Carbon River Area Access Management
Environmental Assessment

September 2010

Mount Rainier National Park
55210 238th Avenue East
Ashford, Washington 98304
(360) 569-2211

Dave Uberuaga, Superintendent

How this Environmental Assessment (EA) is Organized

i. Executive Summary: This section briefly recaps the contents of the Environmental Assessment, including the purpose and need for the project, an overview of the alternatives and other key project information.

ii. Table of Contents: This lists the Chapters and primary sections and where they may be found within the document.

Chapter I. Introduction: This chapter introduces the park, the project area and the planning background for the project, including the purpose and significance of the park and the scope of the project.

Chapter II. Purpose and Need: This Chapter identifies the purpose and need for the proposed actions and the planning background for the project, including related laws, policy, park plans and public participation to date. It also highlights the purpose and scope of the EA and the park purpose and significance. This Chapter also includes *Impact Topics*, which describes the potentially affected resources and laws or policy relating to their inclusion in this Environmental Assessment. It also identifies those resources that have been dismissed from further analysis due to their having no identified or negligible potential environmental consequences.

Chapter III. Alternatives: This Chapter describes the alternative courses of action that may be taken, including the reasons for dismissing options that do not meet criteria for inclusion. It also identifies and provides analysis related to the selection of the Environmentally Preferred Alternative and includes an *Alternative Comparison Chart* (Table 17) to more easily discern the differences among the alternatives.

Chapter IV. Affected Environment: This Chapter describes the existing environment that may be affected by the Alternatives by resource topic.

Chapter V. Environmental Consequences: This Chapter has two sections: Methodology and Environmental Consequences. *Methodology* identifies the means by which impacts to various resources are analyzed. *Environmental Consequences* provides a comparison of effects associated with the alternatives, including cumulative impacts. Similar to Chapter III: Alternatives, the Environmental Consequences section contains an *Impact Comparison Chart* (Table 34) to assist in discerning the differences in projected impacts among the alternatives.

Chapter VI. Consultation and Coordination (List of Persons and Agencies Consulted / Preparers): This chapter provides additional information about public and internal scoping, preparation and review of the Environmental Assessment

Chapter VII. References: This section provides bibliographical information for sources cited in this Environmental Assessment.

Appendices

Appendix 1: Summary of Measures to Avoid, Minimize or Mitigate Environmental Impacts summarizes ways potential impacts to resources will be avoided, minimized or mitigated as included in the Environmental Consequences section.

Appendix 2: Memorandum of Agreement with Advisory Council for Historic Preservation for Ipsut Creek Patrol Cabin (detached)

Appendix 3: Geomax: Site Assessment and Design of Rock Barbs, Check Dams and Other Flood Damage Reduction Measures for Carbon River Road (January 2008) (detached)

Appendix 4: ENTRIX: Final Draft Technical Memorandum: Topographic Survey, Hydraulic Modeling and Design Assessment of Proposed Carbon River Road Flood Damage Reduction Measures (October 2008) (detached)

Appendix 5: Draft Cultural Landscape Inventory (CLI) (detached)

Appendix 6: Cumulative Impacts Project List

Appendix 7: Draft Floodplains Statement of Findings

Appendix 8: Draft Wetlands Statement of Findings

Appendix 9: Draft Biological Assessment (detached)

Appendix 10: Draft Impairment Analysis for Carbon River Area Access Management Environmental Assessment Preferred Alternative

i. Executive Summary

This Environmental Assessment (EA) will define the nature and extent of public and administrative access to the Carbon River area, including for hikers, bicyclists, vehicles, camping, parking and trails, and evaluate the ability to both protect endangered species and National Historic Landmark District (NHLD) consistent with the Mount Rainier GMP. This Environmental Assessment (EA) describes the impacts associated with alternatives that consider repair of the Carbon River Road for public pedestrian and bicycle use or public vehicle access.

The Mount Rainier General Management Plan (GMP) stated that the park would no longer maintain the Carbon River Road after the next major washout. An environmental impact statement was prepared for the GMP and the record of decision was signed in 2002.

This EA has been prepared to determine how to implement the direction provided by the GMP. Its purpose is to provide direction not found in the GMP about how to implement the closure of all or portions of the Carbon River Road to private vehicles, and concurrently, to support public access in some form within the corridor.

Under the approved the GMP, reopening the road to private vehicular access in its entirety is not under consideration (see *Alternatives Considered But Dismissed*). Although the GMP did not define what a major washout is, the decision articulated within the GMP and therefore in this EA is to curtail private vehicular access to the end of the road based on a number of factors, including 1) a long history of flood damage since the Carbon River road was built; 2) rising riverbed elevation (aggradation) that in many cases is equal to or higher than the Carbon River Road; 3) an increase in the frequency and intensity of flood events; and 4) the extent of road damage caused by floods in 1990, 1996 and 2006. The 2006 flood was the largest flood event during the period of record (since 1930) at the Fairfax gauging station downstream of the Carbon River Entrance. The second and third largest events were the 1996 and 1990 floods, respectively. Since the 2006 flood, additional moderate flooding has damaged more of the Carbon River Road. Passage of the three largest floods within the last 20 years underscores the need for additional planning for this unique area.

Alternatives 1-5 are based on the purpose and need for the project and are derived from existing laws, policy and planning documents, including the Mount Rainier General Management Plan (NPS 2002). These alternatives include a range of options for the road, including conversion to a hiking and bicycling trail as called for by the GMP, seasonal shuttle use of the road, and reopening a portion of the road to public vehicles as well as temporary use of the road as a hiking and bicycling trail while a wilderness reroute trail is constructed. Within the document, the NPS preferred and environmentally preferred alternatives are identified.

If reviewers do not identify significant environmental impacts, this EA will be used to prepare a Finding of No Significant Impact (FONSI), which will be recommended by the superintendent for approval by the National Park Service Pacific West Regional Director. Pending approval of a *Finding of No Significant Impact (*FONSI), the selected alternative would be implemented.

Table of Contents

i. Executive Summary 4

CHAPTER I: INTRODUCTION 8

Decision to be Made 8

Project Area 8

A. Significance of the Carbon River Area 8

B. Mount Rainier National Park Purpose and Significance 10

C. Mount Rainier National Park Mission Statement 11

D. Carbon River Road Flood History 11

E. History of the Carbon River Road 18

CHAPTER II: PURPOSE AND NEED 23

A. Purpose and Need 23

B. Scope of the Environmental Assessment 26

C. Relationship to Laws, National Park Service Policies, and Park Planning Documents 27
1. Laws 27
2. Executive Orders 30
3. Policies 31
4. Mount Rainier National Park Plans 32

D. Planning Process 36
Summary of Public Concerns 38
1. Issues Addressed in this Document 38
2. Issues (and Actions) Not Addressed in this Document 39

E. Impact Topics 41
1. Impact Topics Analyzed 41
2. Impact Topics Dismissed From Further Analysis 44

F. List of Federal, State and Local Permits and Other Consultation Requirements 45

G. Additional Public Review 45

CHAPTER III: ALTERNATIVES 46

A. Introduction 46

B. Alternative 1: No Action (Continue Current Management) 48
1. Alternative 1 Public Access Summary 48
2. Alternative 1 Components 50

C. Elements Common to All Action Alternatives (2-5) 56

D. Alternative 2: Improved Hiking and Bicycling Trail in Historic Carbon River Road Corridor (Preferred) 64
1. Alternative 2 Public Access Summary 64
2. Alternative 2 Components 65

E. Alternative 3: Public Vehicle Access on Carbon River Road to Chenuis: Hiking and Bicycling Trail Beyond 77
1. Alternative 3 Public Access Summary 77
2. Alternative 3 Components 79

F. Alternative 4: Seasonal / Weekend Shuttle Access on Carbon River Road for 4.4 Miles: Hiking and Bicycling Trail Beyond 86
1. Alternative 4 Public Access Summary 86
2. Alternative 4 Components 87

G. Alternative 5: Wilderness Hiking Trail Reroute 91
1. Alternative 5 Public Access Summary 91
2. Alternative 5 Components 92

H. Alternatives (and Actions) Considered but Dismissed 103

I. Mitigation Measures 106

J. Environmentally Preferable Alternative 107

CHAPTER IV: AFFECTED ENVIRONMENT 108

Introduction 108
1. Air Quality 109
2. Geology / Geologic Hazards 111
3. Soils 113
4. Water Resources 113
5. Vegetation 127
6. Wildlife 129
7. Federally Listed Wildlife Species 132
8. Special Status and State Status Plants 141
9. Federal Wildlife Species of Concern and State Special Status Wildlife Species 142
10. Ethnography 145
11. Prehistoric and Historic Archaeological Resources 146
12. Historic Structures / Cultural Landscapes 150
13. Visitor Experience 159
14. Wilderness 162
15. Wild and Scenic Rivers 164
16. Park Operations 165
17. Socioeconomics (Local Population and Economy) 166

CHAPTER V: ENVIRONMENTAL CONSEQUENCES 167

A. **Methodology** **167**
1. Definitions 167
2. Impact Analysis 168
3. Cumulative Impact Analysis 170
4. Impairment 170

B. **Environmental Impact Analysis** **172**
1. Air Quality Impacts 172
2. Geology / Soils Impacts 179
3. Water Resources Impacts 184
4. Vegetation Impacts 202
5. Wildlife Impacts 211
6. Special Status Wildlife Species Impacts 215
7. Ethnographic Resources Impacts 238
8. Prehistoric and Historic Archaeological Resources Impacts 240
9. Historic Structures / Cultural Landscapes Impacts 245
10. Visitor Experience Impacts 253
11. Wilderness Impacts 262
12. Wild and Scenic Rivers Impacts 265
13. Park Operations Impacts 266
14. Socioeconomics Impacts 271

CHAPTER VI: CONSULTATION AND COORDINATION 277

Internal and External Scoping 277

Agency and Tribal Consultation 277

List of Persons and Agencies Consulted / Preparers 279

CHAPTER VII: REFERENCES 281

Appendix 1: Summary of Measures to Avoid, Minimize or Mitigate Environmental Impacts 291

Appendix 2: Memorandum of Agreement: National Park Service and Advisory Council on Historic Preservation for Ipsut Creek Patrol Cabin (detached) 302

Appendix 3: Geomax: Site Assessment and Design of Rock Barbs, Check Dams and Other Flood Damage Reduction Measures for Carbon River Road (January 2008) (detached) 303

Appendix 4: ENTRIX: Final Draft Technical Memorandum: Topographic Survey, Hydraulic Modeling and Design Assessment of Proposed Carbon River Road Flood Damage Reduction Measures (October 2008) (detached) 304

Appendix 5: Draft Cultural Landscape Inventory (CLI) (detached) 305

Appendix 6: Cumulative Impacts Project List 306

Appendix 7: Draft Floodplains Statement of Findings 307

Appendix 8: Draft Wetlands Statement of Findings 329

Appendix 9: Draft Biological Assessment (detached) 339

Appendix 10: Draft Impairment Analysis for Carbon River Area Access Management Environmental Assessment Preferred Alternative.. 340

Chapter I: Introduction

Mount Rainier National Park encompasses 235,625 acres (not including boundary expansion lands) on the west side of the Cascade Range, about 65 miles southeast of Seattle and 65 miles west of Yakima. The park was established in 1899 ". . . for the benefit and enjoyment of the people. . ." Regulations within the park were enacted to "provide for the preservation from injury or spoliation of all timber, mineral deposits, natural curiosities, or wonders within said park, and their retention in their natural condition" (Mount Rainier National Park Organic Act 1899).

