for wolves in the North Cascades.

Grizzly Bear (federal – threatened, state – endangered)

Grizzly bears are habitat generalists with large spatial requirements in terms of both foraging and security. No data are available to assess grizzly bear habitat use in the North Cascades. Studies in similar habitats show similarities and differences (McLellan and Hovey 2001; Waller and Mace 1997) in resource selection in areas less than 50 miles apart. This variation in habitat use would be expected in the North Cascades as well. These and other grizzly bear habitat use studies suggest it is likely grizzly bears in this ecosystem use an elevational gradient through the year and, based on availability, rely on avalanche chutes, shrub fruits, riparian areas, carrion and small mammals. Ross Lake NRA is within the North Cascades Grizzly Bear Recovery Zone and provides all of the habitat types grizzly bears prefer, including undisturbed riparian areas that are rare in other parts of the recovery zone.

The North Cascades portion of the *Grizzly Bear Recovery Plan* (USFWS 1993) was approved in 1997. The most current population estimate for the North Cascades ecosystem as a whole (including the portion within British Columbia) is less than 35 individuals (Interagency Grizzly Bear Committee, July 2007 unpublished report). In 1991, the Fish and Wildlife Service first issued a warranted but precluded finding to uplist the North Cascades recovery zone population to endangered status. This uplisting action continues to be precluded by higher priority listing actions (USFWS Species assessment and listing priority

assignment form, 2004). All boat-in campsites within Ross Lake NRA have been or soon will be equipped with bear-resistant food storage boxes (“bear boxes”), and several walk-in sites within Colonial Creek and Newhalem Creek campgrounds likewise have been provided with bear boxes. A non-governmental organization has been conducting extensive grizzly bear outreach and education throughout the recovery zone, including Ross Lake NRA. These measures notwithstanding, given the extremely low number of grizzly bears remaining in the ecosystem it is unlikely they will recover to a sustainable population without the aid of population augmentation. An EIS is required to determine if and how this will be undertaken.

Canada Lynx (federal – threatened, state – threatened)

Lynx are associated with subalpine and boreal forests throughout their range (Witmer et al. 1998; Aubry et al. 1999). This species requires a mosaic of forest seral

stages connected by stands suitable for travel cover. Lynx use late-seral forests for denning and rearing young and use early-seral forests for foraging (Aubry et al. 1999). Primary prey includes snowshoe hares, although lynx will take other prey, particularly when hare density declines.

Lynx generally use higher elevation (above 3,000-4,000 feet) lodgepole pine, subalpine fir, and/or Engelmann spruce forests. Suitable lynx habitat exists east of Ross Lake, but it is found only in small patch sizes. A remote camera survey completed in 2005, targeting forest carnivore species (including lynx) did not document lynx. The NPS currently has no documented records in Ross Lake NRA. However, there is unconfirmed evidence that lynx may occasionally wander as far west as Mount Baker.

Table 5.10 Wildlife Species Associated with Ross Lake NRA and Their Conservation Status

Species	Federal List	State List
Gray Wolf	Endangered	Endangered
Grizzly Bear	Threatened	Endangered
Canada Lynx	Threatened	Threatened
Marbled Murrelet	Threatened	Threatened
Northern Spotted Owl	Threatened	Endangered
Pacific Fisher	Candidate	Endangered
Columbia Spotted Frog	Candidate	Candidate
Bald Eagle	Monitor	Sensitive
Peregrine Falcon	Monitor	Sensitive
California Wolverine		Candidate
Townsend’s Big-eared Bat		Candidate
Northern Goshawk		Candidate
Western Toad		Candidate
American White Pelican		Endangered
Sandhill Crane		Endangered
Western Grebe		Candidate
Golden Eagle		Candidate
Merlin		Candidate
Vaux’s Swift		Candidate
Lewis’ Woodpecker		Candidate
Pileated Woodpecker		Candidate
Common Loon		Sensitive

Bold represents official current federal and/or state listed status.

Marbled Murrelet (federal – threatened, state – threatened)

Marbled murrelets forage almost exclusively in the near-shore marine environment and fly inland to nest in the canopy of mature and old-growth conifer forests. Current monitoring estimates marbled murrelet populations in Washington, Oregon, and California are declining at a rate of 4 percent to 7 percent annually (USFWS 2008). More recently, major declines (22-73 percent) over a decade or more have been documented in Alaska, British Columbia, and Oregon (Strong 2003, Burger 1995, 2002, Chatwin et al. 2000). McShane et al. (2004) projected a mean annual rate of decline of 2-6 percent per decade over the next 40 years based a more detailed demographic modeling procedure.

Prior to 2008, NPS biologists had never conducted a formal inventory of marbled murrelets because the park complex was considered too far inland. Only two incidental observations document the presence of murrelets in the park complex. Both observations were of single birds found on Ross Lake in late summer, after the breeding season was over. However, U.S. Forest Service surveys conducted immediately adjacent to the park complex in the early 1990s documented murrelets using suitable nesting habitat in many of their low elevation drainages within 5 km (3 miles) of the complex boundary. Nelson (1997) states that the most inland occupied nest site in the Pacific Northwest was located 84 km (52 miles) from marine waters in Washington. In 2008, park biologists initiated a radar survey of five drainages in the park complex. Preliminary results show probable detections in Ross Lake NRA along the lower Skagit River (Hamer et al. in progress). Ground surveys will be conducted in Ross Lake NRA in 2009-2010 to try to confirm the 2008 radar detections.

Northern Spotted Owl (federal – threatened, state – endangered)

Northern spotted owls occupy mature, old-growth Douglas fir / western hemlock forests that have multi-layered, multi-species canopies with moderate to high canopy closure (USFWS 2008). The final recovery plan (USFWS 2008) designates Managed Owl Conservation Areas (MOCAs) in non-fire dominated habitats west of the Cascades. Two MOCA-2s are designated within Ross Lake NRA. MOCA-2s have enough “habitat-capable” area to support one to 19 pairs of breeding spotted owls (USFWS 2008).

Surveys completed over three years (1994-1996) by NPS staff documented three spotted owl activity sites within Ross Lake NRA (Kuntz and Christophersen 1996). Kuntz and Christophersen (1996) also documented 23 barred owls sites within Ross Lake NRA. In 1995, they found a hybrid spotted/barrred owl mated to a female barred owl in the Big Beaver Valley. NPS staff will re-survey spotted owl habitat in 2009-2010 to document changes over the past 15 years.

Fisher (federal – candidate, state – endangered)

Fishers are generally associated with late-successional coniferous and mixed coniferous-deciduous forests, though second growth forest with good cover may also be used. Core habitat zones on the east-slope of the Cascades include subalpine fir and grand fir/Douglas fir forests. Fishers require snags and logs for natal and maternal dens and rest sites.

In Washington, due to lack of recent sightings or trapping reports, the fisher is considered to be extirpated or reduced to scattered individuals (Aubry and Houston 1992). Recent remote camera surveys in the park complex, targeting forest carnivore species failed to document fisher presence (Kuntz and Glesne 1993, Duke Engineering and Services 2000, Christophersen et al. 2005, and Christophersen 2006). Occasional observations are reported to park staff, but all sightings remain unconfirmed. In 2007, the fisher was reintroduced in Olympic National Park (P. Happe, NPS, 2008 pers. com.). If reintroduction efforts are successful on the Olympic Peninsula, similar efforts may be implemented in the Cascades.

Columbia Spotted Frog (federal – candidate, state – candidate)

In Washington, Columbia spotted frogs range in elevation from 1700’ to 3100’. Breeding occurs shortly after ice-free water appears, usually in spring and early summer, but can occur in late winter at lower elevations. Jones et al. (2005) states “the species breeds in relatively exposed, shallow waters of sedge fens, riverine overbank pools, beaver ponds and small lakes. Vegetation in the breeding pools generally is dominated by herbaceous plants.” This species is known from only one location in Ross Lake NRA (Holmes and Glesne 1997).

Bald Eagle (federal – monitor, state – sensitive)

Bald eagles are associated with riparian and open water habitats (i.e., rivers, lakes, and bays) with large trees and adequate prey (i.e., fish and/or waterfowl)

concentrations. Nests are generally in the tallest tree in a stand, and nest sites are usually located within 0.25 mile of large bodies of water (Montana Bald Eagle Working Group 1991). In most areas, absence of intense human activity is also an important factor in nest site selection (Stinson et al. 2001). Important habitat components for wintering eagles include concentrations of prey in areas with tall trees that provide suitable perch and roost sites (Stalmaster 1987; Stinson et al. 2001). As with the nesting period, the level of human disturbance also influences wintering habitat quality.

The bald eagle was federally delisted in 2007. The species is now being monitored by federal and state agencies to ensure that the post-delisting monitoring plan goals are being met. Ross Lake NRA hosts one of the continent's largest wintering eagle concentrations along the Skagit River. Eagles arrive in November to take advantage of the numerous spawning salmon using the Skagit. Mild winter weather enables these eagles to continue using this area throughout the winter. They depart the Skagit River for their breeding grounds in early March. Servheen (1975) documented the Skagit River as the most important wintering habitat for Bald Eagles in the continental United States. The Nature Conservancy and National Park Service have monitored eagle use of the upper Skagit River since 1978 (Dunwiddie and Kuntz 2001). Eagle use of the river peaked in the early 1990s and has been stable since that time. The upper Skagit River continues to be an important wintering resource for this species.



A bald eagle near Roland Point on Ross Lake.

Since inception of the park complex in 1968, no breeding pairs of bald eagles have been documented within Ross Lake NRA. However, park staff occasionally observe adult bald eagles during the breeding season along Ross Lake.

Peregrine Falcon (federal – monitor, state – sensitive)

The peregrine falcon is a medium to large falcon that nests on ledges on cliff faces. Peregrines were federally delisted in 1999, but remain a federal “monitor” species under the Endangered Species Act. Over the past decade peregrine populations in Washington have dramatically increased and the species appears to be re-colonizing suitable nesting habitat within the park complex.

Bjorklund (1984) surveyed suitable habitat within Ross Lake NRA. While he surveyed many highly suitable areas of breeding habitat, he did not observe any peregrines during the breeding season. Washington Department of Fish and Wildlife biologists, conducting surveys of breeding habitat over the last several years, have documented four active eyries along the upper Skagit River (P. DeBryun, 2008 pers. com.).

California Wolverine (federal – none, state – candidate)

The wolverine is a rare, secretive mammal that occurs at low densities, even in core areas of its range. They are generally found in areas remote from humans and human development. Home ranges of adults in North America are large and vary from less than 40 miles² to over 350 miles² (Banci 1994). Habitat conditions that influence wolverine distribution and abundance are largely unknown (Banci 1994), but their habitat is probably best defined in terms of “adequate year-round food supplies in large, sparsely inhabited wilderness areas, rather than in terms of particular types of topography or plant associations” (Kelsall 1981). Wolverines are described as opportunistic omnivores in summer and scavengers in winter. In the Yukon and British Columbia, wolverine diets consisted of snowshoe hares, porcupines, sciuridae, birds, small mammals, ungulates, and fish (Banci 1994). Current research being conducted near the east border of the park complex is following the movements of several collared animals and has documented presence in Ross Lake NRA (Keith Aubrey, U.S. Forest Service, pers. com.).

Townsend's Big-eared Bat (federal – none, state – candidate)

This bat is a widespread but declining low- to mid-elevation species found below Pacific silver fir and subalpine fir communities. Christophersen and Kuntz (2003) documented the only known occurrence of this species in the park complex, an individual found along the western bounds of Ross Lake NRA.

Northern Goshawk (federal – none, state – candidate)

The northern goshawk occurs in upland mesic conifer and deciduous riparian forests. This species is an uncommon nester and rare migrant within Ross Lake NRA. Bjorklund and Drummond (1989) documented a dispersed fall south-bound movement of goshawks through the park complex (0.02 birds/hour of survey effort).

Western Toad (federal – none, state – candidate)

Western toads range in elevation from sea level to 7400'. Egg laying sites and aquatic habitat include lakes, springs, ponds, wetlands, stock ponds and slow-moving parts of streams. Terrestrial habitats are forests, grasslands and along streams. Western toads are most common near marshes and small lakes, but they may wander great distances through dry forests or shrubby thickets. Outside of the breeding season, western toads are nocturnal, spending the day buried in the soil, concealed under woody debris, or in the burrows of other animals. While the species can be locally abundant in Ross Lake NRA, reproductive adults are rare and declining.

American White Pelican (federal – none, state – endangered)

The park complex's Wildlife Observation Database documents three observations of this species' occurrence in NRA. The nearest breeding colony is in south-central Washington on the Columbia River. Records for Ross Lake NRA are of birds moving outside their normal range.

Sandhill Crane (federal – none, state – endangered)

This species is a fairly common to locally abundant migrant in Washington, preferring open fields near estuaries and wet farm fields (Wahl et al. 2005). There are only two records for Ross Lake NRA, both along the shores of Ross Lake (NPS files).

Western Grebe (federal – none, state – candidate)

The western grebe is a rare migrant and non-breeding summer visitor to Ross Lake NRA's reservoirs. However, the species is most likely to be seen from mid September through mid November (NPS files).

Golden Eagle (federal – none, state – candidate)

This species is a rare breeder and fall migrant in the Cascades Range, occurring most frequently in subalpine/alpine habitats. Bjorklund and Drummond (1989) documented a fall migration in the park complex of 0.1 birds per hour of survey effort over the period 1984-1988. A Washington state survey in 1985 revealed only 20 territories (11 occupied) in all of western Washington.

Merlin (federal – none, state – candidate)

Merlins are uncommon residents and breeders in Ross Lake NRA. Most breeding pairs are likely the subspecies *Falco columbarius columbarius*, the taiga merlin (Smith et al. 1997). This subspecies prefers high-elevation forests that mimic boreal conditions.

Vaux's Swift (federal – none, state – candidate)

Vaux's swift is a common breeder in forested zones from sea level to 5000'. It nests in tree cavities and eats mostly flying insects. Park studies (R. Kuntz BBS data) have documented this species as regularly occurring in Ross Lake NRA from May through September. This species likely visits high elevation sites (above treeline) strictly as "fly overs".

Lewis' Woodpecker (federal – none, state – candidate)

Lewis' woodpeckers breed in open canopied ponderosa pine forests or in riparian woodlands dominated by cottonwoods, oak woodlands, or cultivated orchards east of the Cascade Crest (Wahl et al. 2005). In Washington, this woodpecker is migratory. There only are three observational records of this species for Ross Lake NRA, all likely representing migrants (Wildlife Observation Database).

Pileated Woodpecker (federal – none, state – candidate)

This species is common in mid-seral and late-seral forests, mostly at low and moderate elevations. It is much less common in subalpine fir and mountain hemlock forest communities. Key habitat needs

include the presence of large snags used for nesting and roosting. Siegel et al. (2004) documented pileated woodpeckers in all conifer or mixed deciduous-coniferous forests for low elevation up to and including the mountain hemlock cover type.

Common Loon (federal – none, state – sensitive)

Common loons are common migrants and winter visitors, and rare breeders in Washington. Breeding pairs prefer lakes and reservoirs with suitable emergent shoreline vegetation and minimal development and disturbance (Wahl et al. 2005). In Ross Lake NRA, common loons are uncommon migrants, visiting reservoirs and a few of the larger lakes. Two of approximately 25 lakes in Washington known to have nesting pairs of this species occur in Ross Lake NRA (Smith et al. 1997).

Special Status Fish

Three species of fish are listed under the federal Endangered Species Act in the Skagit System: Chinook salmon, steelhead trout, and bull trout. Coho salmon and coastal cutthroat are federal species of concern. Chinook and bull trout are also listed as Washington State species of concern (Table 5.11).

Chinook Salmon

The Puget Sound Chinook salmon Evolutionarily Significant Unit was listed as a threatened species on March 24, 1999 by the National Marine Fisheries Service under the federal Endangered Species Act. Chinook salmon stocks originating from the Skagit River have been in a long-term decline. Chinook catches in the Skagit terminal area have declined since at least 1935; ranging from 40,000 to 50,000 in the 1930s, dwindling down to annual catches of a few thousand or even hundreds during the 1990s. Return/spawner rates have been below average since brood year 1983. Since about 1984, Upper Skagit summer Chinook have made up an increasing percentage of the total escapement. Prior to 1984, approximately 60 percent of the summer and fall production unit escapement was comprised of Upper Skagit summer Chinook, yet, since that time, Upper Skagit summer Chinook have averaged about 75 percent of the total summer and fall production unit escapement.

The Ross Lake NRA section of the Skagit River mainly supports all fresh water life history stages (egg, fry, juvenile rearing, and adult spawning) of one of the six separate Skagit Chinook populations (Upper Skagit summer Chinook). Upper Skagit summer Chinook

spawn in the Skagit mainstem and its tributaries upstream of the Sauk River, primarily from September through early October. Genetic analyses have shown that upper Skagit summer Chinook are significantly differentiated from other Skagit Basin Chinook populations.

Bull Trout

The Coastal Puget Sound Distinct Population Segment of bull trout was listed as a threatened species under the Endangered Species Act on November 1, 1999 by the U.S. Fish and Wildlife Service. The Puget Sound Management Unit consists of eight core areas, each supporting one or more local populations of bull trout and their habitat. The Coastal-Puget Sound Distinct Population Segment of bull trout occurs in a unique ecological setting because it supports the only known anadromous forms of bull trout in the coterminous United States.

The Ross Lake NRA section of the Skagit River is part of the Lower Skagit core area and supports bull trout that exhibit anadromous, fluvial and resident life history patterns. Three local populations (Bacon Creek, Goodell Creek and Newhalem Creek) spend a portion of their lives in this section of river. The population trend of the Lower Skagit bull trout is stable to increasing.

Steelhead Trout

The Puget Sound Distinct Population Segment of steelhead was listed as a threatened species under the federal Endangered Species Act on May 11, 2007 by the National Marine Fisheries Service. This section of the Skagit River supports all fresh water life history stages (egg, fry, juvenile rearing, and adult spawning) of both summer and winter steelhead. In 2002 the Mainstem Skagit/Tributaries winter steelhead was rated as depressed due to a long-term negative trend in escapements since 1992 and a short-term severe decline in 2000 and 2001.