In 1988, approximately 97 percent of the park was designated as the Mount Rainier Wilderness, part of the National Wilderness Preservation System. The Mount Rainier National Historic Landmark District was listed on the National Register of Historic Places in 1997. This large and exceptional district includes approximately 1,700-acres, including nearly all of the park's historic developed areas. The National Historic Landmark District is an outstanding example of early park planning and National Park Service rustic architecture of the 1920s and 1930s. The park's outstanding wilderness values, natural and cultural resources, and remarkable scenic characteristics are its signature features.

Decision to be Made

This Environmental Assessment (EA)has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and its implementing regulations (40 CFR Parts 1500-1508); *National Park Service Management Policies* (2006); NPS Director's Order 12 and Handbook : *Conservation Planning, Environmental Impact Analysis, and Decision-making* (DO-12); Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended, and its implementing regulations (36 CFR Part 800), related guidance and applicable Executive Orders.

NEPA requires the documentation and evaluation of potential impacts resulting from federal actions on lands under federal jurisdiction. An Environmental Assessment discloses the potential environmental consequences of implementing the proposed action and other reasonable and feasible alternatives. NEPA is intended to provide decision-makers with sound knowledge of the environmental consequences of the alternatives available to them. In this case, the Superintendent of Mount Rainier National Park and the Pacific West Regional Director are faced with a decision regarding whether to implement the Carbon River Area Access Management Plan as described herein, including modifications to public access that would occur in the Carbon River area depending on the selected alternative or combination of alternatives.

Project Area

The project area includes the Carbon River Road and adjacent areas within 200 feet of the centerline of the road from the Carbon River Entrance (Mount Rainier National Park boundary) to the Wonderland Trailhead past Ipsut Creek Campground. The project area in Alternative 5 also includes the area delineated Sensitive Resource Recreation Area on the south side of the Carbon River Road up to and including areas designated Pristine, approximately one-half mile south of the Carbon River Road. Portions of Alternative 5 would occur within designated wilderness.

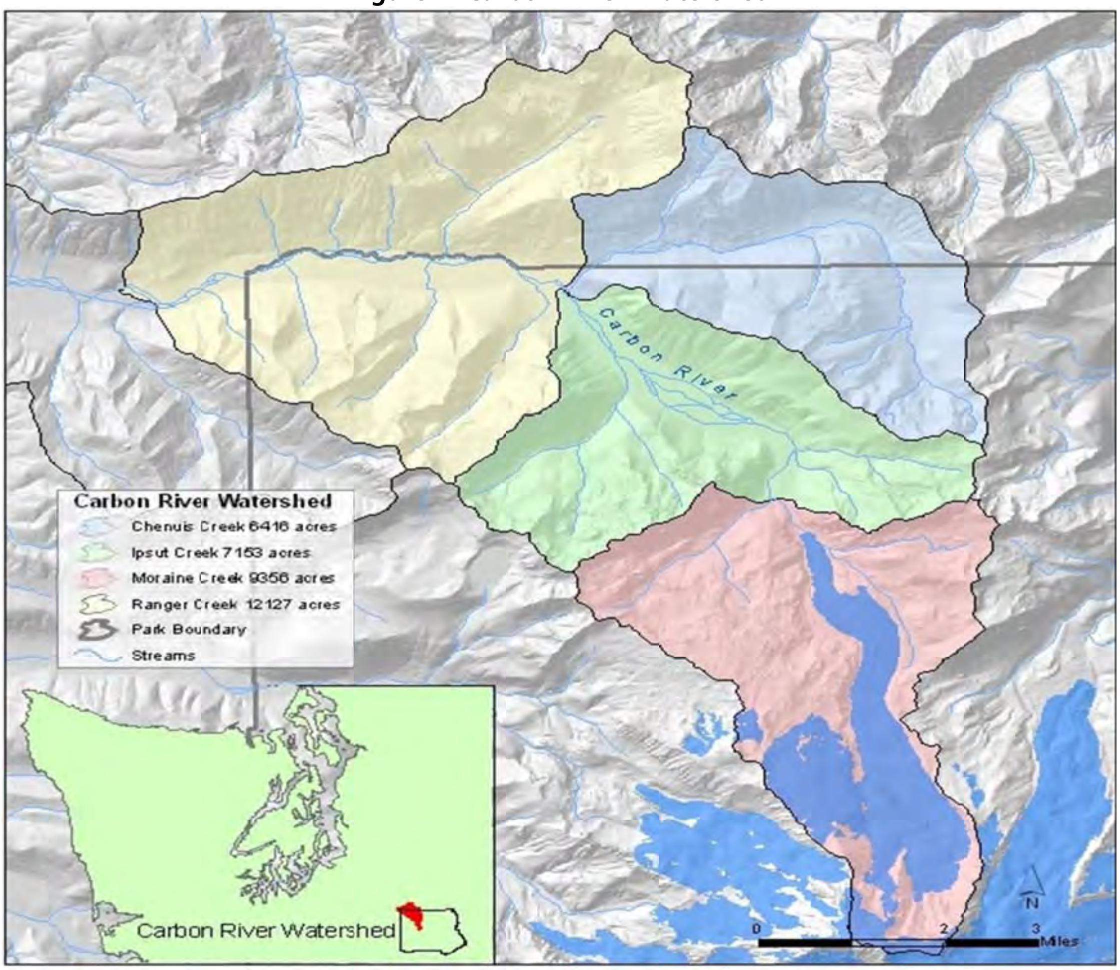
A. Significance of the Carbon River Area

The Carbon River, a tributary to the Puyallup River, is a braided glacial river, which originates at the toe of the Carbon Glacier on the northwest side of Mount Rainier, the lowest glacier in the continental United

States. The Carbon River watershed is approximately 52 square miles and contains both old growth and second growth forest within and outside the park (Figure 1: *Carbon River Watershed)*. The boundary of Mount Rainier National Park lies on the north side of the Carbon River and is adjacent to lands managed by the U.S. Forest Service as part of the Mount Baker-Snoqualmie National Forest.

On the south side of the river, the forests of the Carbon River Valley are among the oldest in the park (501-600 years old) (Franklin *et al.* 1988). This western hemlock / devil's club (*Tsuga heterophylla / Oplopanax horridum*) forest community is the fourth least dominant of community types within Mount Rainier National Park (NPS 2007, Franklin *et al.* 1988). Western hemlock / devil's club dominated forest comprises approximately two percent of the forested habitat in the park. The age of this habitat type within the Carbon River Valley makes it rarer. The Carbon River Valley is also the only place in the park where Sitka spruce are found, making this forest habitat an inland temperate rainforest. The Carbon River Valley provides habitat for several threatened or endangered species, including bull trout, steelhead, Chinook salmon, marbled murrelets and northern spotted owls. The Carbon River also includes designated critical habitat for bull trout.

Figure 1: Carbon River Watershed



The Carbon River Road is among the features listed on the National Register of Historic Places as part of the Mount Rainier National Historic Landmark District (NHLD). The NHLD recognizes that not only does Mount Rainier contain a large number and wide array of historic resources, but it is, in fact, an historic park. The NPS master plan for Mount Rainier was the first of its kind and the best implemented in the national park system. Although numerous subsequent changes occurred in the history of park development, the overall design and intent of the park's master plan remains. As a unique feature contributing to the design intent, the modern visitor experience of traversing the mostly unpaved Carbon River Road (prior to recent flooding) through centuries-old forest along the Carbon River was nearly the same as that of visitors to the area between 1915 -1941, the period of significance of the Carbon River Road.

The Carbon River Road, which remains snow free for much of the winter, provides year-round access to the Wonderland Trail. Prior to flooding, there used to be two year-round drive-in campgrounds in the park; Ipsut Creek Campground at the southeast end of the Carbon River Road was one of these. With flooding-induced loss of the Sunshine Point Campground and closure of the Carbon River Road, there are currently no year-round drive-in campgrounds in the park.

A variety of hiking trails are accessed via the Carbon River area. These include the Carbon River Rainforest Loop Trail, the Old Mine Trail, Green Lake Trail, Chenuis Falls Trail, and the Ipsut Pass/Wonderland Trail as well as to the Northern Loop / Carbon Glacier trails.

In 2005, Congress authorized an approximately 800-acre boundary expansion (Public Law 108-312). This expansion was identified in anticipation of the need for replacement facilities and services within the Carbon River corridor. The GMP calls for these lands to be used to establish a new visitor services area containing a drive-in campground and other facilities that would replace flood-damaged facilities in the Carbon River area.

Near the entrance, but outside the boundary expansion area, land is property owned by *The Mountaineers*, a hiking / climbing club. On the north and west of *The Mountaineers* land, the Carbon River entrance borders Mount Baker-Snoqualmie National Forest lands. Within the boundary expansion lands, approximately 3.0 miles west of the Carbon River entrance, is property partially owned by the Cascades Land Conservancy. Closer, approximately 2.5 miles west, is the former Thompson property now owned by the NPS. The NPS is acquiring these lands within the boundary expansion area from willing sellers as funding is provided by Congress. In the future, a longer term plan for facilities and services in the Carbon River corridor is proposed to be developed in cooperation with Pierce County Parks, local communities and other partners.

B. Mount Rainier National Park Purpose and Significance

The following park purposes and significance come from the GMP.

Purposes (NPS 2002:10)

- To protect and preserve its natural and cultural resources, processes, and values, while recognizing their increasing importance in the region, the nation and the world;
- To provide opportunities for visitors to experience and understand the park environment without impairing its resources;
- To maintain wilderness values and to provide for wilderness experiences.

Significance (NPS 2002:11-12)

- . . . Mount Rainier is the highest volcanic peak in the contiguous U.S. . . .
- As part of the Pacific Ring of Fire, Mount Rainier is an outstanding example of Cascade volcanism.
- Mount Rainier has the largest alpine glacial system in the contiguous United States.
- Mount Rainier's eruptions and mudflows continue to shape the park and are a continual threat to park visitors, employees and surrounding lowland communities.
- Because of its great elevation range and extensive glacial systems, Mount Rainier offers outstanding opportunities to study how biological communities respond to climatic change.

- The park contains outstanding examples of diverse vegetation communities, ranging from old-growth forest to subalpine meadows and ancient alpine heather.
- The park is a vital remnant of the once widespread primeval Cascade ecosystem and provides habitat for many species representative of the region's flora and fauna.
- As urban development expands, the park continues to be a large island of protected open space where ecosystem processes dominate.
- The park's comprehensive national historic landmark district – a cultural landscape district including buildings, roads, the Wonderland and Northern Loop trails, and other landscape structures – is the most significant and complete example of NPS master planning and park development in the first half of the 20th century.
- The developed areas of Mount Rainier contain some of the nation's best examples of "NPS Rustic" style architecture of the 1920s and 1930s.
- Called by some Native American groups "the place where rivers begin," Mount Rainier's watersheds nourish plant and animal communities in the park, extend to the valleys below, and remain an important source of water for the Puget Sound region.
- Mount Rainier, visible throughout the region, is a continuing source of inspiration to people. This quality contributed to the establishment of the national park in 1899. The mountain is a prominent icon that continues to shape the physical environment and human experience in the Pacific Northwest.
- For many generations, Pacific Northwest Native American tribes have been inspired by Mount Rainier's grandeur and massive prominence in the Cascades region. At least five contemporary, descendant tribes – the Nisqually, Muckleshoot, Puyallup, Yakama, and Cowlitz – are associated with traditional uses of Mount Rainier. These peoples are modern representatives of broad regional ancestry that lived in and used lowland and mountain terrain in the vicinity of Mount Rainier. The resources of the park are important to the contemporary Native American tribes, providing spiritual and cultural sustenance.
- The park offers recreational and educational opportunities in a wide range of scenic settings, including wildflower meadows, glaciers and rainforests, all in a relatively compact area that is easily accessible to a large urban population.
- Mount Rainier's terrain and weather conditions offer world-class climbing opportunities that have tested the skills of climbers for more than a century.

C. Mount Rainier National Park Mission Statement

"Together we preserve, for future generations, the natural and cultural resources in Mount Rainier National Park. Through a variety of high quality park experiences, we promote park values, personal connections, and responsibility for the environment in our local and global communities. With integrity, teamwork, pride and motivation, we demonstrate environmental leadership and deepen our understanding of the park's ecosystems. We value our diverse range of individual contributions by showing respect and concern for each other and the park. The Mountain inspires stewardship. Its protection and preservation is our legacy (Mount Rainier National Park 2000)."

D. Carbon River Road Flood History

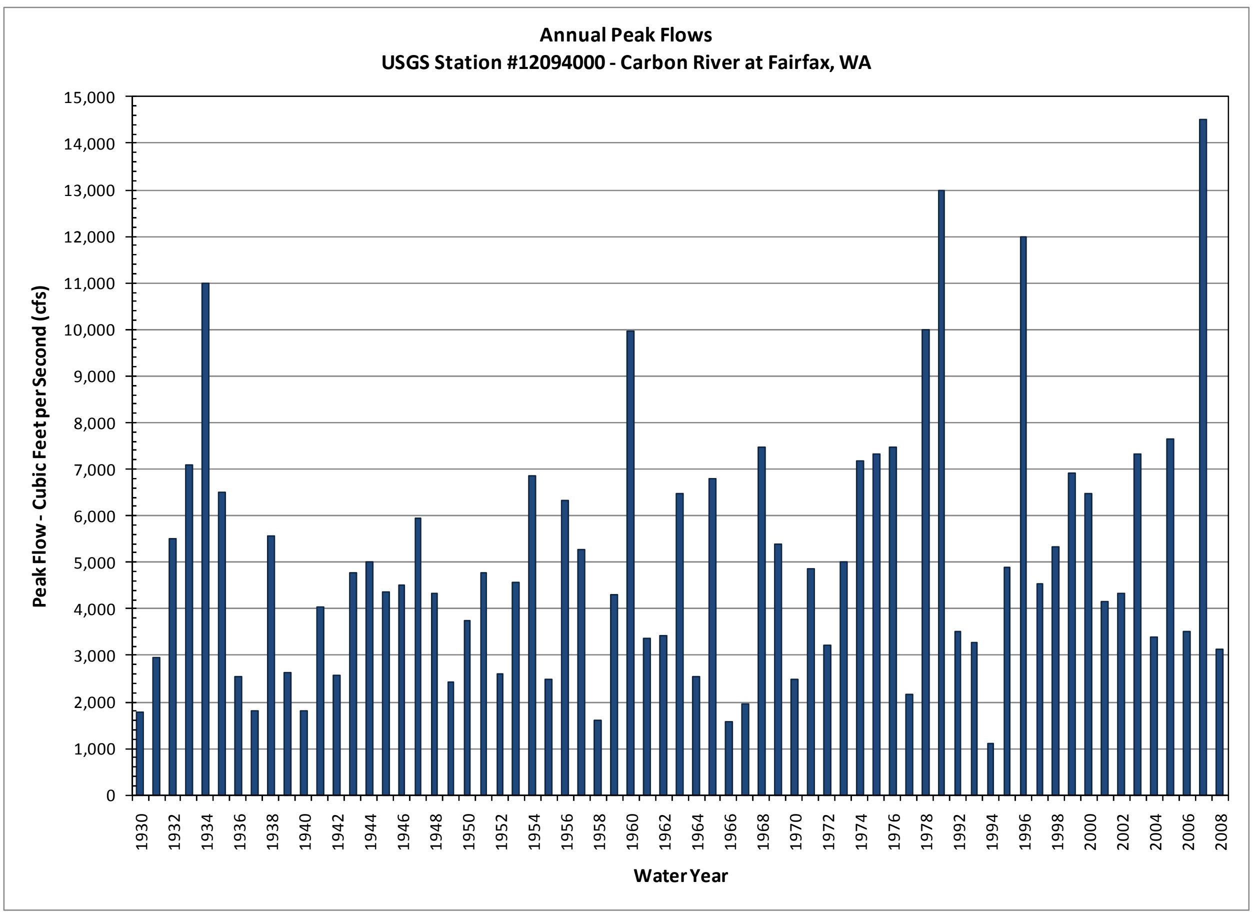
In November 2006, almost 18 inches of rain fell in 36 hours (November 16-19: Mount Rainier National Park Fact Sheet: November 6-7 Flood). In addition to affecting the Carbon River area, resultant flooding washed away a portion of the Nisqually Road, including part of Sunshine Point Picnic Area / Campground; redirected the flow of Kautz Creek; caused damage to the Kautz Creek maintenance area and helibase; significantly damaged the dike at Longmire; undermined the Emergency Operations Center at Longmire; damaged the Community Building access road and affected other areas at Longmire; as well as portions of Highway 123 and the Stevens Canyon Road. It also resulted in widespread backcountry trail and bridge damage and loss. The initial estimate for repairing damage was $36 million, a figure that was subsequently revised to between $24 and $27 million. The storm resulted in the closure of the park's Nisqually Entrance for six months.

Between November 5, 2006 at 2 p.m. and November 7, 2006 at 2:15 p.m., 8.76 inches of precipitation was recorded at the Carbon River Fairfax stream gauge station (USGS gauge12094000) located 1.1 miles upstream from the State Highway 165 (Fairfax) bridge (Figure 2: *Peak Discharge 1930-2008 at the Fairfax Gauge*). The gauge is located 1.2 miles northwest of Fairfax, 2.3 miles downstream from Evans Creek and 4.0 miles south of the town of Carbonado at river mile 16.1.

Flood stage (13.5 feet) was recorded by noon on November 6, 2006 with the highest recorded gauge height by 6:00 p.m. (16.93 feet). This is also the highest flow ever recorded at this site. The river remained well above flood stage until about 10:30 p.m. on November 7, 2006.

The flood damaged the Carbon River Road in several places, with the greatest damage near Falls Creek and just before Ipsut Creek. In these locations, the roadbed was washed away to a depth of 6-10 feet, for 2,600 feet and 1,350 feet respectively. In addition, at two places beyond Chenuis, one lane of the road was washed away (200 feet each) and at one location both lanes were removed (200 feet).

Figure 2: Peak Discharge 1930-2008 at the Fairfax Gauge



As in the 1996 flooding many old growth trees fell, while others remained standing with partially exposed roots along the old shoulder line of the road. The damage then and in 2006 was attributed to a combination of an extreme flood event, decades-long aggradation of the river bed, flow diversions from upstream debris jams and a thick layer of highly erodible material beneath the road bed.

In 1996, because of the extensive damage sustained, the past history of flood damage along the entire Carbon River Road, and the possibility of future damage, the park requested that FHWA complete a comprehensive hydraulics study. Completed in February 1997, the hydraulics report addressed the feasibility and cost effectiveness of reconstructing the roadway in its current location (FHWA 1997).

The report also described the Carbon River as a braided system that actively changes form and concluded that despite the wealth of data, no trend was present (FHWA 1997: 8).