Special Status Plants

Several Washington State listed vascular plant species have been found within Ross Lake NRA. No federally listed species are known to occur within the North Cascades NPS Complex. Washington State listed species are found in Table 5.12.

Table 5.11 Fish Species Found in Ross Lake NRA and Their Conservation Status

Species		Federal List	State List
Steelhead (Puget Sound)	<i>Oncorhynchus mykiss</i>	Threatened	none
Coho salmon (Puget Sound)	<i>Oncorhynchus kisutch</i>	Concern	none
Coastal cutthroat	<i>Oncorhynchus clarki clarki</i>	Concern	none
Chinook salmon (Puget Sound)	<i>Oncorhynchus tshawytscha</i>	Threatened	Concern
Bull trout	<i>Salvelinus confluentus</i>	Threatened	Concern

Table 5.12 Plant Species Found in Ross Lake NRA and Their Conservation Status

Species	Common name	Habitat	State Status
<i>Botrychium pedunculosum</i>	Stalked moonwort	Moist or dry meadows, along perennial streams, and in coniferous forests. Elevations range from 1800' to 6300'.	Sensitive
<i>Botrychium pinnatum</i>	St. John's moonwort	Moist coniferous forests, mossy talus slopes under mixed deciduous and coniferous cover, subalpine meadows, and disturbed areas. Elevation ranges from 1900' to 7300'.	Sensitive
<i>Carex buxbaumii</i>	Buxbaum's sedge	Peat bogs, marshes, wet meadows, and other wet places. Elevations ranging from 700' to 6200'.	Watch
<i>Carex magellanica ssp. irrigua</i>	boreal bog sedge	Fens, bogs, shady wet meadows, shrub wetlands, and marshes, often growing in peat soil, at 1640 to 7000'.	Sensitive
<i>Carex macrochaeta</i>	large-awn sedge	The species grows most often in moist or wet, open places, and near a seepage area close to a slide alder (<i>Alnus sinuata</i>) thicket	Threatened
<i>Carex pluriflora</i>	several flowered sedge	Wetlands, boggy lake margins, prairies and stream banks. This species often grows in sphagnum and peaty soils in areas dominated elevation from 160' to 3160'	Sensitive
<i>Carex saxatilis var. major</i>	russet sedge	Wetlands and lake margins	Watch
<i>Eriophorum viridicarinatum</i>	green keeled cotton grass	Cold, sometimes calcareous, swamps and bogs at moderate to high elevations (2000' to 6600')	Sensitive
<i>Lycopodiella inundatum</i>	Bog clubmoss	Sphagnum bogs, wet, sandy places, wetlands adjunct to lakes, and swampy ground, elevations up to 2000'	Sensitive
<i>Lycopodium dendroideum</i>	treelike clubmoss	Rock outcrops, talus or boulder fields, often with a significant moss and organic debris layer. Elevation ranges from 800' to 3600' in Washington.	Sensitive

Natural Resources Program Emphases

Inventory and Monitoring Program

Ross Lake National Recreation Area, as one unit within the North Cascades NPS Complex, is an active participant in the National Park Service Inventory and Monitoring (I&M) program. As part of this servicewide effort to improve park management through the acquisition and application of scientific knowledge, a primary role of the I&M program is to collect, organize, and make available natural resource data. Furthermore, it contributes to the Service's institutional knowledge by transforming data into information through analysis, syntheses, and modeling (<http://science.nature.nps.gov/im>). This program focuses on completing natural resource inventories and developing a sound scientific monitoring program to track specific resources into the future.

The I&M program is managed largely as a network program, in that park staff contribute to the development and implementation of monitoring projects that can occur in one or more network parks. The park is a member of the North Coast and Cascades Network, which also includes Olympic National Park, Mount Rainier National Park, San Juan Island National Historical Park, Ebey's Landing National Historical Reserve, Lewis and Clark National Historical Park, and Fort Vancouver National Historic Site. The monitoring program focuses on identifying "vital signs," those physical, chemical, and biological elements and processes of park ecosystems that are selected to represent the overall health or condition of park resources, known or hypothesized stressors, or elements that have important human values. Once the vital signs are selected, the expectation is that parks will monitor those resources through a long-term monitoring program.

Development of a parkwide ecological monitoring program initially began in the 1990s, when the park was selected as a servicewide "prototype" park to develop monitoring protocols that focused primarily, but not solely, on aquatic resources. Sufficient funding for this I&M program did not arrive in the park until 2001, and beginning then and in subsequent years, the servicewide I&M program has evolved away from the prototype role for the park to the network approach of developing multiple-discipline protocols for monitoring vital signs.

As of 2009, the network has identified 14 vital signs for development of protocols for long-term

monitoring. Fiscal realities, however, will likely limit implementation of monitoring to perhaps 7-10 of those vital signs across the network, depending on future funding. For the park, the selected Vital Signs for long-term monitoring will likely include glaciers, climate, mountain lakes, landbirds, forest and subalpine vegetation, and broad landscape changes. Each of these six vital signs will be implemented following development of a peer-reviewed protocol. Data will be analyzed and reported out to a variety of audiences, and archived through a database management system. The park will also monitor impaired or potentially impaired waterbodies as part of the I&M program, with similar data analysis, reporting, and archiving requirements. The park's two other vital signs, Wadeable Streams and Invasive, Non-native Vegetation, will likely remain unfunded unless additional funding is secured.

The I&M program is an integral part of the park's broader natural resource management program, in that all I&M projects rely on a mix of park base funds and I&M program dollars to implement the program. The park has adopted the I&M program as a core function to improve park management through a greater reliance on scientific knowledge to guide management decision-making.

Exotic Plant Management Team

A division of the North Coast Cascades Network Exotic Plant Management Team is stationed within the North Cascades National Park Complex. Priorities for the team are assisting the park with the management and control of populations of invasive plant species, especially in "gateway" corridors, including riparian zones, wetlands, roads and trails. This work is focused where invasive plant species adjoin wilderness areas, significantly affect native plant communities and restoration efforts, jeopardize visitor experience or safety, or in areas that may serve to transplant species to non-infested areas. The team has previously conducted control of reed canarygrass (*Phalaris arundinacea*) along the shoreline of Ross Lake, and will continue to be available to assist with the control of non-native, invasive plant species in the park complex.

Fire Management

Natural wildland fire is a frequent and annual visitor to the Ross Lake area and its effects have significantly influenced the vegetative structure that exists there today. Fire size, intensity and impact are strongly correlated to the cyclic nature of drought patterns that

affect the park's many vegetation types. Natural fire typically returns to each forested acre on the average of 100 to 300 years. Some areas show no fire history, suggesting they have never burned, while others, like the unique ponderosa pine-dominated forest near Desolation Peak, experience fire as often as every 50 to 75 years.

The wildfire suppression policy prior to the 1970's has resulted in fewer burned acres during that period than what would occur without human intervention. That policy, which was implemented in the early 1900s, impacted the Ross Lake NRA as we see it today by reducing the vegetative diversity and the ecosystem functionality produced by this vital and necessary disturbance agent. For example, the role of forest pathogens has increased, resulting in dead and moribund forests throughout the Ross Lake NRA. Certainly, the Ross Lake, Diablo Lake, and Gorge Lake reservoirs and the increase in structures in and adjacent to the park and the North Cascades Highway has resulted in fewer opportunities for wildland fire to maintain a dominant role in shaping ecosystem resiliency as compared to historic and pre-settlement times.

The management of wildland fires within the Ross Lake NRA is pursued in the context of being surrounded by federally managed lands, including the Pasayten Wilderness and the North Cascades National Park Complex as a whole. The border with Canada increases the need for suppression of all fires originating within the park that may threaten to burn across the border. Fire management plans for both the park and the Pasayten Wilderness strongly support the use of natural fire to help restore and maintain their fire adapted and maintained ecosystems.

North Cascades managers strongly support the role of lightning-caused fires to burn freely within the Ross Lake NRA, where appropriate. The 2007 *Fire Management Plan* recognizes the necessity of maintaining ecosystem functionality through natural fire, and advocates the necessity to restore fire through prescribed fire techniques in certain vulnerable areas in the Skagit Watershed. The plan also supports the suppression of unwanted fires in certain areas for multiple reasons, including to prevent property damage on federal lands, to private landowners, Seattle City Light, and the Washington Department of Transportation, as well as to prevent undesirable impacts to endangered and threatened species habitats, to prevent fire from burning from the park into Canada, and to protect human life.

Annually, a range of 3-8 fires burn vegetation within the Ross Lake NRA. The North Cascades NPS Complex *Fire Management Plan* provides policy guidance, goals and objectives, mitigation techniques, complexity analyses, staff roles and responsibilities, and strategies and tactics for every ignition occurring within the Ross Lake NRA., whether human- or lightning-caused.

CULTURAL RESOURCES

The National Historic Preservation Act recognizes five property types: districts, sites, buildings, structures, and objects. To focus attention on management requirements for these property types, *NPS Management Policies 2006* categorizes cultural resources as archeological resources, historic structures, cultural landscapes, ethnographic resources, and museum objects. Cultural resources may be linked to historic events or noteworthy people; they may be embodiments of technical accomplishment, design, or workmanship; they may be sources of information important in historical or archeological research; or they may be important in the cultural system of an ethnic group (NPS Director's Order # 28). Evidence of over 9,500 years of human interaction with the environment is embodied in cultural resources of Ross Lake NRA, preserving a diverse record of the complexity of human life in this extraordinary environment.

Historical Overview

The pre-contact history of Ross Lake NRA spans nearly 10,000 years and represents the longest well-dated cultural sequence of the Cascade Range interior. Due to the historic development of hydropower resources in Ross Lake NRA and federal statutes and regulations requiring consideration of project effects to cultural resources, more archeological research has been conducted here than in any other interior mountain valley in western Washington. As a result, archeological data from Ross Lake NRA have been at the forefront of new ideas regarding the extent of indigenous involvement in vast areas of Washington's densely forested, western Cascade Range slopes.

At historic contact, about A.D. 1830, several Native American groups occupied or traditionally used lands included within Ross Lake NRA. Skagit River bands (including Upper Skagit, Sauk-Suiattle, and Swinomish), who affiliate with other groups speaking Northern Puget Sound (Coast) Salish, utilized resources along the Skagit River and its tributaries

along the length of the Skagit River, including upstream of the gorge above Newhalem to the vicinity of today's Ross Lake reservoir. The reservoir basin was also used by the Nlakápmux (Lower Thompson), an Interior Salish-speaking group centered along the Fraser River but who traditionally hunted in the North Cascades. In addition, the archeological record suggests that a variety of other indigenous bands from both sides of the Cascades regularly utilized lands within Ross Lake NRA, including people from the Chilliwack, Nooksack, Similkameen, Fraser, Methow, Wenatchee, and Chelan watersheds.

The early contact history of Ross Lake NRA is not well documented and remains poorly understood. Hudson Bay Company brigades were among the first Europeans to explore the upper Skagit River valley, sometime prior to 1850.

Following this date, engineers and surveyors explored for possible transportation routes and mapped political boundaries.

The discovery of gold at several locations brought an influx of prospectors and miners between 1858 and 1880, which in turn motivated the development of an infrastructure to provide for food and transportation needs. Trails serving pack strings and gardens and roadhouses appeared along the main trail built to follow the Skagit River upstream to mining claims. Upon establishment of the Washington Forest Reserve in 1897, most land in today's Ross Lake NRA came under the administrative authority of the federal government. By 1918 the City of Seattle began development of its Skagit hydroelectric project, spurring the construction of railroads, bridges, power lines, company towns, and related facilities. With the increased demands that followed WWII, the U.S. Forest Service constructed roads for access to logging and recreational sites. In 1968 the U.S. Congress created Ross Lake NRA as part of the North Cascades NPS Complex and in 1988 it designated most of the park complex, including areas of Ross Lake NRA, as the Stephen Mather Wilderness.

An administrative history for the North Cascades NPS Complex was completed in 1998.

Archeological Resources

Archeological resources are the physical remains of past human activity. In many instances they preserve

the only evidence that preserves information about the long history of human use of the land. Archeological resources are often buried but they may extend above ground. In this document the term "prehistoric" refers to archeological resources that date prior to Euro-American contact and which are thus associated with Native American populations. Resource types include long and short-term campsites, toolstone quarries, resource gathering and processing areas, rockshelters, storage features, and rock art sites.

"Historic" archeological resources are those that post-date Euro-American contact. Historic archeological resources may be terrestrial or submerged and include homesteads, mines, trails, building remnants, and a variety of other features.

Since 1984, a program of park archeological investigations has revealed widespread prehistoric and historic use of Ross Lake NRA by Native American groups. Prior to that time, the very few documented sites offered insufficient evidence to support concluding other than ephemeral use of the mountain landscape. Today, archeological resources are found throughout Ross

Lake NRA. The current Ross Lake NRA data

base is developed from 190 archeological sites, many of which have been test excavated and assessed for National Register significance by NPS archeologists.

The most thoroughly studied portion of Ross Lake NRA is the Ross Lake area, where inventory and assessment activities have been conducted annually since 1987, when park funded excavations and Seattle City Light funded planning studies began in earnest. Currently and through the year 2025, archeological resources affected by Ross Lake reservoir are managed in compliance with an archeological resources mitigation and management plan for Ross Lake, which was developed by the North Cascades NPS Complex and SCL staff as part of the City of Seattle's license agreements with the Federal Energy Regulatory Commission (FERC No. 553). The portion of Ross Lake NRA below Ross Dam, particularly along the highway 20 corridor, has been almost as well studied, largely due to residential, recreational, and transportation developments of several agencies requiring compliance with Section 106 of the National Historic Preservation Act.



The Rockshelter Trail in Newhalem

Considered complex-wide, Ross Lake NRA has the largest number of inventoried archeological sites (190) in the North Cascades NPS Complex. One archeological district (Upper Skagit River Valley Archeological District) and two archeological sites have been determined eligible to the National Register of Historic Places. Including sites contributing to the district's eligibility, a total of 18 archeological sites in Ross Lake NRA meet National Register significance criteria. To date, four archeological sites have seen full-scale excavation, two sites have been stabilized by construction of erosion-control structures, and one site serves as a self-guided interpretive exhibit; in each of these cases, the management action was implemented to mitigate an adverse effect. Overall, lands within Ross Lake NRA tend to have high archeological sensitivity, making it necessary for agency planners and managers to strictly adhere to federal guidelines for managing cultural resources.

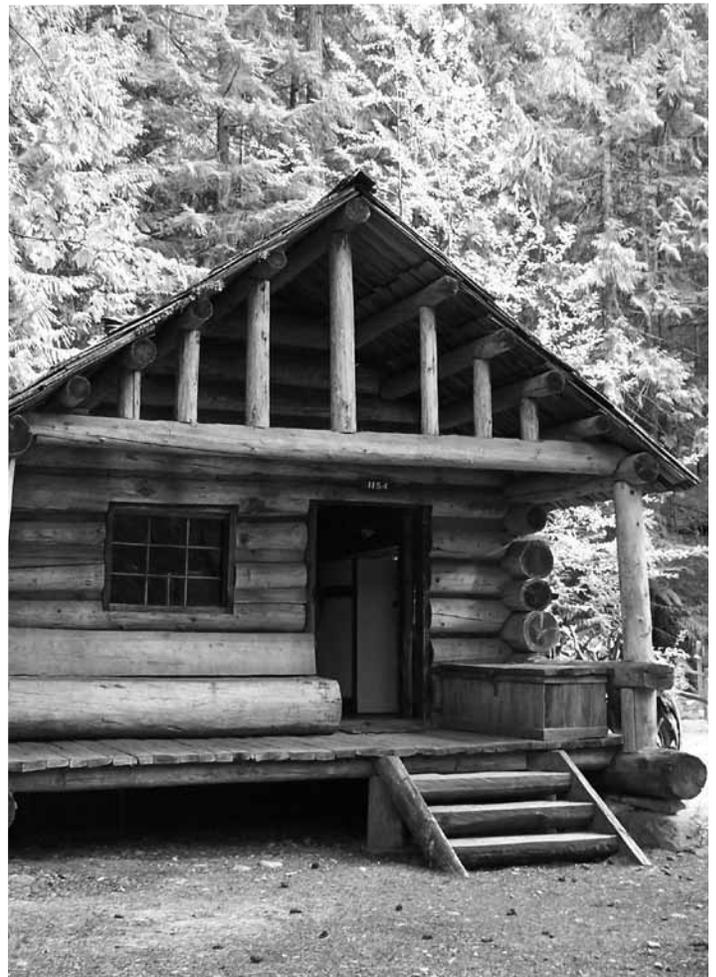
The accumulated knowledge from the above archeological investigations yields a picture of a long pre-contact indigenous history in Ross Lake NRA, and is summarized here. Based on both radiocarbon dated archeological sites and time-sensitive artifacts, the first people began using the upper Skagit valley at least by 10,000 years ago, about the same time that coniferous forests began to colonize the post-glacial tundra-like vegetation. These early people began a tradition of hunting and quarrying Hozomeen chert tool stone, the latter at a scale previously undocumented west of the Cascades. Base camps on stable landforms, especially those affording good solar exposure, occur in high densities, and represent occupation in all seasons for hunting, fishing, and gathering. Many sites reflect task-specific subsistence activities related to procuring and processing resources, such as salmon and mountain goat, as revealed in faunal remains preserved in intact cooking hearths. Radiocarbon-dated archeological remains (60 dates) suggests increasing indigenous populations until about the time of European contact. Overall, these data reveal an intensity of indigenous use and a level of detailed native knowledge of mountain environments and resources that had not been previously suspected. This new information benefits not only cultural resource program implementation of other agencies managing comparable landscapes, but it serves also to offset a historical lowland bias in pre-contact period studies by offering a vastly more comprehensive geographic view of the Northwest Coast Culture Area.

Ross Lake NRA is also rich in historic archeological sites, most of which are associated with 19th and early

20th century settlement and mining and associated activities, and with federal administration of the land. Many historic archeological sites are incompletely inventoried except for their above-ground structures and architectural features and facilities. Although historic archeological sites are not as numerous as those from the much longer pre-contact period, those that have not been assessed for National Register eligibility must be managed as if they are pending a formal assessment, consistent with NPS management policies.