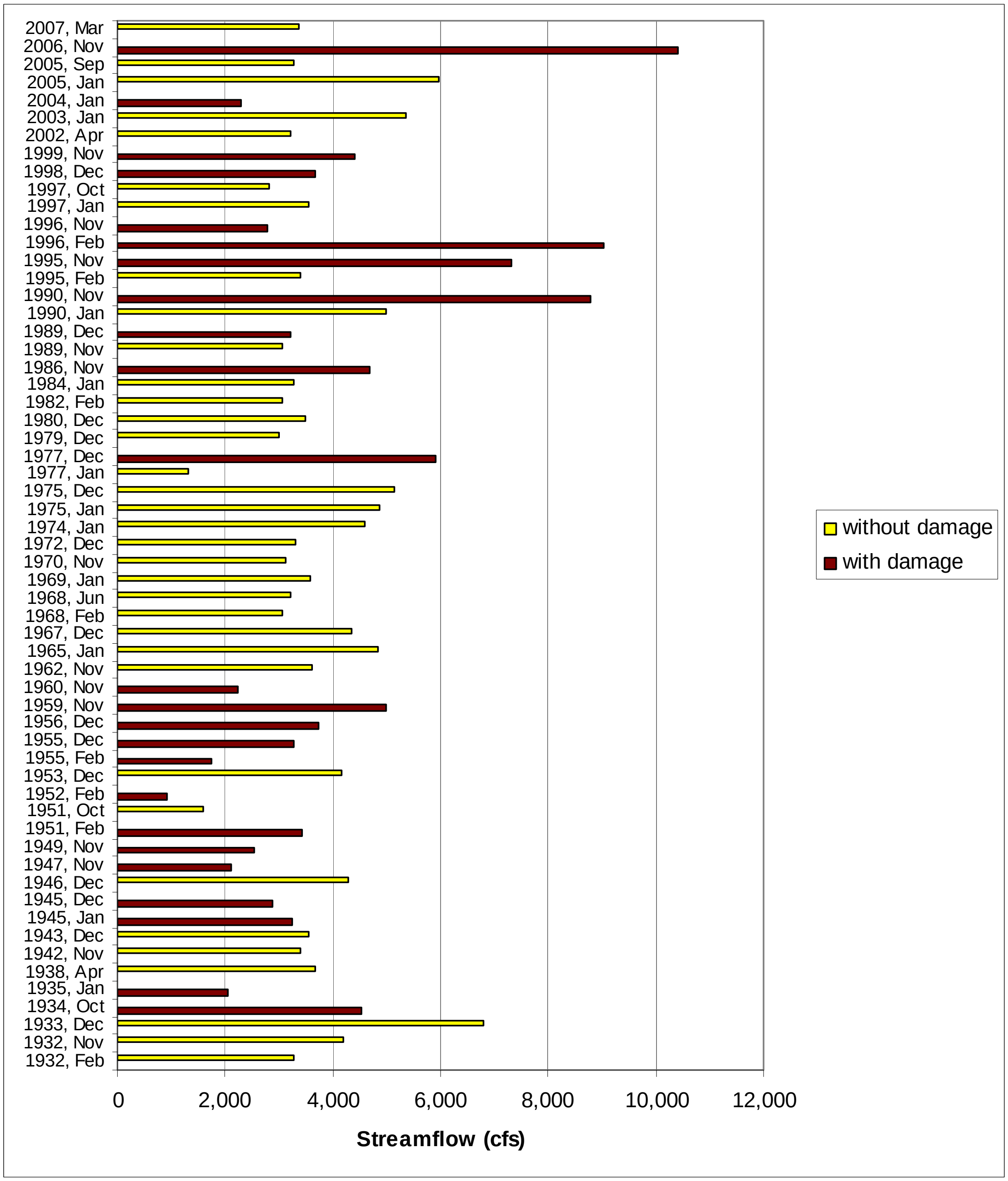
> If any trend is apparent from the historic records, it is that there is no trend, that is, the damage is random in both time and location. In dynamic, braided river systems where the river continually reforms itself, this is to be expected. Give that the road lies in the floodplain, or abuts the river in places, future damage should be expected. Based on past record, flood damage requiring maintenance should be expected every 5 to 10 years. Because the Carbon has a high sediment input, it is probably aggrading, which, over time, may increase the frequency and severity of roadway flooding. The risk analysis estimates an annual risk of nearly $30,000 for keeping the road open. The NPS should, thus, expect to spend about $1.1 million to $1.5 million over the next 70 years to maintain this road.

FHWA determined that reconstruction of the damaged road in its current location was feasible and provided reasonable assurance that this section of road would have a serviceable life, if properly restored. Despite the conclusion drawn by FHWA about random flooding, it is clear from a more detailed examination of the flooding that at least two areas along the road have been repeatedly affected – Falls Creek and Green Lake Trailhead/Chenuis Falls and Ipsut Creek (see Figure 3: *History of Major Carbon River Floods* 1933-2007, Figure 4: *Carbon River Road Damage 1925-2008,* and the *Flood Damage Timeline*).

During the same time that deliberations were ongoing over whether to repair the Carbon River Road following flooding in 1996, the park's general management plan was being revised. As part of the GMP planning effort, a parkwide hazard analysis was undertaken to determine to what extent park facilities were threatened by natural phenomena, including flooding and other geological hazards, particularly debris flows or volcanic eruptions. During that time, field analysis determined the debris flow hazard at the Carbon River Entrance to be Case II, while the Ipsut area facilities were in a Case III zone, with small debris flows affecting the area on the order of one every 100 years or less and the rate of aggradation on the Carbon River to be approximately six inches per year (NPS 1997). NPS staff recommended closure of the walk-in sites at Ipsut Creek Campground and removal of housing at the Carbon River Entrance because these lay within their regulatory floodplain (the walk-in sites have since been closed and the Carbon River Entrance has become a day use only facility). The NPS also determined that even though other portions of Ipsut Creek Campground were not currently within their regulatory floodplain, that they soon would be and therefore it should be classified as a high hazard area (NPS 1997). Since that time, flooding has occurred on the White (2003) and Nisqually Rivers (also November 2006) and studies by others have shown both of these rivers to be aggrading as well. Aggradation rates, including on the Nisqually and White rivers, are approximately 6-12 inches per decade (Beason 2006). Beason (2007) also states that the Carbon River has the highest historical rate of aggradation in the park, at approximately 0.6 feet per year between 1915-1971, for an average total of 31 feet of sediment aggradation in the active channel between the entrance and the Carbon Glacier.

The road near Falls Creek was repaired by November 1998. Despite assurances from FHWA, the newly repaired Carbon River Road washed out in two medium-sized (5,000 cfs and 6,000 cfs) floods five weeks later on December 29, 1998. These floods were caused by caused by winter rains on an established snowpack. The discharge from these floods is as recorded at the Fairfax gauge, therefore it is likely that flows within the park were smaller since the gauge also measures combined discharge from downstream creeks entering the Carbon River. The 1998 floodwaters again destroyed much of the same washout section through the Falls Creek area of the Carbon River Road that had recently been repaired. In 2006, floodwaters initially washed out a 1,200 foot section of road in the Falls Creek area to a depth of approximately 2-3 feet (instead of the previous 6-10 feet deep). The Carbon River subsequently flowed on the road for a short period of time and then subsided into a channel adjacent to the road, and eventually back into the river bed.

Figure 3: History of Major Carbon River Floods 1933-2007



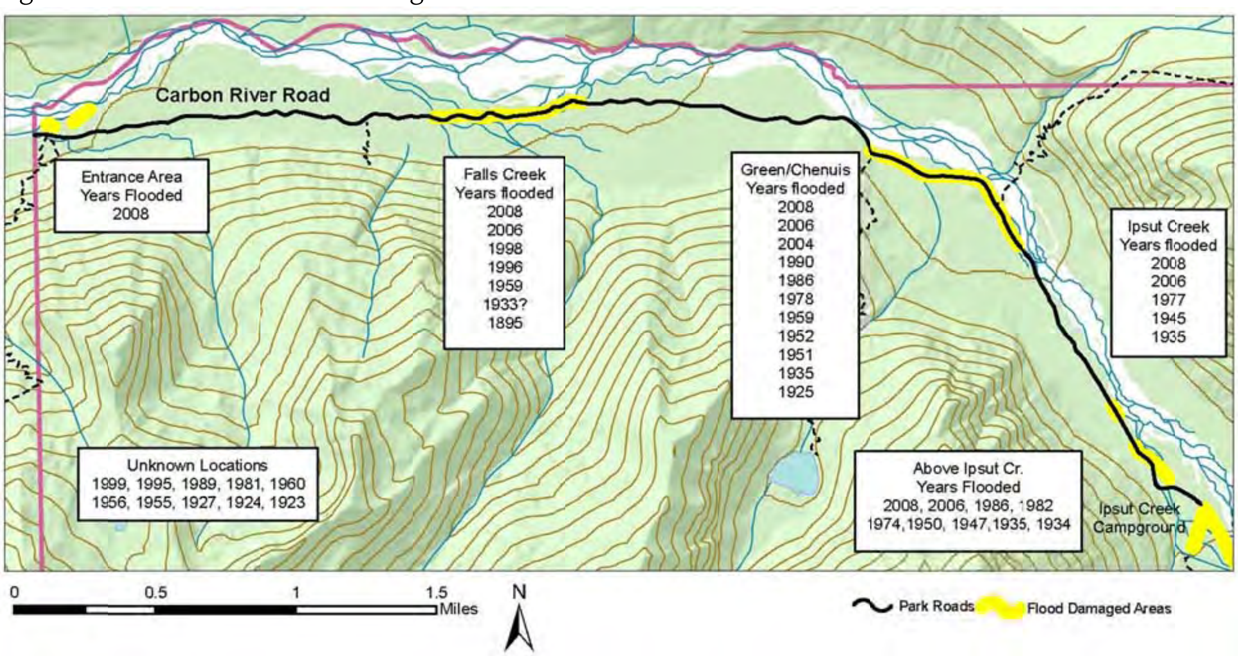
The discharge of 6,000 cfs has been exceeded 22 times in the 86-year history of flow data on the river in Fairfax, Washington since 1912. This most recent peak flow rate is for a flood return frequency of 5 to 10 years, which was predicted in the Hydraulics Report (FHWA 1997). Although the 1998 repair work met a lower standard than originally designed per the hydrologist's recommendation, it performed fairly well in reducing the amount of damage and the road was subsequently repaired in March 1999 by park staff. Together, the efforts to repair the road provided protection to the old growth trees along the roadway that were impacted by the exposure and undermining of their root systems. As a later internal memo wherein park staff were deciding what to do following the second round of flooding (NPS 1998) concludes: "had this repair not been undertaken, more extensive damage may likely have occurred and more trees downed" in this sensitive area.

As noted in the General Management Plan (NPS 2002:36)

> A large stretch of Carbon River Road has been repeatedly damaged by floods. The flood damage of 1996 was recently repaired. Within a month of being repaired, a flood again eroded the same section of road, although to a lesser degree. During the time the road was closed to motor vehicles, some visitors enjoyed the 4.9-mile bicycle ride or hike to the campground; many others saw this closure as an inconvenience, particularly families with children, school groups, and they physically less fit. An economic study, completed for the environmental assessment to repair the road (NPS 1998a) analyzed the costs. Questions have been raised about the cost of maintaining a roadway located in a floodplain. (Although most park roads follow river corridors, for the most part, they are outside of the 100-year floodplains.)

Recent weather patterns in the Pacific Northwest have been resulting in more frequent rain-on-snow fall flooding. This flooding occurs after the first snows have fallen at high elevation, followed by a period of warming that causes rain to fall and melt the first seasonal snows. It is unknown whether this type of flooding regime change will continue to occur. The Fairfax stream gauge, however, has shown an increasing trend of higher flood frequencies and magnitudes (Figure 2: *Peak Discharge 1930-2008 at the Fairfax Gauge*).