Historic Structures

A historic structure is “a constructed work . . . consciously created to serve some human activity” (NPS Director's Order 28). Historic structures are usually immovable, although some have been relocated and others are mobile by design. The historic structures of Ross Lake NRA include buildings, fire lookouts, cabins, homesteads, shelters, ranger stations, guard stations, dams, caches, and other structures of historic, aesthetic, or scientific importance.



The Fish and Game-Hozomeen Cabin was constructed in 1935 and listed on the National Register in 1989.

According to federal law and NPS management policies, all historic structures in which the Park Service has a legal interest are to be managed as cultural resources. Regardless of type, level of significance, or current function, every structure is to receive full consideration for its historical values whenever a decision is made that might affect its integrity. Historic structures that are central to the legislated purposes of parks, especially those that are to be interpreted, may be subjects of additional, specialized efforts appropriate to their functions and significance.

The historical research program for the park complex was initiated in 1970 by a Historic Basic Data Study prepared by Erwin Thomson, which provided an overview of some of the historic themes and known resources associated with the area. The first compilation of a List of Classified Structures (LCS) was undertaken in 1976. Currently nine structures listed on the park complex's LCS are located in the Ross Lake NRA.

These studies were expanded by a Historic Structures Inventory (1984) and a Historic Resource Study (1986), both prepared by National Park Service Historian Gretchen Luxenberg and funded by the Cultural Resources Preservation Fund. The Historic Resources Inventory identifies 26 historic structures within the Ross Lake NRA. The historic contexts identified in the historic resource study included exploration, settlement, commercial development, recreation, and administration of the area by the U.S. Forest Service.

Evaluation of the structures listed on National Park Service inventories for the Ross Lake NRA identify four structures and one monument that are listed on the National Register of Historic Places:

- Desolation Peak Lookout (NR listing 88003451)
- Deer Lick Cabin (NR listing 88003452)
- Devil's Corner Cliff Walk (NR listing 74000909)
- Fish and Game – Hozomeen Cabin (NR listing 88003454)
- International Boundary US – Canada (NR listing 88003450)

The historical research and inventory data also provided the background information for the development of a Historic Structures Preservation Guide (1987) and structure and site-specific studies

addressing issues at the Devil's Corner Bridge structures.

Additional documentation of historic structures within the park complex is being compiled under the on-going update of the LCS, funded by a servicewide initiative and conducted by support office-based historical architects. The complete List of Classified Structures for the park complex was certified in 2005 and is constantly being updated with structure information and condition assessments.

Within the boundaries of Ross Lake NRA, Seattle City Light owns and/or manages approximately 80-30 historic structures, buildings, and features that contribute to the "Skagit River and Newhalem Creek Hydroelectric Projects" Historic District located in Newhalem, Gorge, and Diablo. The district includes buildings and features that contributed to the development and operation of the hydroelectric facilities, such as Diablo Dam and Powerhouse, Gorge Powerhouse, and most of the supporting historic structures.

Cultural Landscapes

The National Park Service defines a cultural landscape as a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values. Four kinds of cultural landscapes, not mutually exclusive, are recognized. A historic site is a landscape significant for its association with a historic event, activity, or person. A historic designed landscape is a landscape significant as a design or work of art, was consciously designed and laid out either by a master gardener, landscape architect, architect, or horticulturist to a design principle, or by an owner or amateur according to a recognized style or tradition. A historic vernacular landscape is a landscape whose use, construction or physical layout reflects endemic traditions, customs, beliefs, or values in which the expression of cultural values, social behavior, and individual actions over time is manifested in physical features and materials and their interrelationships including patterns of spatial organization, land use, circulation, vegetation, structures, and objects. An ethnographic landscape is an area containing a variety of natural and cultural resources that associated people define as heritage resources, including plant and animal communities, geographic features, and structures, each with their own special local names.

The consideration of cultural landscapes in this plan as a distinct group of cultural resources reflects the emergence of the cultural landscape program servicewide. Recently the Secretary of the Interior's *Standards for Historic Landscapes* have been drafted together with a new chapter in the current draft of NPS-28, and a Cultural Landscape Inventory initiative has been implemented in five regions, including the Pacific West Region.

Prior to this recognition, cultural landscape documentation within the complex was completed for several sites. These documents represent early efforts at defining what such documentation should incorporate and, thus, do not meet current standards for cultural landscape reports and related documents. Bringing this information up to current standards is an important recommendation in the following project statements.

The reports do, however, reflect the intrinsic strength of the inherently interdisciplinary approach of cultural landscape research, which requires documenting and understanding both the biotic and cultural resources of a landscape. Evaluation of the significance of a cultural landscape may require drawing on ethnographic, archeological, historical and/or ecological data.

Ethnographic Resources

Ethnographic resources are the cultural and natural features of a park that are of traditional significance to traditionally associated peoples. Ethnographic resources can include sites, structures, objects, resource use areas, or other natural landscape features assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a traditionally associated group.



A display of historical photographs in the visitor center shares the story of the area's history.

Ethnographic resources represent tangible evidence of the past and present behavior or knowledge of identifiable human populations in a geographic area such as the North Cascades. Potential ethnographic resource types include:

- Historic and contemporary human populations (park-associated groups), including relationships/affiliations with prehistoric populations
- Historic and contemporary subsistence uses and residency
- Current uses of ceremonial or religious localities by indigenous peoples
- Traditional sacred localities and/or objects to indigenous peoples
- Ethnogeographic resources
- Traditional Cultural Properties (ethnographic resources defined with reference to the National Register of Historic Places; see National Register Bulletin 38)

These resources are often intimately related to the other categories of both natural and cultural resources. Ethnographic research and studies can provide an added level or depth of understanding of these resources and should thus be coordinated with their inventory, evaluation, and management programs where possible.

Since 1989, several traditional cultural properties studies have been conducted in or near Ross Lake NRA. As with archeological resources, these studies were mandated by non-tribal, land-managing agencies in fulfillment of their obligation to consider the effects of their undertakings on cultural resources. Although several ethnographic resources have been identified by tribal elders in Ross Lake NRA, the location and nature of these resources, and the studies themselves, are protected by adherence to confidentiality agreements outlined in the initial study plans. As a consequence, it is important that agency planning and scoping efforts include consultation with tribal governments during early phases of project development, consistent with federal cultural resource management guidelines (36 CFR Part 800).

Museum Collections

The museum collections contain cultural objects relating to the archeology, ethnography, and the history of the area now within the park complex. The natural collections contain paleontological, geological, and biological specimens. Park archival collections contain resource management records, maps,

photographs and data from research projects, historic photographs, historic objects, and memorabilia. To house the collections within the available space, the museum utilizes compact storage units with moveable carriages. Laboratory space is provided for research and collection maintenance activities. Collection materials are stored in appropriate cabinets. Archives are stored in special archival quality boxes on shelves within the collection.

Since the inception of the park complex in 1968, the idea of collection management at the park level has grown and developed in response to servicewide policies and trends. From 1968 to 1982, the collections grew to contain a park herbarium and small field collections of wet specimens, study skins, geological specimens, and historic artifacts. During this period, collection management consisted of storing the objects in boxes or cabinets residing in a variety of offices and rooms under the auspices of the Research Biologist, or the Interpretive Specialists. During this period, nothing was formally accessioned. In 1976 the park complex headquarters were moved into a new building, and dedicated collections storage space was created.

From 1987 to the present, the collections continued to grow, particularly the archeological and herbarium entries, and collection management at the park complex began taking relatively large leaps of improvement. A draft collection management plan was created in 1984, it provided needed direction for park collection management. A scope of collection statement was written and approved in 1984. The updated scope of collection statement approved in 1998 requires revision. Cataloging and accessioning began and has seen consistent progress since 1983 with the help of volunteers, the Environmental Internship Program, and seasonal museum technicians hired with backlog cataloging program funds. A museum curator was hired in 1996 and funded for 13 pay periods on base funds.

In 1988, the resource management division took over responsibility for collection management in the park. That same year, a collection storage room with a single storage cabinet was created in Marblemount to accommodate the quickly growing archeological collection resulting from archeological investigations on Ross Lake. In 1990, funding was provided from the servicewide museum collections security initiative for a new collection storage facility to be built at Marblemount to house all west slope collections.

In 1993, the Marblemount curatorial facility was completed. The museum collections and cultural resource staff were moved to the new building. The museum collections grew in 1994 with the addition of approximately 550,000 historic museum objects excavated by the University of Idaho at San Juan National Historical Park (San Juan NHP). A letter of agreement was signed between the North Cascades NPS Complex and San Juan NHP to formalize the new arrangement. The San Juan NHP historic museum collection is now stored at the Marblemount curatorial facility and the park complex's museum curator is also the curator of record for San Juan NHP. The park complex's *Museum Management Plan* was approved and signed in January of 2005. In the summer of 1998, the NPS adopted a new cataloging system, Automated National Cataloging System (ANCS+, Rediscovery), which facilitated electronic catalog record keeping and submission of reports to the NPS Washington office. A collection condition survey was also completed in 1998 for the entire North Cascades NPS Complex's museum collections.

In 2002 the Marblemount curatorial facility building was expanded with the addition of the islands room, built to house a significant part of the San Juan Island archeology collection as well as the Ebey's Landing National Historical Reserve (Ebey's Landing NHR) museum collections. The Marblemount curatorial facility expansion allowed the addition of 500 cubic feet of prehistoric bulk material excavated by the University of Washington at San Juan NHP and previously stored at the University of Washington's Burke Museum. Approximately 700 cubic feet of San Juan NHP prehistoric material remained at the Burke Museum. A memorandum of understanding between the Burke Museum and San Juan NHP allows the loan of San Juan NHP prehistoric archeology artifacts to be retained by the Burke. The memorandum of understanding is administered by the North Cascades NPS Complex curator. With the addition of the San Juan Island National Historical Park and Ebey's Landing NHR museum collections the curator became the park complex curator and the curator of record for both San Juan Island and Ebey's Landing National Historical Reserve.

Natural History Collection

The purpose of the natural history collections is to provide onsite documentation of park resources. The collections are frequently used by both park staff and outside researchers. Each year field crews use the collections on a regular basis. The following

disciplines are represented in the park complex's natural history collection.

Geology: Geological specimens are represented by the Rowland Tabor and Peter Misch voucher collections, produced during research on the geology of the North Cascade Mountains. Thin sections are mounted on glass slides and are prepared with hand-written laboratory notes. Maps and field notes accompany the collections. There may be continued growth in the geology collections.

Paleontology: A small number of paleontological specimens represent the floras of the Eocene, Triassic and Jurassic Eras, collected by Rowland Tabor. The paleontological collections could be expected to increase with ongoing research.

Biology: Biological specimens comprise most of the natural history collection. Herbarium specimens from vascular and nonvascular research projects are the most numerous and most often examined. There are small reference collections of insect and fish specimens. Park collections have also been deposited in other institutions, mainly the University of Washington's Herbarium and Burke Museum. Vertebrates and invertebrates are poorly represented. Ongoing research will continue to increase the biological collections.

Cultural Collection

The purpose of the cultural collections is to preserve the park complex's cultural heritage and to increase knowledge and appreciation of that heritage. Cultural objects provide opportunities for research, exhibits, and interpretive programs in the park complex. The following disciplines are represented in the park complex's cultural collections.

Archeology: Archeological artifacts and objects represent collections ranging from prehistoric to historic. They are the result of park research activities, compliance, and inadvertent finds. Less than 5 percent of park complex lands have been systematically surveyed. Thus, archeological collections could be expected to increase with ongoing research.

History: Objects with direct relationships to the park complex from the past to the present can be found in the history collections. Historical

objects in the collections range from farm implements to building fabric to mining implements, and include a wide range of items. There may be moderate growth in the history collection.

Archives

Archival collections are resource management record materials generated by park complex activities from cultural and natural divisions, as well as archival donations. The park complex archives include many types of records, from photographs and oral histories, to original data from research projects or original manuscript collections. Archival collections relating to the park complex are also found at National Archives and Records Administration facilities in Seattle, as well as the University of Washington Library Special Collections. The archival collections will continue to grow.

Historic Contexts and Current Threats

Traditional Tribal Activities

A pristine natural landscape preserves the opportunity for a range of tribal activities centered around traditional subsistence and ceremonial practices. Procurement of salmon from the Skagit River, the hunting of ungulates and other large mammals, and the collection of plants formed the traditional subsistence base. Pristine natural environments remain important today for practicing traditional ceremonial and spiritual activities. Although development in Ross Lake NRA of the highway corridor and hydropower facilities constitute threats to the pristine natural environment, at the same time, these facilities provide access to natural landscapes that would otherwise be inaccessible by many tribal members, particularly elders.

Implementation of the management plan will be carried out in consultation with the Skagit tribes to prevent loss or degradation of traditional landscapes as these are identified by the affected tribes.

Homesteads

The primary threat to these structures is the lack of professional documentation and boundary delineation. Cultural landscapes for John McMillan and Tommy Rowland's homesteads are important for the functional organization of the landscapes that has occurred in these areas.

Federal Land Management Infrastructure

Historic structures are an important aspect of the historic federal land management infrastructure within Ross Lake NRA. Threats to these structures include lack of regular maintenance leading to decreased structural stability. Cultural landscapes for fire lookouts and other features are important.

Tribes of the Ross Lake National Recreation Area

Three federally recognized tribes maintain an association with park lands based on traditional subsistence use, origin beliefs, mythology, and spiritual beliefs and practices. These are the Upper Skagit, Sauk-Suiattle, and Swinomish tribal governments. In addition, NPS recognizes the traditional association of two Canadian First Nations regarding matters that relate to the northern extremity of Ross Lake, which borders the province of British Columbia. These First Nations include the Nlakápmux (also referred to as the “Lower Thompson”) and the Stó:lō, the first of which has been recognized by the U.S. Federal Energy Regulatory Commission as an interested party to the settlement agreements that have led up to Seattle City Light’s relicense of the Skagit Hydroelectric Project No. 553.

STEPHEN MATHER WILDERNESS

Geographic Overview

The Stephen Mather Wilderness was established by Congress in 1988 by the Washington Park Wilderness Act. Over 642,332 acres of North Cascades NPS Complex was designated wilderness, including 69 percent, or 80,043 acres of Ross Lake NRA. Five thousand additional acres within Ross Lake NRA were designated “potential wilderness” contingent on Seattle City Light’s plans to implement other hydroelectric projects. Potential wilderness occurs in two areas within Ross Lake NRA: about 1,554 acres in the Big Beaver Valley to accommodate raising Ross Dam, and about 3,559 acres in the Thunder Creek Valley to accommodate flooding and tunneling of Thunder Creek. Where Ross Lake NRA shares a boundary with North Cascades National Park, the Stephen Mather Wilderness continues seamlessly. The Pasayten Wilderness shares a boundary with Ross Lake NRA to the east, while to the north are Skagit Valley and Manning provincial parks in British Columbia. A corridor of non-wilderness within Ross

Lake NRA encompasses State Route 20, the Seattle City Light towns of Newhalem and Diablo, and the three reservoirs created by the Skagit Hydroelectric Project: Ross, Diablo, and Gorge lakes (See Figures 1.1 and 1.2).

Potential wilderness in the Big Beaver Valley stretches from just upstream of the mouth of Big Beaver Creek where it feeds into Ross Lake to about six miles up the valley. The entire area, except for 22 acres at its southeast corner, falls within the Big Beaver Research Natural Area, which was established in 1989 to protect an exemplary river valley bottom mosaic of terrestrial, semi-aquatic, and aquatic communities and an old growth western red cedar forest. The largest wetlands in the park complex can be found in this area along with cedar trees more than 6 feet in diameter that are estimated to be more than 1,000 years old. The headwaters of Big Beaver Creek rise along the towering eastern flank of the Picket Range, which holds 44 glaciers. The myriad of swamps and ponds in the wide glacial valley represent a unique collection of wetlands in the North Cascades. All of the Big Beaver drainage, except the lower six miles, is in the Stephen Mather Wilderness.

Potential wilderness in the Thunder Creek Valley stretches from upstream (0.5 miles) of the mouth of Thunder Creek where it feeds into Diablo Lake to about five miles up the valley. The Thunder Creek watershed is the most glaciated watershed in the coterminous states. Extreme climate variability results from the drainage being located along the Pacific Crest of the Cascade Range. Temperature and precipitation gradients are very steep, and result in a great diversity of vegetation that represents a unique mix of west and east-side species. Thunder Creek is located in the crystalline core of the North Cascades, where glaciers and rivers have cut deep canyons, towering peaks, and waterfalls. All of the Thunder Creek drainage, except for the lower five miles, is in Stephen Mather Wilderness.

Potential wilderness areas will become designated wilderness upon the Department of Interior Secretary’s determination, published in the Federal Register, that they have finally met the qualifications for designation by the cessation or termination of the nonconforming use.

Wilderness Character

The Stephen Mather Wilderness is at the core of one of the largest protected areas in the lower 48 states.

The portion of this wilderness area found within Ross Lake NRA serves as a gateway to the more remote interior, where jagged mountain peaks flanked by spectacular glaciers and snowfields, colorful subalpine meadows, and countless cascading waterfalls can be seen. Numerous trails provide access from the North Cascades Highway and Diablo and Ross Lake reservoirs. Some of the prominent features within the Ross Lake NRA wilderness include Hozomeen Mountain, Desolation Lookout, and Ruby Peak Mountain.

Agencies responsible for administration of designated wilderness are required by law to preserve the wilderness character of the area. Managers at the park complex use a Minimum Requirement Analysis to determine if, when, and how administrative actions that might impact wilderness character can be implemented. There are four qualities derived from the statutory language of the 1964 Wilderness Act that are used to describe wilderness character:

Untrammeled: wilderness is essentially unhindered and free from modern human control or manipulation

Natural: wilderness ecological systems are substantially free from the effects of modern civilization

Undeveloped: wilderness is essentially without permanent improvements or modern human occupation

Outstanding opportunities for solitude or a primitive and unconfined type of recreation: wilderness provides outstanding opportunities for people to experience natural sights and sounds, solitude, freedom, risk, and the physical and emotional challenges of self-discovery and self-reliance

The current condition of wilderness character within Ross Lake NRA is described below with regard to how well they retain these four qualities.

“Untrammeled”

Ross Lake NRA wilderness is generally unhindered and free from most human manipulation. There are two authorized actions, however, that occur within Ross Lake NRA wilderness that degrade the untrammeled quality of wilderness character: fire suppression and fish stocking or removal. Over the last 38 years (1970-2008), 70 percent (51 of 73) of naturally ignited fires have been suppressed within Ross Lake NRA wilderness. Fire suppression is chosen as a management action when the fire threatens life, improvements, or is determined to be a threat to natural and cultural resources or improvements. The act of suppressing the fire, regardless of how many acres it has burned or will burn, manipulates wilderness.

Six of the eleven mountain lakes (excluding small ponds) within Ross Lake NRA wilderness have a history of being stocked with non-native fish by the Washington Department of Fish and Wildlife as part of its recreational fishery program (See Table 5.13). Fish are not native to these lakes due to downstream barriers such as waterfalls or other high gradients that prevent fish passage. Although three of the lakes are no longer stocked, only one is fishless (Upper Panther Potholes); the remaining two lakes, Lower Bouck and Hozomeen Lake, have populations of reproducing fish. Lower Panther Potholes, Ridley, and Willow lakes are all currently stocked by the Washington Department of Fish and Wildlife. Under the 2008 *Mountain Lakes Fishery Management Plan* removal of reproducing populations of fish and cessation of fish stocking may occur in some lakes. Both stocking and removal of fish is a significant manipulation that degrades the untrammeled quality of wilderness character.

One unauthorized action that has been known to occur within NRA wilderness on at least one occasion is the development of a large-scale marijuana plantation. In 2008 a 4.7 acre plantation was

Table 5.13 Wilderness Lakes with a History of Fish Stocking

Lake	Current Management	Fish Status	Last Stocked
Lower Bouck	No longer stocked	Reproducing fish	1947
Hozomeen	No longer stocked	Reproducing fish	Unknown
Lower Panther Potholes	Stocked	Stocked fish	1994
Upper Panther Potholes	No longer stocked	Fishless	1988
Ridley	Stocked	Stocked fish	2000
Willow	Stocked	Stocked fish	2002

discovered and dismantled near the North Cascades Highway. Over 1,000 pounds of garbage, fertilizers, rodenticides and herbicides, irrigation piping, propane canisters, and equipment were removed from the site. Damage included cutting and limbing of trees to clear the grow sites, terracing of the land, impounding of creeks and installation of irrigation systems, spreading of chemical fertilizers, harassing and trapping wildlife, construction of living quarters and fences, and the spreading of garbage and human waste. This type of action, though it can be small in size, is the most egregious example of trammeling wilderness.

“Natural”

Ecological systems inside Ross Lake NRA wilderness areas are affected by things that happen both inside and outside the wilderness boundary. Affected components can be grouped by plant and animal species and communities, physical resources, and biophysical processes.

Plant species and communities

The condition of plant species and communities in Ross Lake NRA wilderness is generally good; there are no known federally listed species and no known extirpated species in the area. There are 10 known state-listed species; most of which are on this list due to restricted habitats, habitat degradation (outside NPS boundaries), and range limits (those species which are more abundant elsewhere). Out of approximately 200 non-native species in the entire park complex, 40 of them are considered invasive; the number of invasive plants within Ross Lake NRA wilderness areas is an unknown, but assumed to be a lesser amount.

Reed canarygrass (*Phalaris arundinacea*), a non-native invasive plant that is found along the edges of Ross Lake (outside of wilderness), was recently found in the Big Beaver Valley wetland system. This infestation has the potential to change this ecosystem from a highly diverse system, both in habitats and vascular and non-vascular plants, to a monoculture of reed canarygrass. Another non-native invasive plant, cheatgrass (*Bromus tectorum*), has been found along the east-side of Ross Lake in scattered patches that range in size from less than one square yard to more than 20 square yards in size. This annual grass can be stimulated by fire and out-compete native vegetation (Keeley 2006). Its presence has also been linked to increases in fire severity by providing highly flammable fuel in continuous patches during the hottest and driest time of the fire season (Brooks et al. 2004).

White pine blister rust is an invasive, non-native fungus that is threatening the survival of whitebark pines and Western white pines throughout Ross Lake NRA wilderness. White pines, along with other pines (lodgepole, ponderosa, and whitebark), are also threatened by mountain pine beetles, a native species whose population has exploded due to recent warmer winters and an abundance of drought-stressed trees – conditions which are likely the result of climate change and wildland fire suppression. The lodgepole pines are relatively short lived trees, which become decadent in 100-200 years. Wild fire suppression may have exasperated the beetle problem. This major die-off of pine trees will change a large portion of the overstory plant communities within Ross Lake NRA wilderness. As fuel loads continue to build in an area already impacted from past fire suppression, the chance for large, uncontrollable and unnatural wildfires increases.

Ponderosa pine and lodgepole pine occur together on the east-side of Ross Lake, comprising what is considered to be an anomalous vegetation type due to the unlikely assemblage of temperate and continental plant associates (Franklin and Dyrness 1988). It is estimated that these pines and their communities on the east-side of Ross Lake have missed at least one fire return interval due to fire suppression (Agee, personal communication). This estimate is supported by a fire history study performed near Desolation Peak in which the mean fire rotations for stands dominated by ponderosa pine, lodgepole pine and Douglas-fir were 44, 52, and 76 years, consecutively (Agee et al. 1986). Given that 70 percent of the lightning caused fires were suppressed within the last 38 years, it is probable that these relatively short fire cycles have been altered. Fire suppression enables shade-tolerant species, such as western hemlock, to out-compete fire-dependent species for nutrients and light.

Animal species and communities

The condition of animal species, communities, and habitat in Ross Lake NRA wilderness is generally good. Ross Lake NRA wilderness provides habitat for five federally listed wildlife species, three fish species, and one additional state listed wildlife species. Animals are on these lists due to historic over-taking of mammals associated with European settlement, historic and current overtaking of numerous fish species, habitat loss and degradation both outside and to a lesser extent, inside wilderness boundaries (dams control the flow of water to the extent that natural channel forming processes in upper reaches are limited). There are no known mammals, reptiles or amphibians that are non-native species in the area. The

rock pigeon, European starling, and house sparrow are non-native birds known to be within Ross Lake NRA but have not been documented within wilderness. The barred owl, an eastern species that has expanded its range westward, can be found in Ross Lake NRA wilderness. Its ability to outcompete spotted owls may be contributing to dwindling numbers of spotted owls across the west.

Three non-native fish species exist within Ross Lake NRA wilderness as a result of mountain lake fish stocking. In lakes where non-native fish can successfully reproduce, the largest impacts on native aquatic species occur because a multi-aged fish population can prey on all trophic levels in the system. There are various levels of downstream drift and upstream movement of planted fish in the vicinity of stocked lakes where non-native brook trout could potentially breed with native (and threatened) bull trout. Although the reservoirs are located outside of designated wilderness, they have significant impacts on demography and composition of communities within wilderness. When the reservoirs are full they can provide access above formerly impassable barriers (the falls at Big Beaver Creek, for example). The existence of the reservoirs (especially Ross) has increased the use of some streams for spawning (and rearing) for bull trout and rainbow trout. The population explosion of red-sided shiners in Ross Lake has resulted in reduced populations of mosquitoes and their larva, and increased growth of rainbow and bull trout feeding on shiners. It is currently unknown what will happen as a result of the shiner explosion, but it is suspected that once the food source is consumed there could be a population crash.

Physical resources

Air quality is generally good in Ross Lake NRA wilderness. There is no apparent overall degradation in visibility, no apparent trends in sulphur and nitrogen, and a slight decrease in ozone between 1996 and 2005. However, recent research focusing on atmospheric pollution deposited in snow, from fog, and in surface water systems shows that we are receiving mercury and pesticide pollution from sources adjacent to the park complex as well as from across the Pacific Ocean. A wide range of pollutants have been found in vegetation samples, PCBs and pesticides have been found in lichens, and mercury and organochlorine compounds have been found in fish tissue. Water quality is excellent in Ross Lake NRA wilderness. Human-caused soil disturbance or erosion occurs at a very localized scale, usually around trails that are snow-covered well into summer or in campsites where

bare ground disturbance has increased over time. Soil crusts in wilderness are generally in good condition.

Biophysical processes

Most biophysical processes are intact and functioning naturally within Ross Lake NRA wilderness. A few natural processes are disrupted due to human influence, however. It is likely that natural fire regimes have been altered by fire suppression on the east-side of Ross Lake, where the majority of natural fires within Ross Lake NRA occurred (70 percent of which were suppressed). Fire suppression enables dead and downed fuels to accumulate, thus increasing the potential for larger and more severe fires in the future. In turn, these higher severity fires have the potential to exacerbate soil erosion and volatilize more nutrients than would be lost in less severe events (Agee 1993).

Creation of the reservoirs, and to a lesser extent, the North Cascades Highway, has resulted in a loss of connectivity with the surrounding landscape for a number of species. Although black bears and moose have been known to swim across the reservoirs, these features serve as significant barriers to movement for smaller mammals, and have likely altered the movements of the larger mammals as well. Loss of the Upper Skagit Valley due to the creation of Ross Dam has resulted in a general lack of suitable low-elevation winter habitat for ungulates and other species. Although there are some large, flat, low-elevation tributaries like Thunder and Big Beaver, they are higher in elevation and somewhat isolated in comparison to the Skagit.

The impact of climate change on natural processes is a growing concern. Impacts include decreased snow cover, glacial retreat, decreased summer stream flow, increased frequency and magnitude of floods, increased stream temperature, rising tree line, changes in phenology, and longer growing seasons. This partial list of changes is resulting in ecological changes that we are not currently monitoring.

“Undeveloped”

For the purpose of this description, and following guidance of “Keeping it Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System (USDA 2008),” this section only monitors non-recreational developments, such as administrative or instrumentation sites. Recreation-focused developments, such as trails, camps, and toilets, are monitored under the solitude or primitive and

unconfined recreation quality because of the strong connection these features have to recreational experiences.

The “undeveloped” quality of wilderness character in Ross Lake NRA wilderness is generally good. Installations include one mountaintop radio repeater at Ruby Peak consisting of an equipment shelter and a tower measuring 32 feet in height. An additional repeater is scheduled to be installed at Desolation Peak in the near future.

Two historic structures are located within the wilderness: Desolation Lookout and Deerlick Cabin. These protected cultural resources contribute positively to wilderness character because they help us understand our past and present relationship with the land.

Motorized equipment and vehicles, such as chainsaws and helicopters, are used for administrative purposes within the wilderness, consistent with minimum requirement analysis.

The undeveloped quality of wilderness character in Ross Lake NRA wilderness is good. There are no non-recreational structures or developments within this portion of the wilderness, nor are there any inholdings. However, one installation, the Ruby

Mountain radio repeater, is situated on the peak. There are also numerous recreational developments that detract from the undeveloped quality of wilderness, including over 60 miles of trails, numerous bridges, and 17 designated backcountry camps. Two historic structures can be found within the wilderness: Desolation Lookout and Deer Lick Cabin. These protected cultural resources contribute positively to wilderness character because they help us understand our past and present relationship with the land. Motorized equipment and vehicles, such as chainsaws and helicopters, are used for administrative purposes within the wilderness.

“Opportunities for solitude or primitive and unconfined recreation”

Opportunities for solitude within Ross Lake NRA wilderness are abundant. Local topography, dense vegetation, and spacing of campsites and trails within the wilderness provide a sense of remoteness from the sights and sounds of other people that may be nearby. Night sky visibility is excellent at lower elevations but diminishes at higher elevations where light pollution becomes visible from the Seattle and Vancouver metropolitan areas. The natural soundscape is in good condition, though noise intrusions occur from aircraft, motorboats, highway traffic, and NPS administrative activities. Aircraft noise can be heard throughout



A visitor prepares to canoe in the Skagit River from Copper Creek Launch.

the wilderness at any time of day, but motorboat and highway noise significantly drops during nighttime hours. The source of NPS-generated noise typically includes chainsaw use to support trail maintenance activities and helicopter use to support fire management, trails, search and rescue, and resource management activities.

Opportunities for primitive and unconfined recreation are reduced by a number of facilities that decrease self-reliant recreation. A well-developed trail system with over 60 miles of trails and 17 and designated campsites with Wallowa toilets are the norm in this wilderness area. Trail signs at junctions and hitch rails at designated stock camps are common. Bridges made of both natural and steel materials are common facilities used to aid in stream crossings. Well-defined routes can be found in most cross country zones. One bear box is provided at Desolation Camp for the storage of food and other attractants in order to protect bears and visitors; visitors are required to store food appropriately by either hanging or using canisters at all other camps in order to protect visitors, bears, and other wildlife. Management restrictions include backcountry camping permit requirements, limited use of campfires, and required use of designated campsites or campsite setbacks for cross country zone camping. These facilities and management restrictions are used to manage impacts from visitor use by spacing people out along trails and confining impacts to specific, localized areas.

WILD AND SCENIC RIVERS

All river segments within Ross Lake are part of the Skagit River Watershed. The headwaters of the Skagit River begin in British Columbia, Canada in the North Cascades Mountains and the Skagit River flows approximately 150 miles and through three dams before it empties into Puget Sound. Abundant glaciers from the surrounding jagged peaks provide stable flows that help make it the only Puget Sound tributary to host all native species of anadromous fish and one of the highest concentrations of wintering bald eagles in the lower 48 states. It is the largest river draining into the Puget Sound and the third largest river on the west coast of the United States. The entire Skagit River watershed basin covers 3100 square miles; it provides 20-percent of the flows into Puget Sound.

There are no designated wild and scenic rivers in Ross Lake NRA, but the Skagit River is designated just downstream of Ross Lake NRA and managed by the Mt. Baker-Snoqualmie National Forest. In 1978,

Congress designated 158.5 miles of the Skagit River and its tributaries, the Sauk, Suiattle, and Cascade rivers, as wild and scenic rivers. This river's recognized "outstanding remarkable values" are: fish, wildlife, and scenery. The main-stem Skagit River reach begins at the Ross Lake NRA boundary and extends down to Sedro-Woolley and is designated as a recreational river. This reach is known for its salmon resources, bald eagles, and scenic boating opportunities.

Skagit River

As part of this GMP, eligibility and suitability studies were conducted for the main-stem Skagit below Gorge Dam to Ross Lake NRA boundary and the tributaries flowing into this reach. This study found the main-stem Skagit River, Goodell Creek, and Newhalem Creek to be eligible and suitable WSR segments. For more information on these tributaries and the WSR study, please see Appendix D. In addition to the river segments included in the current study, three other tributaries of the Skagit River above Gorge Dam (Thunder Creek/Fisher Creek, Ruby Creek, and Big Beaver) were also found eligible in previous study efforts. Below is a description of these eligible WSR segments.

Thunder Creek/Fisher Creek

Segment: These streams originate from glaciers in the North Cascades NPS Complex and flow into Diablo Lake within Ross Lake NRA over a total of 25 miles.

Potential Outstandingly Remarkable Values:

- *Scenery.* The area provides views of high mountains, rugged peaks, glaciers, waterfalls, old growth forest, and a pristine stream valley.
- *Recreation.* A backcountry trail and several backcountry camps are located along Thunder and Fisher Creeks.
- *Geologic.* These are deep valleys surrounded by high ridges and peaks. There are several active glaciers at the headwaters.

Classification: Wild – These creeks are only accessible by trail.

Ruby Creek

Segment: Ruby Creek from the Ross Lake National Recreation Area Boundary to slack water of Ross Lake over 2 miles.

Potential Outstandingly Remarkable Values:

- *Scenery.* Rapid flowing mountain streams with views of spectacular high mountain ridges and peaks.
- *Recreation.* Driving for pleasure and hiking.
- *Fish.* Important habitat for Dolly Varden rainbow and cutthroat trout.

Classification: Scenic

Big Beaver Creek

Segment: Big Beaver Creek originating on the east side of the Pickett Range in the North Cascades National Park until it flows into the slack water of Ross Lake over a course of 13 miles.

Potential Outstandingly Remarkable Values:

- *Scenery.* A maintained backcountry trail follows much of the lower portion of the creek. The trail offers spectacular views of the adjacent high country including mountain peaks, forested slopes, and the natural stream course with numerous beaver ponds, and old growth forests including spectacular stands of virgin western red cedar.

- *Recreation.* A maintained trail follows much of the lower portion of the creek. There is significant visitor use here and in the surrounding areas.
- *Geologic.* This is an active stream that varies from very steep gradient with falls and cascades to gentle meanders in the valley bottom.
- *Wildlife.* The valley provides diverse wildlife habitat including extensive growth Douglas-fir, western hemlock, and western red cedar; potentially extensive Spotted Owl habitat. This valley has excellent potential for Peregrine Falcon habitat due to the large cliffs and outstanding prey availability. Important mammals are mink, marten, river otter, beaver, cougar, mule, deer, black bear, and possibly gray wolf and grizzly bear.

Classification: Wild – This creek is only accessible by trail.

Below is a summary of the all eligible wild and scenic river segments within Ross Lake NRA (See Table 5.14).