Figure 4: Carbon River Road Damage 1925-2008



Flood Damage Timeline 1895, 1907-2008
Carbon River Road: Maintenance Area, Green Lake Trailhead / Chenuis, Falls Creek and Ipsut Creek

Flood Damage (Location Unknown)

1907	North side Carbon River Trail (3 feet wide, 6 feet cleared) washed out in several places. Riprap planned to protect the trail from future river damage (NPS 2006a).
1923	February 14. Need for river revetments to protect the road noted (NPS 2006a: 33).
1925	Flood waters severely damaged the Carbon River Road, forcing park officials to install extensive revetments near the Carbon River (NPS 2006a:15)
1945	Several segments of the Carbon River Road were damaged by flood waters (NPS 2006a: 16). Some of the damage was below Ipsut Creek Campground (see below).
1955	Another flood washed out two portions of the road, forcing the park to request money for repairs (NPS 2006a: 56). These were likely the repairs needed in 1956 as part of the Mission 66 improvements (see below).
1995	Flood washed out two portions of the Carbon River Road. Fairfax gauge shows flood in November 1995 preceding large event of February 1996.

Photo 1: Log Cribbing Installed in 1930s along Carbon River Road

Maintenance Area Damage History

2008	November 12 flood damage resulted in the loss of 150 feet of riverbank, resulting in the loss of the seasonal ranger quarters into the river and employee parking.

Falls Creek Damage History

1895	First Evans Cabin destroyed by flooding.
1933-1934	Log-cribbing south side of Carbon River at Evan's Cabin (Falls Creek) 1.8 miles from entrance 285 feet long(NPS 2006a: 39). (Remnant extant today)
1956	General improvements to Carbon River Road. Log Bridge at Falls Creek replaced with corrugated multi-plate culvert.
1959	Fall (November) flood washed out 800 feet of the road near Falls Creek – with some places washing out 10 feet below the surface (NPS 2006a: 17, 57).
1977	Carbon River Entrance. The stream bank at both the entrance and maintenance area, severely eroded in the 1977 flood, was stabilized to reduce further intrusion of the Carbon River into the developed area (NPS 1979 DCP).
1996	Spring (February) flood (10,600 – 14,100 cfs) damage to 1,350 feet of Falls Creek area with a six to ten foot deep channel cut in roadway. Falls Creek Picnic Area dike destroyed. Repair completed September-November 1998.
1998	Two December 29 floods (5,000 and 6,000 cfs) washed out 1,200 feet of the Falls Creek repair to a depth of 2-3 feet. Repaired March 1999. Reopened April 1999 (Seattle Times, April 13, 1999 in NPS 2006a: 61).

2006	Fall (November) flood damage to 1,800 feet of Falls Creek area, including much of the same area affected in 1996 (see *Purpose and Need*).
2008	November 12 flood damage resulted in additional damage in the Falls Creek area include loss of trees between river and the road corridor.

Green Lake Trailhead / Chenuis Falls Damage History

1925	Road damage near Green Lake trailhead
1933-1935	Log cribbing constructed by CCC
1935	Roadway damage near Chenuis Falls
1951	Flood washed out 200 feet of the Carbon River Road near the Chenuis Falls turnout (NPS 2006a: 17).
1952	High waters inundated the road at Chenuis crossing in September causing moderate damage to the Chenuis road bridge and a culvert. Fixed by the following year (NPS 2006a: 56).
1956	General improvements to Carbon River Road. Log bridge at Chenuis replaced with corrugated multi-plate culvert.
1959	Flood also destroyed parts of the road near the Chenuis crossing and near the Ipsut Creek campground with several culverts washing away (NPS 2006a: 17, 57).
1978	Roadway damage between Green Lake and Chenuis trailheads.
1986	Roadway damage to 0.284 miles between Green Lake and Chenuis trailheads (NPS 2006a: 60).
1990	In November 1990, fourteen inches of rain fell in five days. According to Catton (1996:569), resultant flooding damaged the dike at Longmire, undermined bridge abutments at Kautz Creek, damaged the riprap protection above and below the Tahoma Creek Bridge, washed out sections of the Westside Road at and above Fish Creek, damaged the Stevens Canyon Road below Bench Lake, and wiped out a turnout on the Carbon River Road at Chenuis Falls. A turnout at Chenuis Falls was destroyed by flood waters (NPS 2006a: 18 and 60). Chenuis was rebuilt by the park as an expanded turnout retained by riprap to accommodate a picnic area.
2004	Roadway damage east of Chenuis trailhead repaired by road crew with a rock barb and additional poured riprap (S. Dolan pers. comm. 7-25-07).
2006	Roadway damage between Chenuis and Ipsut (see *Purpose and Need*).
2008	November 12 flood damage resulted in additional damage to bits east of Chenuis.

Ipsut Creek and Beyond Flood Damage History

1913	Bridge across the Carbon River at Cataract Creek damaged due to recent flood activity and reconstructed 1914 (NPS 2006a: 24).
1934	Floods destroy a 3,000 foot section of the Carbon River Road near Cataract Creek (NPS 2006a: 16). (Reference states road was closed but it was used later and designated in 1942 as a truck trail and later in 1948 was reportedly used by the public for its entire length until 1950 when it was permanently closed – see below)
1935	Relocation of a 600-foot section of roadway through Cataract Creek Campground (NPS 2006a: 41).
1935	Road dam age between Chenuis Falls trailhead and Ipsut.
1941	Road near Cataract Creek Campground made impassable by a rock slide (NPS 2006a: 42)
1945	Carbon River washed out a portion of the road below Ipsut Creek, necessitating extensive repair work (NPS 2006a: 54).
1947	A portion of the Carbon River Road, above Ipsut Creek was washed out as a result of heavy rains. The last mile of the road was impassable (NPS 2006a: 17).
1948	Rockslide cleared and last 2 ½ miles widened and used by the public for its entire length (NPS 2006a: 55).
1950	Road closed above Ipsut Creek until repairs. 0.8 miles reopened in 1952 (NPS 2006: 55). Turnaround at Wonderland trailhead built, formalizing closure above

	Ipsut Creek and its conversion to a trail (NPS 2006a: 17, 56).
1956	General improvements to Carbon River Road.
	Log Bridge at Ipsut Creek replaced with corrugated multi-plate culvert.
1959	Flood also destroyed parts of the road near the Chenuis crossing and near the Ipsut Creek campground with several culverts washing away (NPS 2006a: 17, 57).
1977	Another destructive flood washed out road culverts at Ipsut Creek. A "Bailey Bridge" was constructed as a temporary measure until the Ipsut Creek Bridge was constructed in 1979 (NPS 2006a: 59).
1979-1980	Ipsut Creek Bridge constructed (NPS 2006a: 18) from Emergency Relief Project Funds.
2006	Flood damage from Chenuis to Ipsut (see *Purpose and Need*).
2008	November 12 flood damage resulted in additional damage to road corridor west of Ipsut Creek due to flow diversion from Carbon River entering Ipsut Creek southeast of campground.

<u>Carbon River Road Structural Bank Protection</u>

1907	Revetment planned for Carbon River Trail.
1913	Cataract Creek Bridge reconstructed.
1923-1924	Some revetments installed during construction of Carbon River Road (NPS 2006a).
1925	Road damage near Green Lake Trailhead.
1933-1934	Log-cribbing south side of Carbon River at Evan's Cabin (Falls Creek) 1.8 miles from entrance 285 feet long(NPS 2006a: 39). (Remnant extant today)
1933-1935	Log-cribbing south side of Carbon River behind comfort station at entrance 366-feet long (NPS 2006a: 41). (Remnant extant today)
	Log-cribbing at Copley Lake Trailhead (approximately 100 yards east of the Falls Creek culvert) 112-feet long (NPS 2006a: 41). (Remnant extant today)
	Log-cribbing just above Ipsut Creek Campground 400-feet long (NPS 2006a: 41-42).
1934	Rock berm at Evan's Cabin (Falls Creek) (NPS 2006a: 39). (Remnant extant today).
1948	Slide areas re-cribbed with cedar logs and backfilled with soil and rock (NPS 2006a: 55).
1951	Repairs to 200 feet of washed out road adjacent to the Chenuis Falls turnout.
1952	Dam constructed near Ipsut Creek to protect the road and Ipsut Creek Road Bridge (NPS 2006a: 55).
1956	Log bridges at Falls Creek, Ranger Creek, Chenuis Crossing and Ipsut Creek replaced with corrugated metal plate culverts (NPS 2006a).
1979	Ipsut Creek Bridge constructed (NPS 2006a: 59).
1985	Installation of log barriers, riprap and surfacing (NPS 2006a: 18)
1986	Chenuis bank protection added during road repair of 0.284 miles (NPS 2006a: 60)
1990	Chenuis riprap protection added (NPS 2006a: 18, 60)
2004	Chenuis riprap protection added.
2007	Interim emergency stabilization of the Carbon River Road Historic Corridor.

E. History of the Carbon River Road

The Carbon River Road was to have been the northwest leg of the road around Mount Rainier. By the time the road was constructed, however, a movement to leave the northwest side of Mount Rainier roadless was underway and the Carbon River Road was never connected (as originally envisioned in the 1928 master plan) to the Westside Road.

According to the Cultural Landscape Inventory (CLI) (NPS 2006a:64) access to the Carbon Glacier was the primary objective behind the design of the road. It was constructed beginning in 1921, when $150,000 was appropriated for it by Congress. Surveys in 1915 had estimated that a 7-mile road to the Carbon Glacier terminus would cost $100,000 to build. By 1924, then Mount Rainier National Park Superintendent Owen Tomlinson reported that the road had been constructed to within one mile of the

Carbon Glacier, with the last three miles a one-lane road (Catton 1996:226). Pierce County, however, did not complete the approach road to the park, over the Fairfax Bridge, until 1925 (NPS 2006a:64).

From its earliest history (during and immediately following its construction) the Carbon River Road was subject to flooding (Photo 2: *Early Slumping along the Carbon River Road*). As construction resumed in 1923, more time and money was requested to repair sections damaged by winter flooding. Spring flooding caused additional damage and consequent emergency repairs the following year. Despite the repeated damage, NPS Director Stephen Mather urged completion of the road and authorized additional resources to protect the government's investment (CLI: 33). Simultaneously, the road's Chief Engineer (Goodwin) recommended abandonment of the project due to his frustration with Pierce County's delayed implementation of the connecting county road and perhaps also his own desire to see the Yakima Park Road (Sunrise Road) constructed (NPS 2006a:33).