Table 5.14 Summary of All Eligible Waterways within Ross Lake NRA

River Segments	Classification	Outstandingly Remarkable Values						
		Fish	Wildlife	Geology	Pre-history	History	Recreation	Scenery
Big Beaver Creek	Wild		X	X			X	X
Ruby Creek	Scenic	X					X	X
Thunder Creek	Wild			X			X	X
Skagit River	Recreational	X	X	X	X	X	X	X
Newhalem Creek	RM 0 – RM 0.5 –Recreational RM 0.5 – headwaters- Wild		X	X	X	X	X	
Goodell Creek	Mouth to RM 0.5- Recreational RM 0.5 to headwaters - Wild	X	X	X				X

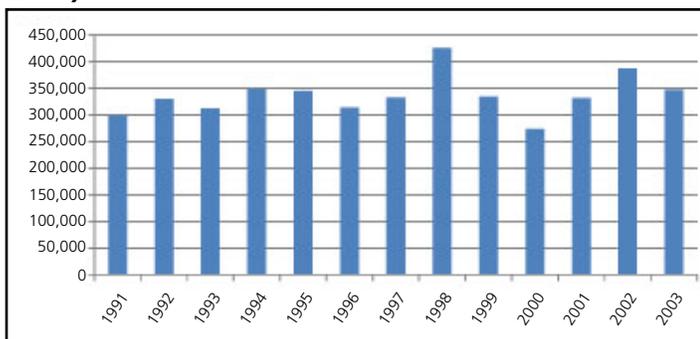
VISITOR USE AND EXPERIENCE

Visitation Overview

Since the park complex has no entrance stations, visitation is difficult to calculate. For this GMP, visitor use numbers were estimated using numerous traffic counters placed at key locations, campground and visitor center counts collected by park staff, backcountry camping counts collected from the backcountry permit database, and reporting by partners and concessioners. Due to inconsistent reporting and dilapidated recording equipment in recent years, visitation numbers collected by the NPS since 2003 are unreliable. For this analysis visitation numbers from 1991 to 2003 have been used. Improvements to the visitor use data collection and reporting system is recognized as an immediate need in this planning effort.

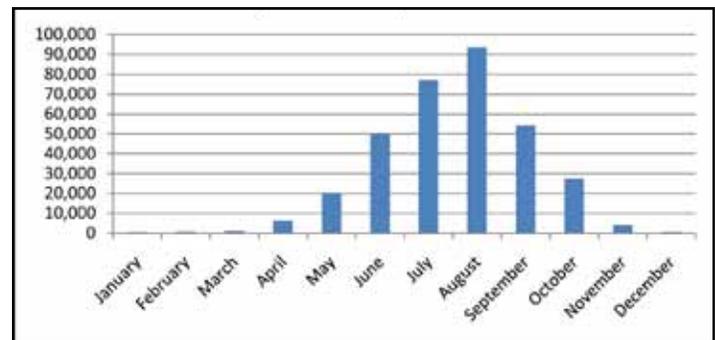
Visitation to Ross Lake NRA from 1991 to 2003 averaged about 337,000 people per year. During this same time period, visitation has fluctuated between a high of 425,000 people in 1998 and a low of 273,000 people in 2000. We are unable to report any current trends in visitation due to a lack of reliable data. Figure 5.7 shows the total annual recreation visits from 1991 to 2003.

Figure 5.7 Total Annual Recreation Visits (1991 – 2003)



Visitation to Ross Lake NRA is seasonal in nature, with 82 percent of all visits occurring in June through September. Twenty-eight percent of visits occur during the peak month of August. There is some late shoulder season use (April and November), but winter use is very limited due to access issues, the very low level of the reservoir, and the weather. There are currently detailed monthly use reports available. Figure 5.8 shows the average amount of visitation to Ross Lake NRA by month. Note: winter visitation is underestimated because recording equipment has been removed during that season in the past.

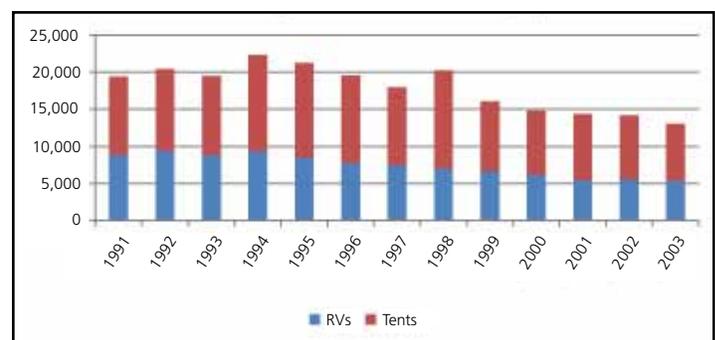
Figure 5.8 Average Monthly Recreation Visits (1991 – 2003)



Overnight Use

Overnight stays within Ross Lake NRA are recorded at NPS auto campgrounds, backcountry camps, the Ross Lake Resort concession, and the Environmental Learning Center. Auto campground use has declined since the 1990s, when 19,600 visitor use nights (number of visitors multiplied by number of overnight stays) on average were recorded each year. From 2000 to 2003, about 14,000 visitor use nights on average were recorded each year. The proportion of tent and RV users also slightly changed since the 1990s to include more tent users (59 percent in 2003 vs. 54 percent in 1991). Figure 5.9 shows visitor use nights at auto campgrounds each year and the proportions of tent and RV users.

Figure 5.9 Visitor Use Nights at Auto Campgrounds



In 1974, the first year for which backcountry visitor use night data is available, the park complex recorded 28,800 visitor use nights. After dipping to an all-time low of 17,800 in 1977, use climbed to its highest level of 39,500 in 1981. Another severe dip occurred in the mid-1980s, and then use climbed again to a secondary peak in 1995 of 38,900 visitor use nights. Since then, backcountry use has fluctuated, dropping again in 2004 to 29,870 visitor use nights, but currently on an upward trajectory through 2009 (35,956 visitor use nights). The average visitor use nights for the park

complex between 2000 and 2009 are 33,785. Separate data for Ross Lake NRA is more limited, and begins in 1991 with 13,500 visitor use nights recorded. This number reached a high of 17,300 in 1994, and has fluctuated since then. For the last ten years (2000 – 2009) visitor use nights for Ross Lake NRA averaged 14,325 with a low of 12,707 in 2003, and a high of 16,405 in 2008. Although visitor use nights dropped a minor amount in 2009, the general trajectory is upward.

On average from 2000 to 2009, backcountry use in Ross Lake NRA represents about 42 percent of total visitor use nights for the park complex. This percentage has been on an upward trajectory over the years. For example, in 1985 Ross Lake NRA backcountry use represented about 38 percent of total complex use. In 2009, the amount is at 45 percent. In the last two years, visitor use nights for Ross Lake NRA have surpassed the park for the first time. Much of this use is centered on Ross and Diablo Lakes, which represent about 78 percent of all backcountry

use nights for Ross Lake NRA, and 33 percent of for the park complex. The remaining 22 percent of backcountry use for Ross Lake NRA is in wilderness.

Overnight lodging is provided by the Ross Lake Resort concession and the Environmental Learning Center operated by North Cascades Institute. The resort operates from mid-June through October. Visitation averages about 6,500 visitor use nights per year (1998-2008). Reservation rates at the resort have been in the 90 percent range for the last few years and this trend is expected to continue in the future. Many guests will book their reservation for the next year at the time of their stay at the resort.

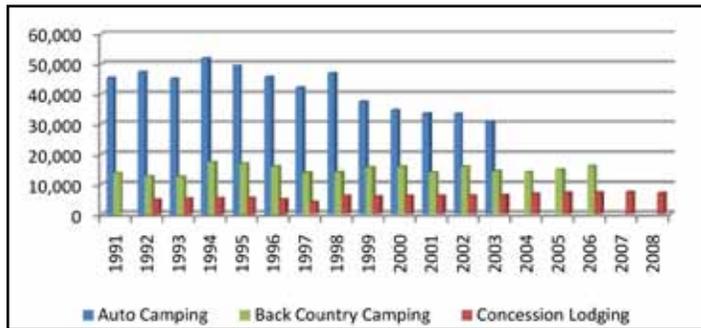
Since the 2005 opening of the Environmental Learning Center, participation in overnight programs lasting two to four days has increased from almost 1,000 participants in 2005 to 2,800 in 2008. Mountain School enrollment has increased from 800 participants in 2000 to over 1,800 in 2008. Figure 5.10 summarizes overnight use within Ross Lake NRA for auto

Table 5.15 North Cascades Highway Corridor Users and Ross Lake NRA Users

Profile of Corridor Users	Profile of Ross Lake Users
Most parties were families (68%)	Most parties were families (46 – 57% depending on survey location)
51% of visitors traveled in groups of two, 12% traveled in groups of three, and 15% traveled in groups of four	46% and 44% of visitors traveled in groups of two at Ross Dam Trail and Hozomeen, respectively, 15% and 13% traveled in groups of three, and 17% and 11% traveled in groups of four. In contrast, only 25% of visitors traveled in groups of two at Diablo Portage, 9% traveled in groups of six, and 11% traveled in groups of nine or more
29% of parties included children under age 18; however if Ross Lake NRA was a primary destination 45.2% of the parties included children	35% of parties included children under 18
Visitors were most commonly residents of Washington (62%), followed by other US states (30%)	At Ross Dam Trail and Diablo Portage, visitors were most commonly residents of Washington (71% and 93%, respectively); while at Hozomeen, visitors were most commonly from Canada (66%)
For 63% of visitors, this was their first trip to Ross Lake NRA	For 65% of visitors along Ross Dam Trail, this was their first trip to Ross Lake NRA, compared to 39% at Hozomeen and 31% at Diablo Portage
Trip Motivation for Corridor Users	Trip Motivation for Ross Lake Users
“Viewing scenery” was the trip motivation that received the highest importance rating, followed by “being close to nature,” “getting away from the usual demands of life,” and “experience tranquility”	“Viewing scenery” was the trip motivation that received the highest importance rating for Ross Dam Trail and Diablo Portage visitors, followed by “experience tranquility,” “being close to nature,” and “getting away from the usual demands of life.” For Hozomeen visitors the highest importance rating was “getting away from the usual demands of life,” followed by “experience tranquility,” “viewing scenery,” and “being close to nature”

campgrounds, backcountry camps, and concession lodging.

Figure 5.10 Overnight Stays (Visitor Use Nights) by Type*



*Data on overnight stays for auto campers is unreliable beyond 2003. Back Country Camping visitor use nights for 2007 were 15,991; 2008 were 16,405; and 2009 were 16,259.

Visitor Survey

During the summer of 2005 the Protected Areas Social Research Unit at the University of Washington conducted surveys of North Cascades Highway corridor users and Ross Lake users. The primary objectives of the Corridor User Survey were to obtain general visitor and trip information and to gather information such as awareness, use, and satisfaction related to facilities and programs introduced since the 1988 GMP. The primary objectives of the Ross Lake User Survey were to describe current lake users, the types of experiences they expect and have, and their attitudes toward potential management policies. Survey results are summarized below:

Trip Characteristics of Corridor Users

- Visiting Ross Lake NRA was the primary reason for the trip for 26% percent of visitors, was one of several reasons for 33% percent of visitors; and 41% percent of visitors were incidental visitors (visiting Ross Lake NRA was not a reason for their trip although they did stop at Ross Lake NRA)
- Most visitors came by auto (65% percent); motorcyclists made up 8% percent of incidental visitors and 6% percent of visitors for whom Ross Lake NRA was one of several destinations; no visitors for whom Ross Lake NRA was a primary destination came by motorcycle
- Visitors were more likely day users (61% percent) than overnight (39% percent)
- 63% percent of overnight visitors spent one or two nights and 92% percent spent between one and four nights

- Day users stayed four hours when Ross Lake NRA was a primary destination and 2.4 hours when it was an incidental visit
- Intentional visitors most frequently engaged in taking walks/hikes (80.6% percent), viewing lakes (79.0% percent), and viewing wildflowers/vegetation (75.8% percent)
- The three most important activities for intentional visitors include camping overnight in an auto campground, taking walks/day-hiking, and driving around viewing scenery

Trip Characteristics of Ross Lake Users

- Most lake users stayed overnight in Ross Lake NRA (98% percent at Diablo Portage, 86% percent at Hozomeen, and 56% percent at Ross Dam Trail)
- 70% percent of visitors at Ross Dam Trail spent one or two nights, 60% percent of visitors at Hozomeen and Diablo Portage spent two to three nights, and 26% percent of visitors at Diablo Portage spent five or more nights
- 48% percent of Hozomeen visitors described their trip as “camping overnight along lakeshore,” followed by 18% percent that described it as car camping
- 33% percent of Ross Dam Trail visitors described their trip as “drove from home or other lodging to spend the day,” followed by 19% percent that described it as car-camping, and 17% percent that described it as “camping overnight along lakeshore”
- 53% percent of Diablo Portage visitors described their trip as “staying overnight at Ross Lake Resort,” followed by 35% percent that described it as “camping overnight along lakeshore”
- Hozomeen visitors were the most likely to car camp (52% percent), Ross Dam Trail visitors were the most likely to day-hike (79% percent) and to backpack (29% percent), and Diablo Portage visitors were the most likely to stay at Ross Lake Resort (55% percent), to go motor-boating (64% percent), to kayak/canoe (38% percent), and to camp overnight at a boat-in campsite (46% percent)

Facilities and Programs (Corridor Users)

- The top three sources of trip information were 1) NPS website, 2) travel guide/tour book, and 3) NPS map/brochure
- The facilities or programs with the highest visitation rates were 1) North Cascades Visitor

Center (62% percent), 2) Diablo Overlook restrooms (37% percent), 3) Gorge Overlook Trail (24% percent), and 4) Newhalem area trails (23% percent)

Impacts of Other Visitors (Ross Lake Users)

- The number of people seen on Ross Lake by those who were surveyed was as expected for 38% percent of visitors, fewer than expected for 23% percent of visitors, and a lot fewer than expected for 14% percent of visitors
- 62% percent of respondents indicated that the number of people seen on the lake was as preferred, 17% percent indicated there were more people than they preferred, and 3% percent indicated there were a lot more people than they preferred. Three percent of visitors indicated they saw fewer people on the lake than they preferred
- The number of people seen on inland trails by people hiking on inland trails was as expected for 39% percent of visitors, fewer than expected for 30% percent of visitors, and a lot fewer than expected for 11% percent of visitors
- Two-thirds of visitors said the number of people seen on inland trails was as preferred

and 10% percent said the number of people were more than they preferred. Six percent of visitors indicated that the number of people seen on inland trails was fewer than they preferred

- 19% percent of visitors indicated that another party's behavior detracted from their enjoyment. These incidents were most likely to occur when respondents were on the shore of Ross Lake. Visitors contacted at Hozomeen were most likely to describe the party that affected their experience as having 8 or more party members whereas visitors contacted at Ross Dam Trail or Diablo Portage were more likely to describe the party that affected their experience as being in motorized boats
- Visitors contacted at Hozomeen reported a greater degree of detraction than visitors contacted at the other two sites. Over half (52% percent) of visitors contacted at Hozomeen indicated that this behavior detracted greatly whereas 63% percent of visitors contacted at Diablo Portage and 56% percent at Ross Dam Trail reported that this behavior detracted slightly. Review of the descriptions of these behaviors indicated that loud behavior that often goes on late into the night and sometimes accompanied by alcohol



View from Thunder Knob Trail.

was more prevalent at Hozomeen than the other locations and may be the behavior that results in the higher detraction ratings

- About one fourth of visitors contacted at Diablo Portage and Ross Dam Trail and 40% percent of visitors contacted at Hozomeen reported feeling crowded to some extent. The two factors rated highest as contributing to feelings of crowding were number of boating parties seen and number of parties camped within sight or sound
- 47% percent of people who saw evidence of human impacts indicated that the impacts did not detract from their experience and 39% percent indicated the impacted detracted slightly
- The most common impacts seen were litter (48% percent) and hiker-made trails (36% percent). Nine percent of visitors who saw evidence of human impacts specified in the other impact option the dam and dam-related items (i.e., power lines, maintenance equipment, road) as a human impact seen.

Recreation Opportunities

Recreation opportunities in Ross Lake NRA can be found within the highway corridor, on lakes, the Skagit River, smaller streams, and in the backcountry. Table 5.16 shows the primary recreational activities reported by overnight visitors to Ross Lake NRA.

Table 5.16 Ross Lake NRA Activities by Average Use Nights (2001-2009)

Activity	Percent
Boating (paddle)	39.3
Hiking	29.4
Fishing	12.4
Boating (power)	11.4
Other (other, admin., unknown)	3.6
Climbing	0.5
Stock Packing	0.4
Hunting	0.1

North Cascades Highway Corridor

The majority of visitors who come to Ross Lake NRA pass through on the North Cascades Scenic Highway, also known as State Route (SR) 20. This highway is the northern-most crossing of the North Cascades

in Washington State. In addition to connecting the east and west sides of the state, it provides access to a number of trails, auto campgrounds, the Skagit River, the North Cascades Visitor Center, and the Seattle City Light towns of Newhalem and Diablo.

Numerous recreational opportunities exist within the highway corridor. According to the 2005 Corridor User Survey, some of the most popular activities include taking walks or hiking, taking photographs, viewing lakes, auto-touring and viewing scenery, and viewing wildflowers or vegetation. Other activities that occur within the corridor include camping, bicycling, bird-watching, going to the North Cascades Visitor Center, going to the Seattle City Light Visitor Center and tour, rock climbing, reading interpretive displays, attending NPS programs, attending North Cascades Institute programs, and staying at Ross Lake Resort. Winter recreation within the corridor includes cross country skiing, snowshoeing, snowmobiling, and ice climbing. Snowmobiling occurs on the closed portion of the highway beyond Ross Dam Trailhead, which closes each winter due to high avalanche danger.

Lake and River Recreation

Numerous water-based recreational activities also exist within Ross Lake NRA. On the Skagit River, activities include rafting, kayaking, canoeing, motorboating, fishing, and sightseeing. Although Ross Lake has limited access, it is popular among both motorized and non-motorized boat operators. Although early data activity is unavailable, anecdotal evidence suggests that use on Ross Lake has changed from a primary fishing destination to a primary paddling and hiking destination, with the proportion of non-powered craft such as kayaks and canoes



The North Cascades Visitor Center in Newhalem provides exhibits and information for visitors.

gaining in popularity relative to fishing and power boating. From 2001 to 2009, the latest timeframe for which detailed activity use reports are available, backcountry permit data reveals that 39.3 percent of visitor use is paddling (canoe/kayak) and 29.4 involves hiking. Fishing is still listed as a primary activity for 12.4 percent of use, with power boating at 11.4 percent. Climbing, stock packing, and hunting are all minimal (less than 1 percent).

Ross Lake Resort provides boat rentals and a water taxi service on Ross Lake as well as the portage of small vessels around Ross Dam. Diablo and Gorge lakes also attract a smaller number of motorized and non-motorized boat operators. There are currently no restrictions on motorboats on any of the reservoirs or the Skagit River, although personal watercraft are prohibited. Seaplane landing is currently allowed on Diablo and Ross Lake; a small but unknown number of seaplanes (estimated at 5-15) land each year on the reservoirs.