Photo 2: Early Slumping along the Carbon River Road

One year after the Carbon River Road was finished, the NPS and Bureau of Public Roads (BPR), precursor to the Federal Highway Administration, signed a Memorandum of Understanding to allow BPR engineering and construction oversight of NPS roads, while authorizing the NPS to provide landscape architecture design to preserve the scenic qualities of roads.

During the first federal inspection of the new Carbon River Road, BPR officials "identified a problem the NPS had overlooked: the Carbon River Road would be prone to flooding in perpetuity, due to its naïve alignment in the river floodplain" (NPS 2006a:35). In fact, BPR engineers were prompted to recommend abandoning the Carbon River Road in favor of a new alignment for the northern terminus of the West Side Road and an approach link road (NPS 2006:35). In a letter to Stephen Mather, Superintendent Tomlinson (February 25, 1929) recounted that BPR believed the NPS would save money in the long run by avoiding costly flood repairs to the Carbon River Road (NPS 2006a:35).

Nevertheless, park supporters continued to advocate for the retention and use of the Carbon River Road as part of the Around-the-Mountain Road they had supported. In a February 19, 1929 letter from T.H. Martin, General Manager of the Rainier National Park Advisory Board, to Asahel Curtis was a plea for continuation of the Around-the-Mountain Road and the Carbon River Road's integral part in the plan. Martin cited the investments made, not only by the NPS, but also by the U.S. Forest Service (USFS) and Pierce County in building connecting roads on their lands: and stated that "in the light of present day conditions it must be admitted that the location along the Carbon River, made by National Park Service engineers, was erroneous; or at least it was unsatisfactory." He went on to say, however, "We cannot see the plan abandoned, it would be unthinkable" (NPS 2006a:36). Afterwards, Curtis wrote to then Superintendent Tomlinson, wherein he noted that "Had engineering knowledge been the guide rather than political expediency, the road would never have been located where it is" (NPS 2006a:36). Despite its initial influence on park planning, eventually the Around-the-Mountain Road concept gave way to a more feasible reliance on regional roads to link the various areas of the park (NPS 2006a:42).

Despite ongoing problems with the Carbon River Road, Superintendent Tomlinson did not advocate for the road's replacement. Instead, Tomlinson, following direction from Stephen Mather, began to master plan the park with NPS Chief Architect Thomas Vint (Branch of Plans and Designs in San Francisco) and incorporated the road into a system of rustic park villages and scenic connecting roads in the park, according to Mather's vision. National parks were then experiencing a great increase in visitation due to a dramatic rise in automobile ownership. In spite of its poor engineering design, the Carbon River Road was therefore incorporated as a key piece of the park's original (1928) master plan and it became part of subsequent versions as well (NPS 2006a:37).

By the early 1930s, a resurgence of activity in the park was underway, including in the Carbon River area. The Civil Works Administration (CWA) Emergency Conservation Work (ECW) was established in fall 1933 to provide winter emergency relief jobs nationwide. A crew of 108 men were assigned to the Carbon district and stayed initially in the Manley-Moore Lumber Company's facilities near Fairfax (Catton 1996:355). In the four months between December 15 and March 31, 1933, these workers spent 25 percent of their time on river bar cleanup and crib construction for flood control and the remaining 75 percent on improving the Carbon River Road (Catton 1996:355). CCC Camp #3 was later housed at Ipsut Creek Campground and worked on projects which included repair to the Carbon River Road and area facilities, as well as construction of new facilities.

In 1933, CCC crews constructed log cribbing along the banks of the Carbon River near Evan's Cabin (Falls Creek). The structure was composed of 17,000 linear feet of logs laid parallel and perpendicular to the riverbank to form a type of basket, bound with heavy gauge wire and filled with 3,000 cubic yards of rock (NPS 2006a:39) (Photo 3: *Carbon River Road 1930s Log-Cribbing*).

Photo 3: Carbon River Road 1930s Log-Cribbing

Later, in December 1933 and January 1934, when floods damaged additional sections of the Carbon River Road, CCC crews immediately filled potholes, repaired washouts and installed more wood culverts to better drain the road. They repaired a section of road above Ipsut Creek where 200 feet of road washed out and rebuilt the Ipsut Creek Bridge. As noted in the CLI (NPS 2006: 40), these efforts and those that followed indicate "a perceived worthiness of the road's role in the park's master plan, despite the persistent efforts required to maintain the road." The 1934 field season found CCC crews experimenting with a different type of revetment that did not require logs – instead it consisted of boulders piled into a dike and bound by a light mortar poured over the top. These rock berms were then enclosed in a galvanized wire mesh.

By 1957, the Mission 66 10-year development and improvement program for the national parks (in preparation for the 50th anniversary of the NPS) identified a variety of improvements for the Carbon River area, demonstrating once again the NPS's commitment to the area and the road. Plans included improving minor park roads, including the Carbon River Road, along with a desire to improve inadequate facilities in all national parks and to spread visitor use more evenly throughout Mount Rainier (Catton 1996:4 in NPS 2006a:56). Plans called for Ipsut Creek Campground to be improved and expanded and for road repair, construction and interpretation in the Carbon River District to accommodate visitors seeking the unique remoteness of the area (NPS 2006a:56). Ideas considered, but either not implemented or not fully implemented included a proposal to pave the Carbon River Road (eventually only about 1.4 miles were paved) and a proposal to relocate the Carbon River District headquarters to a less flood-prone location outside of the park (not implemented because nearby areas were also subject to flooding). With the road fully part of the Mission 66 plan, work in 1956 included repair of flood damage from 1955 as well as raising the vertical alignment of the road from two to five feet, allowing for the installation of larger culverts and replacement of log road bridges at Falls and Ranger Creeks, Chenuis Crossing and Ipsut Creek with large, corrugated multi-plate culverts (NPS 2006a:57). As the Mission 66 improvements ended, the park began to develop the 1972 Park Master Plan.

According to Catton (1996:594-595), the 1972 Mount Rainier National Park Master Plan (a precursor to the GMP) called for closing the Carbon River Road to private vehicles and establishing a minibus service, along with foot and bicycle access. It stated:

> This unique resource area of the park is particularly appropriate for the immediate implementation of a visitor circulation system using vehicles other than automobiles. Unlike the loop road accesses to the heavily visited areas of the park, access to this area is by a dead-end road.

As noted later, however, "Subsequently, Park Service officials quietly dropped the proposal to close the Carbon River Road to private vehicular traffic." Catton cited the problem of heavy use in summer that tapered in spring and fall to an unprofitable margin and the lack of cost savings to maintain the road since the road would need to be maintained for the buses and administrative use. There was also a fear that closing the road would turn away visitors, rather than draw them to this side of the park and that they would be diverted to the more heavily used areas of the park.

With that plan abandoned, improvements continued at the Carbon River area in 1974, including installation of a shelter over the Carbon River Ranger Station at the entrance and construction of the Carbon River Rainforest Loop Trail. By 1977, the Carbon River area recorded approximately 52,000 visitors (NPS 2006a:59). Later that year the Ipsut Creek culverts washed out, requiring temporary use of a "Bailey Bridge" until the current Ipsut Creek Bridge was built in 1979. As a result, additional consideration in the new "Development Concept Plan" (DCP) was given to relocating administrative facilities outside the park, but again there were no sites found within a reasonable distance that were not subject to flooding (NPS 2006a:59).

The 1979 DCP for the Carbon River District "emphasized the importance of providing a 'relatively undeveloped, rustic outdoor recreation experience' for park visitors" (NPS 2006a:59). Additional parking was proposed for the Entrance Station, Ranger Creek, Chenuis Falls, and near Ipsut Creek Campground. It also called for replacement of pit toilets with vault toilets and creation of a dormitory near the Ipsut Creek Patrol Cabin to replace flood-prone facilities at the entrance NPS 2006a:59). In the mid-1980s some work was completed, including resurfacing 1.4 miles of the road with pavement and the rest with crushed aggregate. Proposed expansion of parking occurred and picnicking expanded at Falls Creek. Housing at the entrance was modified by removing half of the trail crew bunkhouse to become a laundry and restroom facility and by adding two trailers there.

By 1986 another flood destroyed just over a ¼ mile of the road east of Chenuis Creek. Repairs to 0.3 miles occurred there in 1987. Again in 1990, flood damage in November occurred to the Chenuis area when 14 inches of rain fell in five days. This time, the Chenuis area was repaired with poured riprap and expanded to accommodate a picnic area (Catton 1996:569 in NPS 2006a:60).

In February 1996, a 100-year flood (10,600 – 14,100 cfs) occurred and destroyed more of the dike near Falls Creek, washing out the picnic area and 1,350 feet-long section of the roadway to a depth of six to ten feet. When this area was repaired in November 1998, two much smaller floods (5,000 and 6,000 cfs) five weeks later on December 29, 1998 washed out 1,200 feet of the newly repaired road to a depth of two to three feet, which was later repaired by the park (March 1999) as a one-lane road (NPS 2006a:61).

In 1997, when the Mount Rainier National Historic Landmark District (NHLD) was listed on the National Register of Historic Places, the Carbon River Road and other historic features were included. The NHLD included nearly all unaltered infrastructure built in the park between 1906 and 1957. Despite numerous flood repairs throughout the 20th century, the NHLD nomination found that overall, the Carbon River Road retained integrity to its original alignment and design (NPS 2006a:61).

Photo 4: Cabled Logs Near Falls Creek

Photo 5: Cobble Gabions Near Falls Creek

In 2002, the GMP affirmed the park's desire to preserve the NHLD and called for a variety of actions associated with the Carbon River area, including eventual closure of the road and construction of a hike and bike trail with administrative use within the NHLD corridor. These actions were to be consistent with the NHLD and to have no adverse effect on its designation (see detailed information about GMP under "Plans" below). During some interim period, shuttles would carry park visitors from a parking area outside the entrance to Ipsut Creek Campground / Wonderland Trailhead. It also called for removal of the non-historic entrance facilities and for establishment / expansion of picnicking in the former maintenance area.

The GMP proposed a boundary expansion adjacent to the Carbon River Entrance that would encompass private lands from willing sellers (Marsh and Thompson landowners and Plum Creek Timber Company) and public lands managed by the USFS. A total of 1,063 acres were proposed for the expansion. Of this acreage, some was added and some was withdrawn when Congress formally approved an 800-acre boundary expansion in 2004. It was determined that the USFS would continue to manage the lands between the private property and the park as park lands and that an exchange of these lands was unnecessary to accomplish the goals of the expansion. (This also allowed these lands to continue to be used for hunting.) The Marsh property was in turn transferred to Pierce County to hold for NPS purchase and the NPS purchased the Thompson property. Additionally, the Trust for Public Lands secured the purchase rights to a 440 acre property owned by Plum Creek within the boundary expansion area. In the GMP, in addition to protection of sensitive resources, proposed plans for these boundary expansion lands include establishment of a new campground and picnic area and the relocation of non-historic administrative facilities to it from the Carbon River Entrance. In addition, connection to the Foothills Trail (a hike and bike trail in a former railroad corridor) was planned (NPS 2006a:61 and NPS 2002).