Backcountry and Wilderness Recreation

World-class primitive recreational opportunities exist in the backcountry and designated wilderness of Ross Lake NRA. There are over 100 miles of trails in the recreation area, over half of which are open to stock use. Several of the trails within Ross Lake NRA are long-distance segments that continue on into North Cascades National Park or the Pasayten Wilderness. Hiking and backpacking are the most popular activities, while stock use, mountaineering, fishing, swimming, skiing, and hunting also occur.

Hunting and fishing in Ross Lake NRA are both authorized in accordance with the enabling legislation for Ross Lake NRA. Both activities require a valid license from the Washington Department of Fish and Wildlife; however, no permit is needed from the NPS. Hunting within Ross Lake NRA is managed in accordance with 36 Code of Federal Regulations, Sec. 2.22. In general, the NPS defers to the WDFW regulations for specific fishing and hunting seasons, gear restrictions, and bag limits. Trapping is illegal. Two game management units encompass Ross Lake NRA: the Diablo unit (GMU 426) comprises approximately 203,546 acres, of which about 114,689 acres lie within Ross Lake NRA. The Sauk GMU lies mostly to the west of Ross Lake NRA; a very small area of this GMU is within Ross Lake NRA. The fishery is broken down according to water body and reach, and restrictions vary.

Big game hunting within Ross Lake NRA includes deer, bear, and cougar. Hunting mountain goats is not legal within the Diablo GMU. Small mammals that can be hunted include bobcat, coyote, snowshoe hare, raccoon and red fox. Various species of waterfowl and upland game including forest grouse and dove are also legal to hunt.

Hunting is not allowed within ¼ mile of: nature trails, Thunder Knob Tail, the first few miles of Thunder Creek Trail as far as the Thunder Creek Bridge, Happy Creek Boardwalk, North Cascades Environmental Learning Center, Hozomeen Road, Ross Lake Resort, Colonial Creek and Goodell Creek Campgrounds, the towns of Newhalem and Diablo, the dams and their powerhouses, and the Ross Dam Trail and haul road. Hunting use is generally considered a minor use, amounting to 0.1 percent of total activity use on average between 2001 and 2009.

Climbing, which represents almost 12 percent of the activity use in the park complex as a whole, is limited to 0.5 percent of activity use in Ross Lake NRA because very few mountaineering objectives lie wholly within Ross Lake NRA (Ruby and Hozomeen Peaks are the exception, and climbing use is light on these routes).

Use of the Ross Lake area by organized groups appears to have increased in the last 10 years, with more commercial use permittees (camps, outdoor schools, guided services) as well as more church groups, educational organizations, Boy Scout troops, etc. This use tends to focus heavily on Ross Lake, Diablo Lake, and to a lesser extent the East Bank Trail. Ross Lake is also becoming increasingly popular as an area for projects with park partners. The number of projects has increased over the last few years as well, with regular programs run by the Student Conservation Association, North Cascades Institute, and other park partners. These programs all generally work with youth and provide an opportunity for combining service work, learning, and recreation in the backcountry. There is also a small amount of stock packing use, representing about 0.4 percent of total activity use in Ross Lake NRA.

Popular day-use destinations are Thunder Creek, Fourth of July Pass, Pyramid Lake, Ross Dam, Hozomeen Lake, and (for backpackers or boaters already on the lake), Desolation Peak.

Opportunities for People with Disabilities

Ross Lake NRA is the most accessible unit of North Cascades NPS Complex. Accessible restrooms are available at all visitor information stations and most campgrounds. The North Cascades Visitor Center, the Park and Forest Information Center in Sedro-Woolley, and the Wilderness Information Center are fully accessible. The Sterling Munro Trail at the North Cascades Visitor Center and the Happy Creek Forest Walk along the North Cascades Highway are fully accessible boardwalk paths. The River Loop Trail, Linking Trail and Newhalem Creek Rockshelter Trail, all in the vicinity of the North Cascades Visitor Center, are accessible trails with good surfaces and less than 10 percent grade throughout. The Rockshelter Trail ends in a boardwalk providing a view and interpretation of an archeological site. East of Newhalem along the North Cascades Highway the Gorge Overlook Trail is partially paved. There are accessible campsites and restrooms in Ross Lake NRA campgrounds along the North Cascades Highway and accessible picnic shelters at Newhalem and Goodell Creek campgrounds. There is also an accessible fishing pier at Colonial Creek Campground.

Visitor Facilities and Services

Visitor facilities within Ross Lake NRA include visitor information centers, campgrounds, overnight lodging facilities, and a small store.

Visitor Information Centers

North Cascades Visitor Center at Newhalem

The North Cascades Visitor Center is designed for visitors to explore the park complex's primary interpretive themes. Exhibits, a large relief map, two large-format audio-visual programs, and a staffed information desk give visitors an overall introduction to the park complex that will help them plan their visit. The various media, park rangers, network of short trails, and the cooperating association sales area also help visitors learn about the variety of park resources and introduce the key interpretive themes. Volunteers are a vital component in the operation of the visitor center. The facility is open May through October, serves approximately 40,000 annual visitors, and was designed to accommodate double the current visitation.

Wilderness Information Center at Marblemount

The Wilderness Information Center is designed for visitors to obtain information about backcountry travel and obtain necessary permits. Exhibits, a large relief map, and a staffed information desk help visitors understand the park complex's backcountry, and how to explore it safely and ethically. The various media, park rangers, and the cooperating association sales area also help visitors learn about the variety of park resources and introduce the key interpretive themes. Volunteers are a vital component in the operation of the information center. The facility is open May through October and serves approximately 10,000 annual visitors.

Park and Forest Information Center at Sedro-Woolley

The Park and Forest Information Center is a jointly operated facility with the Mount Baker Ranger District of the Mount Baker-Snoqualmie National Forest that is designed for visitors to obtain orientation and trip planning for the park complex and surrounding national forests. A large relief map and a staffed information desk help visitors understand the park complex and forests, and how to explore them safely. The facility is open year-round and serves approximately 20,000 annual visitors.

Hozomeen Ranger Station

The Hozomeen Ranger Station is designed as a contact station for visitors entering Ross Lake NRA from Canada. It is situated along a gravel road and is often mistaken for a Border Patrol station. Its primary function is to provide backcountry campsite availability information and to facilitate backcountry campsite self-registration. The ranger station does not have electricity or running water and is rarely staffed.

Skagit Tours Information Center at Newhalem

The Skagit Tours Information Center is operated by Seattle City Light and serves as a contact point for visitors who participate in the *Diablo Lake Adventure* or *Diablo Dam Good Dinner Tour*, and contains exhibits that cover the history of the Skagit Hydroelectric Project. The facility is open April through October and serves approximately 10,000 visitors.



Campers at Colonial Creek Campground.



Boaters at Ross Lake Resort.

Campgrounds

Auto Camping

There are five auto-accessible campgrounds within Ross Lake NRA. None of the campgrounds provide utility hook-ups. Fees vary based on level of amenities available at each location. Information on when auto campgrounds are filled to capacity is not currently collected.

Goodell Creek Campground and Group Camps

The Goodell Creek Campground is the western-most facility along the North Cascades Highway. It has 21 sites appropriate for tents and small RVs. Drinking water and vault toilets are provided (no flush toilets). Campsites are filled on a first-come, first-served basis. The facility is open year-round and no fees are charged during the wintertime when potable water is not available. Group camping is available with eight sites at Lower Goodell Creek Campground and three sites at Upper Goodell Creek Campground. Group camp reservations can be made via an on-line reservation system. There is no potable water at the group camps.

Newhalem Creek Campground

The Newhalem Creek Campground is located on the south side of the Skagit River just west of the town of Newhalem. It has 111 regular sites, two group sites, and can accommodate larger RVs. A fully accessible site is available. Drinking water and flush toilets are provided. A portion of the sites in the campground can be reserved; other sites are filled on a first-come, first-served basis. The facility closes during winter months.

Gorge Lake Campground

The Gorge Lake Campground is the smallest of the five auto-accessible campgrounds. It is located just off

of the North Cascades Highway on the access road to Diablo. It has six campsites and no water or services. Camping is free of charge at this location. The facility is open year-round.

Colonial Creek Campground

The Colonial Creek Campground is the largest and most popular of the auto campgrounds. It has 142 campsites and can accommodate larger RVs. Fully accessible sites are available. Drinking water and flush toilets are available. All sites are filled on a first-come, first-served basis. A small number of sites remain open year-round with no water, services or fees. Remaining sites are closed during winter months.

Hozomeen Campground

The Hozomeen Campground is accessible via a 42-mile gravel road from Hope, British Columbia or via boat, foot, or floatplane in the US; it is not accessible by road from the US. It has 79 designated campsites plus other camping areas at Winnebago Flats. Drinking water and vault toilets are provided. All sites are filled on a first-come, first-served basis; the facility closes during winter months.

Boat Camps

There are 19 boat-accessible camps on Ross Lake (including Hozomeen Campground) and three on Diablo Lake. On average there are three sites per camp, but numbers range from one to seven sites per camp. Nine of the sites are also accessible by trail. Over half of the sites have boat docks and group site availability. All sites are furnished with picnic tables, bear boxes for storage, well-defined tent pads, and outhouses. Boat-in camps are regularly filled to capacity during peak season, especially on the southern half of Ross Lake.

Hiker and Stock Camps

Fourteen hiker camps and nine stock camps are accessed via trails within Ross Lake NRA (an additional nine boat-access camps can also be accessed by trail). Camps have designated tent pads and Wallowa-style toilets. Visitors are required to either hang food and other attractants or use bear canisters for storage. Some hiker camps are regularly filled to capacity on weekends during peak season.

Lodging

Ross Lake Resort provides the only concession-operated overnight lodging within Ross Lake NRA. The resort is located on the north/west side of Ross Lake near Ross Dam. It is accessible by foot, boat, or floatplane. Accommodations sleep 86 and include twelve individual cabins and three bunkhouses built on log floats. All cabins have their own fully equipped kitchens; since there is no food service at the resort, guests are required to bring their own food supplies. There are no phones or televisions in the cabins and there is no reception for cell phones or wireless Internet. Equipment rentals include motorboats, canoes, kayaks, and fishing gear.

Ross Lake Resort operates an on-demand water taxi to and from trailheads along Ross Lake for a fee. This is a popular service which serves the general public and supports other commercial hiking/backcountry guide services operating within Ross Lake NRA. The resort also provides a truck portage between Diablo Lake and Ross Lake. This service, while mostly serving their clients in accessing the resort with gear and food supplies, is also used by visitors wishing to transport kayaks, canoes or other small vessels from Diablo Lake to Ross Lake. The resort is extremely popular with anglers as well as those who just want to “get away from it all.”

Overnight lodging is also available at North Cascades Institute’s Environmental Learning Center for program participants. The ELC is a residential field campus that provides lodging for up to 69 guests. Program participants enjoy meals at the dining hall, featuring local, organic foods, while learning about the local “foodshed.” As allows, the facility is available for private groups hosting educational retreats and conferences.

Supplies and Stores

The Skagit General Store, owned and operated by Seattle City Light, is the only store within Ross Lake

NRA. Established in 1922 in Newhalem, the store was originally a commissary that served Skagit River Hydroelectric Project employees and their families. In the 1940s the store was opened to the general public. Today visitors can purchase convenience foods, locally made fudge, souvenirs and other supplies. The building is listed in the National Register of Historic Places.

INTERPRETATION AND EDUCATION

Educational programs are presented within Ross Lake NRA through numerous methods and at various locations. The majority of education programs are developed and presented in partnership with the North Cascades Institute and take place at the North Cascades Environmental Learning Center. The keystone partnership education program is Mountain School, which brings 3rd through 12th graders to the Center for a three-day residential education experience exploring the natural and cultural history of the North Cascades. Other education programs include classroom visits and field trips to the park complex for area schools. There is a need to expand the number and variety of education programs for neighbors, area residents, and other diverse audiences.

Interpretive programs are presented within Ross Lake NRA through numerous methods and at various locations. Interpretive talks, guided walks, Junior Ranger programs, and evening programs are offered July through August at Hozomeen. Interpretive talks, guided walks, Junior Ranger programs, evening programs, exploration tables, and interpretive roves are offered June through September at campgrounds and other facilities throughout the North Cascades Highway corridor.



An interpretive ranger provides an interactive educational program at the visitor center.

Information and Orientation

Information about Ross Lake NRA, as well as the other units of the park complex, can be obtained over the Internet; through wayside exhibits, signs, and brochures; and at visitor information centers. A variety of interpretation and education opportunities are available.

Internet Site

The park complex's official website provides a wealth of information for prospective visitors. The website also serves national and international audiences, including people who may never have the opportunity to visit Ross Lake NRA.

Wayside exhibits, Signs, and Brochures

There are 72 wayside exhibits in Ross Lake NRA that provide information on a variety of subjects, representing all of the park complex's natural and cultural themes. Interpretive signs at the trailheads provide the public with information specific to the area, park natural and cultural resources, and information on park rules and regulations. There is a large kiosk on the Canadian side of the border at Hozomeen that explores the natural resources and cultural history of the region. There are self-guided interpretive trails at The Trail of the Obelisk, To Know a Tree Trail, Thunder Woods Nature Trail, and Happy Creek Forest Walk.

Outreach

Outreach programs are designed to connect the park with members of the surrounding communities by making them aware of the park and its opportunities

for recreation and stewardship. These programs foster relevancy between the park and the individuals who live near it. In recent years, the NPS has embraced two initiatives to accomplish this goal: diversity outreach and developing pathways for youth from education and stewardship programs to employment opportunities.

The target audience for diversity outreach is Latinos and Hispanics who comprise the fastest growing ethnic group in the communities surrounding the park. The North Cascades NPS Complex staff collaborate with partners to provide education programs to Latino and Hispanic groups and field trips to the park. The NPS also attempts to hire Spanish-speaking employees throughout its organization.

The park and its partners collaborate to develop pathways for youth from diverse backgrounds so that those who participate in education and stewardship programs comprise a recruitment pool for additional education and stewardship programs over time, with a select few progressing to internships and seasonal jobs in the park.

Partnerships

To accomplish its mission, the park complex collaborates with a wide-variety of partners.

North Cascades Institute

The North Cascades Institute (NCI) was founded in 1986 and seeks to inspire people through direct experiences in the natural world. Its mission is to conserve and restore Northwest environments through education. It accomplishes this through science, art, literature and hands-on study of natural



Visitors can purchase supplies at the Skagit General Store.



A family views an informational exhibit at the visitor center.

and cultural history. In 2005, a partnership between the NPS, North Cascades Institute and Seattle City Light opened the North Cascades Environmental Learning Center (ELC) on the shore of Diablo Lake. The NPS views the ELC as a cornerstone of the educational program to connect people to the North Cascades ecosystem. The Institute also serves as the park complex's cooperating association, operating five retail sales outlets within the North Cascades NPS Complex. A variety of youth, family, and adult programs are offered by NCI, and detailed below.

Natural and cultural history seminars, field excursions and retreats for adults

These programs are tuition based and are open to the public. Classes are taught by trained NCI staff, and contracted experts in the field. They take place at inspiring locations throughout the Pacific Northwest including the North Cascades NPS Complex.

Family getaways

Family programs are based out of the ELC where kids and adults learn about nature through adventures on the lake and trails, games, arts and crafts, storytelling and scientific explorations.

School programs and summer youth adventures

“Mountain School” is a residential education program for elementary, middle and high school students. Students come to the ELC with their school class, teacher and chaperones to learn about the ecosystems, geology and natural and cultural history of the mountains. “North Cascades Wild” is a canoe camping and conservation service program for underserved high school students. At the heart of the program is a 12-day canoe camping and backpacking program exploring Ross Lake. Underserved high school youth will complete valuable conservation service projects for the NPS while learning leadership skills, community building and the natural and cultural history of the region. “Cascades Climate Challenge” is a program that brings together students from cities across the U.S. for a one-month residency at the ELC to study glaciers and climate change in a hands-on way, and work closely with park scientists and naturalists. The experience is followed by a trip to Washington, D.C. to meet with national experts on climate change and share their experiences with elected officials and policy makers. When the students return home, they'll participate in service and leadership projects in their own communities facilitated by the NPS.



Visitors participate in an educational North Cascades Institute canoe trip.

Volunteer stewardship programs

These include Eagle Watchers and Mountain Stewards, which help to educate visitors and help restore and protect local ecosystems.

Graduate Master of Education program in environmental education

NCI, in partnership with Western Washington University, offers a Master Degree in Environmental Education and a Certificate in Leadership and Non-Profit Administration. The two year program focuses on leadership and nonprofit administration, curriculum development and instructional strategies, natural and cultural history, and residential program operations. Students spend one year in residency at the ELC and finish their second year of course work at Western Washington University.

Seattle City Light

Seattle City Light is a key partner of the NPS on numerous visitor information, maintenance, and resource management projects. Seattle City Light is a publicly-owned utility that manages the Skagit Hydroelectric Project—a complex of four hydroelectric dams within Ross Lake NRA. Seattle City Light constructed and owns the North Cascades Environmental Learning Center and operates two “company towns” within Ross Lake NRA for its employees. Additional explanation about Seattle City Light and its projects are located in the chapter under “Skagit River Hydroelectric Project” and “Newhalem Creek Hydroelectric Project.”

Mount Baker-Snoqualmie National Forest

The Mount Baker-Snoqualmie National Forest surrounds the west boundary of the park complex and serves as a gateway for hikers to access to the park. The forest and park complex jointly operate the Park and Forest Information Center in Sedro-Woolley and park staff augment the forest staff at the Glacier Public Service Center in Glacier. The forest and park complex collaborate on numerous visitor information projects.

British Columbia Parks

Three British Columbia Provincial Parks are located to the north of the park complex and collaborate with the park to provide an interpreter for summer programming in Hozomeen (a region that comprises the northern portion of the Ross Lake National Recreation Area and the southern portion of Skagit Valley Provincial Park). The park also provides an interpreter for summer programming in this area and the two uniformed representatives from each country jointly develop and present programs for the public that support the theme “nature has no borders.”

Skagit Environmental Endowment Commission

The Skagit Environmental Endowment Commission was established by a 1984 treaty between Canada and the U.S. based on an agreement between the City of Seattle and the Province of British Columbia to not build a higher dam on Ross Lake, and which also resulted in the creation of the Commission to manage an endowment fund to preserve the area, pristine wilderness and fish and wildlife habitat in the Upper Skagit Watershed until 2065. The Commission works together with the park to plan visitor information, interpretation, restoration, and inventory and monitoring projects to fund – many of which the park carries out.

ACCESS AND TRANSPORTATION

Visitors access Ross Lake NRA via the North Cascades Highway, the Silver/Skagit Road to Hozomeen, or on foot from numerous trails.

Roads and Vehicular Access

Ross Lake NRA is bisected by the North Cascades Highway, also known as the North Cascades Scenic Highway. Completed in 1972, it is the northernmost route across the Cascades in Washington, hence its

original name: the North Cross State Highway. The highway connects the Skagit and the Methow river valleys by crossing two mountain passes east of the Ross Lake NRA boundary: Rainy Pass at 4,855’ and Washington Pass at 5,477’. In 1984 the highway was designated a National Forest Byway and a Washington State Scenic Byway. The Cascade Loop, a 440-mile scenic byway, travels through Puget Sound, the North Cascades, and the Columbia River Valley.

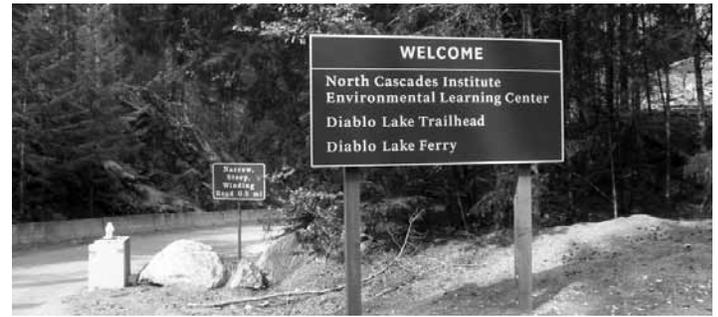
The North Cascades Highway is a state highway operated and maintained by the WSDOT under a right-of-way easement. Right-of-way conditions require WSDOT to be responsible for the following areas and/or activities: road surface; rock slope stabilization; road drainage; snow removal, sanding, and opening; signs (regulatory, warning, destination, and delineators); guardrails; bridges, tunnels, cribbing, and retaining walls; storm damage repair and slide removal; vegetation control within the road prism; paved pullouts; and rock patrol. The NPS is responsible for signs (entrance signs, information signs, and rock sign bases); hazard trees outside the road prism; vista clearing; and litter pickup.

The highway maintenance shed at Newhalem is WSDOT’s base for the North Cascades Highway operations. Four staff members report to the building and are responsible for a section of the highway extending from milepost 89 to milepost 148. WSDOT closes thirty-six miles of the highway east of the Ross Dam parking lot during the winter to protect motorists and maintenance workers from snow and avalanche danger. The highway is also occasionally closed due to rock fall, mudslides, and other natural events. WSDOT initiated avalanche control with explosives for the first time in the Gorge area in 2008. The NPS is working with WSDOT to address potential concerns regarding wildlife and wilderness impacts in response to any avalanche control they may need to undertake in the future.

The North Cascades Highway provides the only vehicle access to Ross Lake NRA in the US (the Silver/Skagit Road in Canada provides access to Hozomeen). Recreationists, truck drivers, and other users alike travel the highway to cross the Cascades, driving cars, RVs, motorcycles, and tractor-trailers. The NPS also uses the highway to access all of its facilities, trailheads, and other access points for administrative use within Ross Lake NRA. Large traffic volumes occur along this crossing during peak season weekends (July and August). Traffic counters placed at east and west entrances along the highway help to estimate use



Old signage at Diablo Dam access road.



New replacement signage at Diablo Dam access road.

(due to unreliable equipment, the North Cascades Highway traffic counts have been unavailable since 2000). According to the counters, a greater proportion of drivers travel from west to east (over 170,000 per year on average during the summer from 1993-2000) than from east to west (over 140,000 during the same period). Summertime traffic counts show no noticeable trend during this time, possibly because of poor or inadequate recording.

From the North Cascades Highway the Thornton Lakes Road is a five-mile, rough gravel road that provides access to the Thornton Lakes Trailhead. The Newhalem Creek Road is a 1.5-mile gravel road that provides access to the Newhalem Creek Trail, a USGS gauging station, and the diversion structure for Seattle City Light’s Newhalem Creek Hydroelectric Project. Other access points along the North Cascades Highway include the North Cascades Visitor Center, auto campgrounds, Newhalem and Diablo, the Environmental Learning Center, and various trailheads and overlooks.

The only other vehicle access to Ross Lake NRA is achieved via the Silver/Skagit Road in Canada. The Silver/Skagit Road joins Highway 1 just west of Hope, British Columbia. It is a 40-mile long gravel road that provides access to Hozomeen. The road parallels Ross Lake for about two miles before it dead-ends at the water’s full pool edge.

Improvements Needed

Several issues related to access, congestion and potential safety concerns have been identified along the North Cascades Highway. At the Ross Dam Trailhead parking lot, traffic congestion at points of egress and ingress, as well as a lack of clearly defined parking spaces, are safety issues. During the summers of 2005 through 2008, NPS employees recorded informal daily tallies at the parking lot that included the total number of vehicles at the parking lot, the number of oversized vehicles, and the number of government-owned vehicles (See Table 5.17). Results show that on average, 27 vehicles are parked in the parking lot in the daytime during the summer. The average number of vehicles parked in the parking lot on weekends increases to 34. The maximum number of vehicles recorded at the parking lot during the four-year period is 72. It is estimated that the parking lot is filled to capacity when anywhere from 60 to 72 vehicles are present. This number varies based on the size of vehicles and how they are parked in the lot. The maximum number of oversized vehicles parked in the parking lot at one time is four, and the average number turns out to be less than one at a time over the four year recording period. The maximum number of government-owned vehicles parked in the parking lot at one time is 10, and averages out to be two vehicles at one time over the four years.

Table 5.17 Number of Vehicles at Ross Dam Trailhead Parking Lot *
*excluding oversized and government vehicles

	All days			Weekends only	
	Average # vehicles	Median # vehicles	Maximum # vehicles	Average # vehicles	Median # vehicles
2005	24	22	62	32	29
2006	28	26	61	36	37
2007	27	27	56	32	34
2008	28	28	72	38	40
4-year Summary	27	26	72	34	36

SOCIOECONOMIC ENVIRONMENT

Regional Socioeconomics

The area of influence for economic and social consideration associated with the Ross Lake National Recreation Area encompasses Whatcom, Skagit, and Okanogan counties in northwestern Washington; the community of Stehekin, within Lake Chelan National Recreation Area at the northern end of Lake Chelan; and the district municipality of Hope, located within Fraser Valley Regional District in British Columbia. Socioeconomic data is most readily available at the county and regional district level, therefore this analysis uses that data. The reader should note however, that Ross Lake National Recreation Area is located in and near the eastern, rural portions of Skagit and Whatcom counties, while the more populated, western portions of these counties strongly influence the data presented. Fraser Valley Regional District also has a population concentration in its western portion, including the communities of Abbotsford, Chilliwack, and Mission. The population of Hope, nearest the recreation area is much lower than in those western communities.

Ross Lake National Recreation Area is located between the north and south units of North Cascades National Park. The recreation area is located just over 100 miles from both Seattle, Washington and Vancouver, British Columbia. The recreation area contains most of the developed areas of the North Cascades NPS Complex and the only road through the complex. The North Cascades Highway is one of a few roads that traverse the North Cascades mountain range. Communities along the route to the recreation area include Sedro-Woolley, Concrete, Rockport, and Marblemount to the west; Newhalem and Diablo within the boundaries; and Mazama, Winthrop, and Twisp to the east. The other access road to the recreation area, Silver Skagit Road, is a 40-mile unpaved road that takes visitors from Hope, British Columbia, to Hozomeen, a campground within the recreation area boundaries on the northern shores of Ross Lake.

Demographics

Population

The influence area has seen steady growth in population from 1990 to 2000, with growth slowing slightly from 2000 to 2006. Whatcom and Skagit counties and Fraser Valley Regional District grew

The Panther Creek Trailhead location poses another safety issue. Because the trailhead has no formal parking area, most hikers park at the East Bank Trailhead. To reach the trailhead, hikers must cross the North Cascades Highway, walk about 75 yards along the shoulder of the highway, cross the Panther Creek highway bridge (60 yards), then walk another 50 more yards along the highway shoulder. Because hikers are exposed to high-speed traffic, especially along the bridge (which lacks a pedestrian walkway), this situation is a safety concern. The safety risk is greatest in the spring and fall when the highway and the bridge may be icy and slick

Another safety concern along the highway involves the lack of a pedestrian route and parking in the gorge to reach designated climbing areas. Climbers currently park along the road shoulder or in Newhalem and walk along the highway to reach climbing destinations. In many areas climbers end up walking between Jersey barriers, placed along the shoulder, and fast moving traffic.

Water access

Boat launches are available at Gorge Lake, Diablo Lake, and at the north end of Ross Lake at Hozomeen. Two graded-concrete boat launches at Hozomeen are normally usable from mid-June through September. Canoes, kayaks and small craft can be launched at Colonial Creek Campground and boated five miles to the end of Diablo Lake. To get from Diablo Lake to Ross Lake, boats and gear must be portaged around Ross Dam over a mile-long gravel road with switchbacks. Ross Lake Resort also provides portage service for motorboats under 14 feet as well as canoes and kayaks.

Bicycle Access

Bicycles are allowed on roads within Ross Lake NRA and are prohibited on all trails and in wilderness. The North Cascades Highway is a popular bicycling route and is part of the Northern Tier TransAmerica bike route. Between the towns of Newhalem and Diablo there are two tunnels. The longer tunnel, closer to Newhalem, is fitted with a “Bikes in Tunnel” flashing safety light that can be turned on at either end.

faster than Washington and British Columbia from 1990 to 2000. Okanogan grew at a rate slightly slower than the state's average rate during that time and had almost no change from 2000 to 2006.

The three counties and Fraser Valley Regional District had an average annual growth rate of 3.0 percent in the 1990s and 1.6 percent from 2000 to 2006. The state population grew at an average annual rate of 2.1 percent in the 1990s, and slowed to 1.4 percent annually from 2000 to 2006. (U.S. Census Bureau 2006; Washington State Office of Financial Management 2008; British Columbia Stats 2008). British Columbia grew at an average annual rate of 2.3 percent in the 1990s and 1.4 percent from 2000 to 2006 (British Columbia Stats 2008). The community of Stehekin had a loss in population from 2001 to 2006 (Washington State Office of Financial Management 2007). Hope had no growth in that same period (Statistics Canada 2006). Table 5.18 shows historic and projected population growth for this area.

Population trends in the counties are driven by different influences. In Skagit and Whatcom counties, growth has been driven largely by migration into the areas. In Okanogan County, new births are offset by out-migration (U.S. Census 2006). The Fraser Valley

Regional District has experienced growth because the number of births has been greater than the number of deaths, and the district is experienced in-migration (British Columbia Stats 2008). Migration patterns are closely related to employment—people follow the jobs. The recent population changes reflect growing job sectors in Skagit and Whatcom counties and Fraser Valley, and a slightly retracting job sector in Okanogan County.

Population Projections

Population projections to the year 2030 indicate rates of growth very similar to those from 2000 to 2006 for each of the regions. The influence area is projected to grow at a greater rate than either the state of Washington or the province of British Columbia during the period from 2000 to 2030, with a projected 1.9 percent average annual growth vs. 1.5 percent and 1.4 percent respectively (Washington State Office of Financial Management 2008 and British Columbia Stats, 2008).

Age

Okanogan and Skagit counties have older populations than does Whatcom County and the state of

Table 5.18 Historic and Projected Population Growth

Area	Historic		Projected			Projected Growth, 2000 to 2030	Average Annual Growth Rate, 2000 to 2030
	1990	2000	2010	2020	2030		
Okanogan County, WA	33,350	39,564	42,739	46,526	49,239	24%	0.8%
Skagit County, WA	79,545	102,979	123,888	150,305	178,036	73%	2.4%
Whatcom County, WA	127,780	166,826	195,633	230,008	261,416	57%	1.9%
Fraser Valley, British Columbia	183,847	243,728	289,072	336,579	379,144	56%	1.9%
Three County and Fraser Valley Total	424,522	553,097	651,332	763,418	867,835	57%	1.9%
Washington	4,866,663	5,894,143	6,792,318	7,698,939	8,509,161	44%	1.5%
British Columbia	3,290,814	4,039,198	4,563,927	5,172,715	5,706,179	41%	1.4%

Source: U.S. Census Bureau; British Columbia Stats; Washington State Office of Financial Management 2007.

Washington. The median ages are 38 and 37 for Okanogan and Skagit counties and 34 and 35 for Whatcom County and Washington, respectively. Hope has an older population than does British Columbia as a whole. The median age is 42 in Hope, while it is 38 in British Columbia.

Race

The racial composition among the three U.S. counties and Fraser Valley Regional District is predominately white (between 75 percent and 88 percent).

Washington and British Columbia are more diverse, with 82 percent and 74 percent of the population white, respectively. American Indians account for 12 percent of the population in Okanogan County. Fraser Valley has a South Asian population of 8 percent and an aboriginal population of 5 percent. The Hispanic or Latino populations of Okanogan and Skagit counties are greater than for the state overall (See Tables 5.19 and 5.20).

Economic Overview

Employment

The influence area had over 325,000 jobs in 2006 and employment has grown at an average annual rate of 1.9 percent since 2000. This was slightly higher than the state's average annual growth of 1.7 percent during the same period. Total full- and part-time employment in Okanogan County grew by 1.2 percent annually, or by 1,600 jobs. In Skagit County, employment increased in that same period by 1.7 percent annually or by 7,000 jobs and in Whatcom County, by 2.7 percent or by 16,600 jobs.

However, employment is cyclical, often responding to swings in the national or regional economy. Okanogan County experienced a decline in employment that was not mirrored in statewide data from 1997 to 2001. The losses were likely due to retirement and an aging population, loss of timber and wood-related work, and declining employment opportunities in the fruit packing industry due to structural and technological changes. A challenge for Okanogan County is the large share of seasonal employment: 41.3 percent of county employment was concentrated in seasonal industries, compared to 14 percent statewide. Industries with seasonal employment patterns are characterized by large employment increases and decreases in particular months of the year (Washington State Employment Security 2002).

Skagit County has experienced general employment growth over the past decade, with some periods of decline. High employment growth occurred through 2000, and then employment decreased during the recessionary period of 2001 and 2002. Growth rebounded following 2002 (Washington State Employment Security, 2006).

Whatcom County's employment rate also increased from 1990 to 2000 and into 2006 at a rate greater than the state's rate overall.

In 2001, the labor force numbered 115,655 people in Fraser Valley, and increased 1.5 percent annually to 125,725 by 2006. This was a lower rate than the 1.8 percent annual growth British Columbia's labor force experienced (See Table 5.21).

Unemployment

Unemployment in the three U.S. counties has increased slightly in the period from 2000 to 2006, as it did in the state. Skagit and Whatcom counties and Washington have rates from 4 percent to 6.4 percent; these rates are relatively low in historic terms. Okanogan County has had a high rate of unemployment over the years, averaging 5 percentage points higher than the state from the period 1970 to 2001 (Washington State Employment Security, 2002). The seasonal nature of agricultural industries is a cause of high unemployment in the county, with the highest unemployment occurring during the winter and early spring months. In Hope, the unemployment rate of 9.2 percent in 2006 was fairly high. It is a higher rate than in the province, but it does reflect a decrease since 2000. Unemployment in British Columbia also decreased during that time period (See Table 5.22).

Industries

Trade and services dominate the influence area economies, with retail trade and health services driving much of the jobs in this sector. Government also has a strong presence in the U.S. counties, and agriculture—especially apple production—is important in Okanogan County (Washington State Employment Security 2002).

In Fraser Valley, the primary economic activities include agriculture, forestry, and manufacturing. Industrial and warehousing operations have been attracted to this area due to the lower land prices (British Columbia Stats Quarterly Regional Statistics, 2008).

Table 5.19 Demographics, Area of Influence, United States

Area	Median Age	Race/Ethnicity						
		White	Black	American Indian & Alaskan Native	Asian and Pacific Islander	Other	Two or more	Hispanic or Latino
Okanogan County	38.2	75%	0%	12%	1%	9%	3%	14%
Skagit County	37.2	87%	0%	2%	2%	7%	2%	11%
Whatcom County	34	88%	1%	3%	3%	3%	3%	5%
Washington	35.3	82%	3%	2%	6%	4%	4%	8%

Source: U.S. Census Bureau 2000.

Table 5.20 Demographics, Area of Influence, Canada

Area	Median Age	Race							
		Chinese	South Asian	Filipino	Japanese	Other Visible Minority	Multiple Origins	Total Aboriginal People	Rest of Population
Hope	42.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fraser Valley	36	1%	8%	0%	0%	2%	0%	5%	83%
British Columbia	38.4	9%	5%	2%	1%	4%	0%	4%	74%

Source: British Columbia Stats 2001.

Table 5.21 Employment Growth by Area, 2000-2006

Area	1990	2000	2006	Growth, 2000-2006	Average Annual Growth Rate, 2000-2006
Okanogan County	13,632	22,502	24,130	7%	1.2%
Skagit County	34,121	59,483	65,660	10%	1.7%
Whatcom County	61,657	94,837	110,180	16%	2.7%
Fraser Valley Regional District					
(2001, 2006)	N/A	115,655	125,725	9%	1.5%
Total	N/A	292,477	325,695	11%	1.9%
Washington	2,487,073	2,793,722	3,084,652	10%	1.7%
British Columbia (1991, 2001, 2006)	1,721,685	1,883,975	2,092,770	11%	1.8%

Source: U.S. Census Bureau 1990, 2000, 2006; British Columbia Stats 2001, 2006; Statistics Canada 2001, 1991, 2006.