In 2006, the draft CLI for the Carbon River Road's contribution to the NHLD and as a cultural landscape found that the road possessed integrity associated with the following characteristics: natural systems and features, spatial organization, land use, circulation, topography, vegetation, buildings and structures, views and vistas, and archaeological sites (NPS 2006a:62). These cultural landscape characteristics are significant because they retain historic integrity as expressed during the period of significance for the NHLD (1915-1941) (see also evaluation of integrity in *Historic Structures / Cultural Landscapes* in *Chapter III: Affected Environment*).

When Mount Rainier National Park completed its GMP (Record of Decision signed February 2002), it included a boundary adjustment in the Carbon River area to acquire 800 acres to replace the facilities lost when projected additional flooding occurred. These lands to be added to the park include private and Plum Creek Timber lands. The GMP called for constructing a campground on the boundary expansion lands and use of these as a hub for other attractions in the Carbon River Valley.

The NPS has now completed purchase of the Thompson property (including 188.5 acres for the main parcel and four smaller parcels comprising 25.78 acres). The NPS has also purchased the Plum Creek property (440 acres) from The Trust for Public Land, which had an option on the property. Appraisals are also pending on a 163.68 acre parcel owned by Pierce County Parks and Recreation and a 2.03 acre parcels owned by the Cascades Land Conservancy (formerly owned by Hooper).

The former Thompson home site is currently being rehabilitated to replace the Carbon River Ranger Station for visitor contact, staff offices, employee housing and maintenance facilities. The new Carbon River Ranger Station is proposed to be open by summer 2011.

Chapter II: Purpose and Need

A. Purpose and Need

In November 2006, extreme flooding damaged several portions of the Carbon River Road, altering the course of the Carbon River and Ipsut Creek, and removing sections of existing roadway. An early December windstorm increased damage to the area. Since that time, some water from the Carbon River has continued to flow around Ipsut Creek Campground in a new Ipsut Creek channel, adjacent to instead of under the Ipsut Creek Bridge near the campground. Additional damage occurred in November 2008, increasing damage to some areas and affecting new areas, including the Carbon River Maintenance Area and Milepost 4.8 (Table 1: *Carbon River Road Damage / Area Location Guide*).

Photo 6: Carbon River Road Full of Water

Deep gullies amounting to approximately 0.95 mile, or 19 percent of the road's length (5.0 miles) were formed in two different locations, at Falls Creek and beyond the Chenuis Falls Picnic Area. Another approximately 600 feet (0.11 mile) (in three different areas) was damaged by removal of part or all of one lane. In addition, other portions of the road, amounting to approximately another mile were scoured such that grading and culverts would be needed if the road was stabilized or fixed. Altogether 1.06 mile is severely damaged, with approximately an additional mile scoured. The Federal Highway Administration (FHWA) Damage Survey Report described specific locations where repair is warranted, noting that more of the forest buffer between the river and the road is gone and that, in some places, the river is as high as or higher than the road (FHWA 2007).

Although some emergency repairs were undertaken in spring 2007 to provide for administrative and visitor access, and in fall 2007 (as soon as it was possible to stabilize the Carbon River Road cultural resource while avoiding impacts to endangered species), the current condition of the road is similar to its condition after flooding in fall 2006.

The Carbon River Road, which in some areas is lower than the aggrading Carbon River bed, has been damaged by flooding many times over its history, and increasingly so over the last few decades (see *History of the Carbon River Road* in Chapter I: *Introduction*). The 2006 flood was the largest recorded at the downstream Fairfax stream gauge. As a result of long-term flooding effects, the park General Management Plan (GMP) Record of Decision (NPS 2002:3) states that the park would eventually "close the Carbon River Road to private vehicles when there is a major washout of the road and convert the Ipsut Creek Campground to a walk-in / bike-in camping area." The 2006 fall flooding is considered the major washout referred to in the GMP.

Table 1: Carbon River Road Damage / Area Location Guide

Mile	Feet	Area Name	Amount Missing	Notes / Date Damaged
0	0	Carbon River Road at Entrance	N/A	No damage
0.152	800	Carbon River Maintenance Area	50-75 feet	Loss of river bank. November 2008.
1.241	6,550	Old Mine Trailhead	N/A	Minor road damage November 2006.
1.457	7,695	Beginning of Falls Creek Washout	2,600 feet	Deep channel with both lanes missing November 2006. Similar to 1996.
1.959	10,341	End of Falls Creek Washout / Former Falls Creek Picnic Area	(see above)	(Same as above)
3.142	16,590	Ranger Creek Culvert Area Scour	240 feet	Partial lane missing. November 2006.
3.459	18,265	Two lane washout area	120 feet	November 2008
3.586	18,935	Chenuis Falls Picnic Area	N/A	Eroding bank November 2006 and 2008.
3.670	19,379	One lane washout area	599 feet	One Lane missing. November 2006 and 2008.
3.784	19,978	End of washout area	(see above)	(Same as above)
3.939	20,800	Edge of road washed out 6-foot cut-bank	unknown	
4.470	23,600	Beginning of Two-Lane Washout	200 feet	Two Lanes Missing. November 2006.
4.508	23,800	End of Two-Lane Washout	(see above)	(Same as above)
4.581	24,188	Road at same elevation as river	unknown	
4.624	24,416	Carbon Ipsut channel	1,350 feet	Deep channel with both lanes missing. November 2008.
4.823	25,466	Ipsut Creek Bridge (former channel)	100 feet	New Ipsut Creek Location (approximately same width as former Ipsut Creek Channel). November 2006.
5.05	26,670	Wonderland Trailhead	N/A	


Photo 7: Falls Creek Washout


Photo 8: Road Scouring Below Chenuis


Photo 9: Milepost 4.470 Washout


Photo 10: Milepost 3.142 Washout

Photo 11: Ipsut Scour No Parking Any Time


Photo 12: Ipsut Creek Bridge Logjam

This Environmental Assessment (EA) implements the Mount Rainier GMP. The GMP set the framework and the end result for the future of the Carbon River Road, but did not define specific criteria for the closure of the Carbon River Road. The Mount Rainier National Park GMP calls for the preservation of the Carbon River Road *corridor* so as to have *no adverse effect* on the Mount Rainier NHLD (NPS 2002: 255 see also pages 84 and 113). Although the GMP calls for closure of the Carbon River Road to private vehicles following a major washout, it also provides for continued use by administrative vehicles and conversion of the road to a hike and bike trail. The GMP also identified expansion of the park boundary in the Carbon River area to provide replacement facilities for those that would eventually be left inaccessible to private vehicles as a result of the conversion of the Carbon River Road to a hike and bike trail. (This proposed expansion is outside the scope of this Environmental Assessment because proposed expansion lands have not fully been acquired by the National Park Service – see *Alternatives Considered But Dismissed*).

Because of effects to the Carbon River Road from recent flooding, exacerbated by effects from changes in fall precipitation patterns, the remaining roadway may be unable to be maintained as a trail without the use of motorized vehicles. The effect of recent flood-induced changes to the roadway and actions needed to maintain the corridor as a hike and bike trail were not fully understood during the planning process for the GMP.

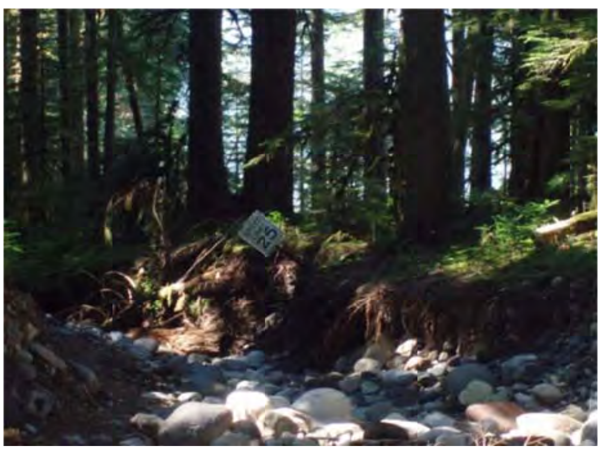


Photo 13: Ipsut Scour Speed Limit 25

Photo 14: Ipsut Creek Patrol Cabin Undermined

Environmental analysis is needed to determine how to implement the GMP closure of the Carbon River Road to private vehicles while continuing to provide public access to the area for the next 10-15 years until a more comprehensive plan for visitor facilities and services within the corridor is developed and implemented. In planning for the future of the area, the park's goal (developed by the planning team) is "to preserve year round public access to the northwest corner of the park and to the unique and popular natural, historical and recreational features of the Carbon River Valley." This EA will define the nature and extent of public and administrative access to the Carbon River area, including for hikers, bicyclists, vehicles, camping, parking and trails, and evaluate the ability to both protect endangered species and NHLD consistent with the Mount Rainier GMP.

B. Scope of the Environmental Assessment

This Environmental Assessment (EA) has been prepared to satisfy the requirements of the National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190, 42 U.S. C. 4321-4347, as amended), including the Council on Environmental Quality (CEQ) regulations found at 40 CFR 1500 -1508 and other applicable laws, *National Park Service Management Policies* (2006) and management directives. This EA facilitates compliance with Section 106 of the National Historic Preservation Act, Section 7 of the

Endangered Species Act, and the Wilderness Act, as well as other laws enacted for the protection of the environment.

NEPA requires the documentation and evaluation of potential impacts resulting from federal actions on lands under federal jurisdiction. Federal actions may include projects financed, assisted, conducted, regulated or approved by a federal agency. An EA discloses the potential environmental consequences of implementing the proposed action and other reasonable and feasible alternatives. NEPA is intended to provide decision-makers with sound knowledge of the environmental consequences of the alternatives available to them. In this case, the superintendent of Mount Rainier National Park and the NPS Pacific West Regional Director are faced with a decision regarding how to repair the lower portions of the Carbon River Road to restore public vehicle access and/or to change use the upper portions of the road as described herein.