Table 5.22 Unemployment Rates

Area	2000	2006
Okanogan County	7.0%	N/A
Skagit County	4.3%	4.7%
Whatcom County	4.9%	5.7%
Washington	4.1%	6.4%
United States	5.8%	6.4%
Hope	12.0%	9.2%
Fraser Valley	8.6%	5.8%
British Columbia	8.0%	6.0%
Canada	7.4%	6.6%

Source: U.S. Census Bureau 2000, 2006; Statistics Canada 2007.

Electrical power generation is an important economic component of Ross Lake National Recreation Area; it is the reason for the creation of the lakes. The Skagit River is dammed within the recreation area at three points, creating Ross, Diablo, and Gorge lakes. In addition, Newhalem Creek is dammed within the boundaries. These four dams (owned by Seattle City Light) provide 17 percent of the electricity for the city of Seattle and surrounding municipalities (Seattle City Light, 2008). Seattle City Light has proposed to gain an additional 30 megawatts of power from the Skagit River system by constructing a bigger tunnel through the Gorge Reservoir.

Tourism

Recreation and tourism also have a role in the economy of the influence area. Ross Lake is one of several visitor attractions in the area, which also includes North Cascades National Park, Lake Chelan National Recreation Area, and Mount Baker (located within the Mt. Baker Snoqualmie National Forest). Forests, rivers, and towns in the influence area attract visitors with opportunities for skiing, whitewater rafting, camping, hiking, fishing, boating, and art and cultural experiences. Visitors and travelers support numerous jobs in the influence area’s retail trade, accommodations, dining, entertainment, and other affiliated industries. In the three U.S. counties, 6 percent of jobs are in the tourism industry, making up 3 percent of the counties’ earnings (Washington State, 2006). The percentage of jobs and earnings from tourism are greater in the three-county region than in the state of Washington overall. In Fraser Valley, 8 percent of jobs are in the industries of accommodation, food services, arts, entertainment, and culture (Statistics Canada, 2006).

Tourism is important to Stehekin, which has several businesses providing accommodations, recreation, transportation, food services, arts, and culture to visitors.

Commercial Services Provided at Ross Lake National Recreation Area

As of 2008, one concessioner, Ross Lake Resort, operated within Ross Lake NRA, providing lodging, boat rentals, fishing equipment, and transportation across the lake. The concessioner is interested in expanding services. Several companies operate under commercial use authorizations to offer services, such as fishing and rafting tours, to the recreation area visitors.

Table 5.23 provides a breakdown of employment in the area by major category.

Income

Median household income has increased in all the counties and the regional district from 2000 to 2006. Skagit and Whatcom counties are 9th and 12th out of 40 in a state ranking of highest median household incomes by county, while Okanogan is ranked 39th. Median household income in Hope is only 86 percent of the median income for British Columbia (See Tables 5.24-5.27).

Housing

Occupancy Rates

At the time of the 2000 census, Okanogan, Skagit, and Whatcom counties all reported vacancy rates above the statewide average of 7.3 percent, although other

Table 5.23 Employment by Major Category, 2006

Area	Farming	Industrial**	Trade & Services***	Government****	Total
Okanogan County*	4,531	3,999	9,802	5,330	24,162
Skagit County	2,568	15,175	37,943	10,810	66,496
Whatcom County	3,108	24,624	68,399	15,337	111,468
Fraser Valley	9,530	34,915	74,395	6,875	125,715

Sources: Bureau of Economic Analysis, 2006; British Columbia Stats 2001; Statistics Canada, Census of Population 2001

* Some industry numbers not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.

**Industrial includes forestry, mining, utilities, construction, manufacturing, and transportation and warehousing.

***Trade and services includes wholesale and retail trade, information, finance and insurance, real estate, professional and technical services, management of companies, administrative and waste services, education and health care, arts and recreation, accommodation and food services, and other services.

****Government includes federal, state, and local government in the US counties.

Table 5.24 Total Personal Income, 2006 (in \$US)

County	2006
Okanogan County	\$699,000,000
Skagit County	\$2,665,000,000
Whatcom County	\$4,189,000,000
3 County Total	\$7,553,000,000

Source: Washington State 2006.

Table 5.25 Total Personal Income, 2006 (in \$Can)

Municipality	2006
Hope, British Columbia	\$157,110,000

Source: British Columbia Stats 2006.

Table 5.26 Median Household Income: Counties, State, and U.S. (in \$US)

Area	2000	2006	% of 2006 State Median Income	Statewide Rank (of 40 counties)
Okanogan County	\$29,726	N/A	N/A	39
Skagit County	\$42,381	\$48,222	92%	9
Whatcom County	\$40,005	\$43,798	83%	12
Washington	\$45,776	\$52,583	100%	-
United States	\$41,994	\$48,451	92%	-

Source: U.S. Census Bureau 2000, 2006.

Table 5.27 Median Total Income: District Municipality, Province, and Canada (in \$Can)

Area	2000	2006	% of 2006 Province Median Income
Hope	\$16,932	\$23,988	86%
British Columbia	\$22,189	\$27,862	100%
Canada	\$22,356	\$27,500	99%

Source: British Columbia Stats 2000, 2006.

than in Okanogan County, the rates are still fairly low in a historical context. Okanogan had a high vacancy rate of 21.3 percent, much of which is attributable to vacation homes and winter vacancies of farm worker homes (2008 *Okanogan County Comprehensive Plan*). Hope and Fraser Valley had low vacancy rates of 6.8 percent and 5.5 percent respectively (See Table 5.28).

New Construction

Skagit County and Whatcom County experienced residential construction increases of 17 percent and 15 percent respectively from 2000 to 2006, reflecting population growth (U.S. Census Bureau 2006). Fraser Valley had a 15 percent increase in residential units during that time. Hope had a 5 percent increase in housing units during the same period (British Columbia Stats, 2006). Note that data on growth or decrease in housing units for Okanogan County cannot be quantified due to the 2006 data not being available. However, in Okanogan County, 723 building permits were issued in the years 2003-2006 for new residential construction, indicating increases in housing stock (Okanogan County Building Department, 2008).

Employee Housing

In the summer, the recreation area employs many seasonal workers. Efforts to find housing for the influx of people have proven difficult, and employees often must make long commutes due to the lack of suitable rental housing. Table 5.29 shows median area rents. At recreation area sites, such as Hozomeen, Ross Guard, and Newhalem, the National Park Service owns and rents housing for more than 22 people, in a mix of housing types, from homes for permanent employees to shared apartments and rooms for seasonal employees.

At Marblemount, the National Park Service owns housing for 38 employees, including housing for seasonal employees. At Diablo, the National Park Service typically rents 2 houses for up to 12 employees.

Land Use and Ownership

Ross Lake NRA is surrounded by public lands, with North Cascades National Park to the north and south of the recreation area, Skagit Valley Provincial Park and Manning Provincial Park also to the north, Mount Baker Snoqualmie National Forest to the west, and Okanogan National Forest to the east.

In the three U.S. counties, an average of 56 percent of the land is public, including state and national parks and forests. Rangeland, agricultural lands, and forested lands are dominant land uses in the counties (Okanogan County 2008; Skagit County 2007; Whatcom County 2008). These uses make up 23 percent of the land in Okanogan County, 43 percent of Skagit County, and 25 percent of Whatcom County. Urban areas occupy 2-3 percent of the three counties. Tribal lands make up 11 percent of Okanogan County. Similar data was not available for Fraser Valley. Table 5.30 shows median area house values.

Newhalem Townsite and Diablo Townsite are located within the boundaries of Ross Lake NRA. Seattle City Light employees live and work in these areas which are managed by Seattle City Light. Much of the dam maintenance has been automated and currently the townsite is not fully occupied. The house and facilities are owned by Seattle City Light.

Although federal lands are not subject to property taxes by local governments, the Bureau of Land Management administers a program called payment in lieu of taxes, which helps offset lost property taxes. In Skagit County, 539,838 federal acres netted a payment of \$410,870. Whatcom County's 847,031 acres received payment of \$663,834, and Okanogan County received \$1,076,930 for its 1,568,288 federal acres (Bureau of Land Management, 2006).

Economic contributions of Ross Lake National Recreation Area

Visitor Spending

Total visits to Ross Lake National Recreation Area were recorded as 290,701 in 2007. Of that total, 46,472 visits involved overnight stays in the recreation area. Visitor spending in the influence area was estimated at \$9.3 million in 2007, with \$8.3 million coming from non-local visitors. Discover Your Northwest, formerly the Northwest Interpretive Association, sold books, posters, and other items at the gift shops in the North Cascades NPS Complex through 2009. Annual gross sales are about \$80,000. Non-local visitor spending is new money coming to the influence area, which results in more local income being generated and supports local jobs. Visitors supported an estimated 165 jobs and \$2.9 million in personal income (Stynes et al. 2008). This is in addition to jobs and income associated with national recreation area operations and staff, which are discussed in the next section.

Table 5.28 Vacancy

Housing and Vacancy 2000	Total Units	Vacant for seasonal, recreational or occasional use	Vacancy rate for seasonal, recreational or occasional use	Total Vacant Units	Total Vacancy Rate
Okanogan County	19,085	2,355	12.30%	4,058	21.3%
Skagit County	42,681	1,971	4.60%	3,829	9.0%
Whatcom County	73,893	5,946	8%	9,447	12.8%
Washington	2,451,075	60,355	2.50%	179,677	7.3%
Hope (2006)	2,855	N/A	N/A	195	6.8%
Fraser Valley (2006)	100,157	N/A	N/A	5,532	5.5%
British Columbia (2006)	1,788,474	N/A	N/A	145,324	8.1%

Sources: U.S. Census 2000, British Columbia Stats 2000.

Table 5.29 Area Monthly Rents

Area	Median Rent (in \$US)		
	2000	2006	Growth
Okanogan County	\$423	N/A	N/A
Skagit County	\$668	\$828	24%
Whatcom County	\$622	\$753	21%
Washington	\$663	\$779	17%

Area	Average Rent (in \$Can)		
	2001	2006	Growth 2001 to 2006
Hope	\$656	\$683	4%
Fraser Valley	\$688	\$700	2%
British Columbia	\$751	\$752	0%

Sources: U.S. Census 2000, 2006; British Columbia Stats 2000, 2006.

Table 5.30 Area House Values

Area	Median House Value - Owner Occupied (in \$US)		
	2000	2006	Growth 2000 to 2006
Okanogan County	\$91,400	N/A	N/A
Skagit County	\$158,100	\$240,600	52%
Whatcom County	\$155,700	\$281,800	81%
Washington	\$168,300	\$267,600	59%

Area	Average House Value - Owner Occupied (in \$Can)		
	2001	2006	Growth 2001 to 2006
Hope	\$145,154	\$228,001	57%
Fraser Valley	\$184,143	\$336,853	83%
British Columbia	\$230,645	\$418,703	82%

Sources: U.S. Census 2000, 2006; British Columbia Stats 2000, 2006.

Operations Spending

The national recreation area provides salaries to employees who go on to contribute to the local and regional economy. The recreation budget also includes spending for utilities, leasing, supplies, and local services, which supports regional sales, jobs, and income. The effects of these amounts are in addition to effects of spending by visitors.

The staff at Ross Lake National Recreation Area are employed by North Cascades NPS Complex. Many among the staff divide their time between Ross Lake and the other three units of the complex: the north and south units of the North Cascades National Park, and the Lake Chelan National Recreation Area. Therefore, an analysis of the payroll impacts of Ross Lake has not been split out specifically for the recreation area. NPS payroll for the complex in 2007 was \$6.6 million, plus benefits for 155 NPS full time employees. This spending generates an estimated additional \$1.8 million in local income and 62 jobs (Stynes et al, 2008).

Combined Effects of Visitor and Operations Spending

Ross Lake National Recreation Area contributes an estimated \$11.3 million annually to local income (\$2.9 million from visitor spending, \$6.6 million for NPS employee income, and \$1.8 million in generated income from operations spending). Total personal income was \$699 million in Okanogan County in 2006, \$2.67 billion in Skagit County, and \$4.19 billion in Whatcom County (US\$). In Hope, total income was \$157 million (Can\$). Of the influence area's total income of approximately \$7.7 billion (\$US), the contribution of the recreation area is a small but important 0.15 percent.

An estimated 382 additional jobs are created by the recreation area (including NPS jobs, jobs created by visitor spending, and jobs created by spending

associated with NPS operations). These jobs make up 0.12 percent of the 325,695 jobs in the influence area. Table 5.31 shows the economic impacts from visitor spending and recreation area operations spending.

MANAGEMENT AND OPERATIONS

Administrative Facilities

Park headquarters is located approximately 45 miles west of Ross Lake NRA boundary in Sedro-Woolley. The station is operated jointly with the Mt. Baker District of the Mt. Baker-Snoqualmie National Forest. North Cascades Institute, U.S. Geological Survey, and the North Cascades branch of the Discover Your Northwest also share this office. The Marblemount Ranger Station serves as the base of operations for many park functions, including trails, wilderness, fire management, cultural resource management, and portions of natural resource management. In addition to administrative facilities, staff housing is also located at the station.

Operations and Staffing

The North Cascades NPS Complex is managed by a team composed of the superintendent, science advisor, chief of administration and business practices, chief of natural and cultural resources, chief of maintenance, chief of visitor and resource protection, and chief of interpretation and education. Employees for all divisions are generally based out of offices in the headquarters complex in Sedro-Woolley, the Stehekin and Marblemount district offices, the U.S. Forest Service Ranger District Office in Chelan, and field offices in other smaller developed areas within the park complex. Most park employees within the complex have work responsibilities that encompass activities and functions for all three units of North Cascades NPS Complex.

Table 5.31 Impacts from Visitor Spending and Recreation Area Operations Spending, 2007

	Estimated Additional Influence Area Personal Income Created	Estimated Additional Influence Area Jobs Created
Visitor Spending	\$2,900,000	165
Operations Spending*	\$8,400,000	217

*Includes payroll and jobs of NPS employees and additional jobs created in the region

Source: MGM2 2007.

The science advisor is responsible for encouraging and facilitating scientific research in the park complex. This employee works with the Natural and Cultural Resource Management Division and research scientists to identify research needs and opportunities, collaborates with other agencies and partners regarding research, and facilitates a dialogue between managers, scientists, and educators. The science advisor is based in park headquarters.

The Administration and Business Practices Division is responsible for the park budget, fiscal and real property management activities, revenue and fee management, contracting, information technology services, concessions management, and human resources. These employees are based in the headquarters complex, the Stehekin and Marblemount district offices, and the U.S. Forest Service Ranger District Office in Chelan.

The Natural and Cultural Resources Division is responsible for preserving and managing the natural and cultural resources of the park complex. Natural resource staff is primarily responsible for resource inventory, monitoring, and evaluation; impacts restoration and mitigation; aquatic and terrestrial resources management; physical sciences; wilderness preservation and monitoring; fire management; invasive, non-native plant control; geographic information systems; and environmental compliance and planning. The cultural resource staff is primarily responsible for cultural resources inventory and identification, monitoring, mitigation, preservation, research, maintaining the museum collections, and coordination with the Washington State historic preservation officer and area tribes. The staff is responsible for compliance with requirements of the National Historic Preservation Act (as amended). Division staff is based at headquarters and in the Marblemount and Stehekin districts.

The Maintenance Division performs maintenance and rehabilitation on the park complex's physical assets, infrastructure and equipment. The primary maintenance facilities are located in Marblemount and in Stehekin, with some additional maintenance facilities located in other developed areas of the park complex. Although approximately 94 percent of the park complex is designated wilderness, the rest consists of road accessible frontcountry developed areas with developed infrastructure including water treatment facilities, wastewater treatment facilities, electrical utilities, phone, trails, roads, parking areas, campgrounds, housing, and other administrative and

public use facilities. In addition, some infrastructure exists within designated wilderness. Maintenance division staff is based throughout the park complex.

The Resource and Visitor Protection Division manages for resource protection and visitor safety and experience. Responsibilities include various visitor management and resource protection duties, including enforcing laws, providing emergency medical services, fighting wildland fires, managing visitor use in the park, performing search and rescue activities, managing wilderness activities, and issuing camping permits. Division staff is based throughout the park complex.

The Interpretation and Education Division facilitates the connections between park resources and the public by operating park visitor centers; maintaining the park website, wayside exhibits, and bulletin boards; offering interpretive and curriculum-based educational programs; developing publications; and fostering media and community relations. Division staff is based throughout the park complex. Table 5.32 lists the staffing levels by division.

Table 5.32 Staffing Levels by Division

Management	3 Permanent
Administration	15 Permanent
Maintenance	44 Permanent
Interpretation/Education	13 Permanent
Resource Management	43 Permanent
Visitor Protection	15 Permanent
Total Staff	133

VOLUNTEER PROGRAM

North Cascades NPS Complex has an active Volunteers-In-Parks program with over 500 volunteers participating in a variety of projects in the course of a year. Most service work occurs between May and October although volunteers are active year round.

Volunteers contribute to almost all park operations. Service work varies greatly and may include clerical work; skilled and unskilled maintenance; trail maintenance; highway clean-up; biology and hydrology data collection; invasive, non-native plant removal and native plant restoration; visitor contact in campgrounds, on trails or at visitor centers; or backcountry patrols. The few campground host positions are quickly filled. Long-term volunteers

may be provided with uniforms and sometimes a reimbursement for meals or transportation.

Many volunteers are individuals who work with Park Service staff on a part time basis for multiple years. Other volunteers may contribute a few hours as part of a visiting school or tour group. Park staff frequently train and work with volunteers through partner groups including The North Cascades Institute, the Washington Trails Association, The Wilderness Society, Boy Scouts of America, Outward Bound etc. The Student Conservation Association (SCA) has been an important partner for the park complex. SCA offers a subsistence stipend as well as the possibility to earn tuition assistance through the AmeriCorps program for intern volunteers.

Volunteer work is most successful when it includes education, recreation, restoration and inspiration. North Cascades NPS Complex staff are particularly committed to engaging young and/or first time visitors to national parks in meaningful service work. Involvement in stewardship activity provides an excellent opportunity to work with NPS staff and gain a unique perspective on the park complex.

Volunteers provide very important contributions to almost all facets of park complex operations. Volunteer work contributions help extend the services and benefits the park can provide to visitors and assists in the protection of natural areas.