This EA evaluates options for continued public pedestrian, bicycle and vehicle access to the Carbon River Area in Mount Rainier National Park based on the goals of the Mount Rainier National Park General Management Plan (NPS 2002). Existing conditions constitute the baseline for evaluating the effects of the proposed actions. The alternatives are compared in Table 17: *Alternative Comparison Chart*. The effects of the alternatives are compared in Table 34: *Impact Comparison Chart*. Existing conditions constitute the No Action Alternative (Alternative 1). The preferred and environmentally preferred alternative is Alternative 2.

An interdisciplinary team comprised of NPS natural and cultural resources professionals and other subject matter experts identified the likely beneficial and adverse effects of the proposed actions compared to existing conditions as documented herein.

C. Relationship to Laws, National Park Service Policies, and Park Planning Documents

1. Laws

National Park Service Organic Act (1916) (16 USC 1)
The key provision of the legislation establishing the National Park Service, referred to as the 1916 Organic Act is:

> The National Park Service shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified . . . by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (16 USC 1).

1970 National Park Service General Authorities Act (as amended in 1978 – Redwood amendment)
This act prohibits the NPS from allowing any activities that would cause derogation of the values and purposes for which the parks have been established (except as directly and specifically provided by Congress in the enabling legislation for the parks). Therefore, all units are to be managed as national parks, based on their enabling legislation and without regard for their individual titles. Parks also adhere to other applicable federal laws and regulations, such as the Endangered Species Act, the National Historic Preservation Act, the Wilderness Act, and the Wild and Scenic Rivers Act. To articulate its responsibilities under these laws and regulations, the National Park Service has established management policies for all units under its stewardship.

National Parks Omnibus Management Act (1998) (PL 105-392, 112 Statute 3497)
The National Park Service Omnibus Management Act addresses resources inventory and management in Title II. Section 201 defines the purposes of this title to enhance and encourage scientific study in National Park System (NPS) units. Section 202 authorizes and directs the Secretary of the Interior to ensure management is enhanced in NPS units by a broad program of high quality science and information. Section 205 states the Secretary may solicit, receive, and consider requests from Federal and non-Federal public or private entities for the use of NPS units for scientific study. Such proposals must be: 1) consistent with applicable laws and NPS Management Policies, and 2) the study would be conducted in a manner as to pose no threat to park resources or public enjoyment of those resources.

National Environmental Policy Act (1969) (NEPA) (42 USC 4341 *et seq*.)
NEPA requires the identification and documentation of the environmental consequences of federal actions. Regulations implementing NEPA are set for by the President's Council on Environmental Quality (40 CFR Parts 1500-1508). CEQ regulations establish the requirements and process for agencies to fulfill their obligations under the act.

Clean Water Act (CWA) (1972, 1977 as amended) (33 USC 1241 *et seq*.)
Under the Clean Water Act, it is a national policy to restore and maintain the chemical, physical, and biological integrity of the nation's waters, to enhance the quality of water resources, and to prevent, and control, and abate water pollution. Section 401 of the *Clean Water Act* as well as NPS policy requires analysis of impacts on water quality. *NPS Management Policies* (2006) provide direction for the preservation, use, and quality of water in national parks.

Endangered Species Act (1972) (16 USC 1531 *et seq*.)
The Endangered Species Act (ESA) requires federal agencies, in consultation with the Secretary of the Interior, to use their authorities in the furtherance of the purposes of the act and to carry out programs for the conservation of listed endangered and threatened species (16 USC 1535 Section 7(a)(1)). The ESA also directs federal agencies, in consultation with the Secretary of the Interior, to ensure that any action authorized, funded, or carried out by an agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat (16 USC 1535 Section 7(a)(2)). Consultation with the United States Fish and Wildlife Service (USFWS) is required if there is likely to be an effect.

Clean Air Act (1977 as amended) (42 USC 7401 *et seq*.)
The Clean Air Act states that park managers have an affirmative responsibility to protect park air quality related values (including visibility, plants, animals, soils, water quality, cultural resources and visitor health) from adverse air pollution impacts. Special visibility protection provisions of the Clean Air Act also apply to Class I areas, including new national rules to prevent and remedy regional haze affecting these areas. Under existing visibility protection regulations, the NPS has identified "integral vistas" that are important to the visitor's visual experience in NPS Class I areas, and it is NPS policy to protect these scenic views.

In 1980, the views from Tolmie Lookout and Camp Muir were inventoried and selected as integral vistas. Integral vistas warrant special protection under NPS implementation of the Clean Air Act. Other important vistas (but not selected as integral) are Klapatche Point, Ricksecker Point, Paradise Visitor Center, Pinnacle Peak, Upper Stevens Canyon, Mid-Stevens Canyon, Box Canyon Picnic Area, Box Canyon Overlook, Backbone Ridge, East side, Backbone Ridge, Chinook Pass, Tipsoo Lake, Sunrise Point, and Mount Fremont Lookout.

Wilderness Act (1964) (Public Law 88-577) (16 USC 1131-1136)
The Wilderness Act and legislation establishing individual units of the national park system as wilderness (for example, the Washington Parks Wilderness Act for Mount Rainier) establish consistent direction for the preservation, management, and use of wilderness and prohibit the construction of roads, buildings and other man-made improvements and the use of mechanized transportation in wilderness (with

exceptions). The public purpose of wilderness in national parks includes the preservation of wilderness character and wilderness resources in an unimpaired condition, as well as for the purposes of recreational, scenic, scientific, education, conservation, and historical use. Under one of the alternatives, portions of the project area are located in wilderness, including areas beyond the road on the south side of the Carbon River west of Chenuis and on both sides of the river (beyond the road) east of Chenuis.

Wild and Scenic Rivers Act (16 USC 1271-1287, Public Law 90-542)
The Wild and Scenic Rivers Act (WSRA) states: ". . . certain rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations."

> "In 1989 it was determined that . . . 8 miles of the Carbon River were eligible for inclusion in the national wild and scenic rivers system. The U.S. Forest Service has also found that downstream segments of these rivers are eligible. The Park Service would work with the Forest Service in preparing a suitability study to determine whether these rivers should be recommended for congressional designation and inclusion in the system" (NPS 2002:30).

As a result, identified "outstandingly remarkable values" (ORVs) must be preserved to ensure continued eligibility for the Wild and Scenic Rivers system (see E. *Impact Topics*).

Antiquities Act (1906) (16 USC 431- 433, 34 Statute 225)
This act was the first to provide protection for archeological resources. It protects all historic and prehistoric ruins or monuments on federal lands and prohibits their excavation, destruction, injury or appropriation without the departmental secretary's permission. It also authorizes the President to proclaim as national monuments public lands having historic landmarks, historic and prehistoric structures, and other objects of historic or of scientific interest. It also authorizes the President to reserve federal lands, to accept private lands, and to accept relinquishment of unperfected claims. This act was superseded by the Archaeological Resources Protection Act for the prosecution of antiquities violations in national park system areas.

National Historic Preservation Act (1966 as amended) (16 USC 470)
Section 106 of the National Historic Preservation Act (NHPA) directs federal agencies to take into account the effect of any undertaking [a federally funded or assisted project] on historic properties. "Historic property" is any district, building, structure, site, or object that is eligible for listing in the National Register of Historic Places because the property is significant at the national, state, or local level in American history, architecture, archeology, engineering, or culture. This section also provides the Advisory Council on Historic Preservation and the State Historic Preservation Officer (SHPO) an opportunity to comment on the undertaking. The 1992 amendments to the act have further defined the roles of American Indian Tribes and the affected public in the Section 106 process. Section 10 of the Act requires the ongoing documentation of historic resources by federal agencies.

Archaeological Resources Protection Act (ARPA) (1979) (16 USC 470aa - 470mm, Public Law 96-95)
This act secures the protection of archeological resources on public or Indian lands and fosters increased cooperation and exchange of information between the private / governmental / professional community to facilitate the enjoyment and education of present and future generations. The act regulates excavation and collection on public and Indian lands. It defines archeological resources to be any material remains of past human life or activities that are of archeological interest and are at least 100 years old. It requires notification of Indian tribes who may consider a site of religious or cultural importance prior to issuing permits for excavation or collection of historic objects. It was amended in 1988 to require the development of plans for surveying public lands for archeological resources and systems for reporting incidents of suspected violations.

Native American Graves Protection and Repatriation Act (NAGPRA) (1990)
Section 3 has provisions regarding the custody of cultural items found on federal or tribal lands after November 16, 1990, while section 8 provides for repatriation of items found before that date. Section 3 also identifies procedures regarding the inadvertent discovery of Native American remains, funerary objects and objects of cultural patrimony during federal actions. NAGPRA regulations are found at 43 CFR Part 10.

Americans with Disabilities Act (ADA) (1990) / Architectural Barriers Act (ABA)
This act states that all new construction and programs will be accessible. Planning and design guidance for accessibility is provided in the Architectural and Transportation Barriers Compliance Board (36 CFR Part 1191). NPS Special Directive 83-3 states that accessibility will be proportional to the degree of development, with areas of intense development (visitor centers, drive-in campgrounds, etc.) more accessible than areas of less development (backcountry trails and walk-in campgrounds, etc.) which may have fewer accessibility features.

2. Executive Orders

Floodplain Management Executive Order 11988 (May 2, 1977, 42 CFR 26951, PL 93-234 Section I)
The Floodplain Management Executive Order (EO) was issued "to avoid to the extent possible the short- and long-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development whenever there is a practicable alternative." NPS implementing guidance for this EO is found in Director's Order 77-2: Floodplain Management.

EO 11988 requires federal agencies to provide leadership and take action to:
1) reduce the risk of flood loss;
2) minimize the impact of floods on human safety, health and welfare; and
3) restore and preserve the natural and beneficial values provided by floodplains.

Agencies implement these actions in:
1) acquiring, managing and disposing of federal lands and facilities;
2) providing federally undertaken, financed, or assisted construction and improvements; and
3) conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating and licensing activities.

In doing so, "each agency has a responsibility to evaluate the potential effects of any actions it may take in a floodplain; to ensure that its planning programs and budget requests reflect consideration of flood hazards and floodplain management; and to prescribe procedures to implement the policies and requirements of this Order."

Protection of Wetlands Executive Order 11990 (42 FR 26961)
Under this EO, the federal agencies are ". . .to avoid to the extent possible the short- and long-term adverse impacts associated with the destruction or modifications of wetlands and to avoid direct or indirect support of new construction in wetlands whenever there is a practicable alternative." NPS implementing guidance for this EO is found in Director's Order 77-1: Wetland Protection (October 22, 1998). Under NPS 77-1, the NPS adopted a "no net loss of wetlands" goal and the Cowardin *et al.* (1979) wetland classification system as the NPS standard for defining, classifying, and inventorying wetlands.

Under the EO, federal agencies are to:
1) provide leadership and take action to minimize the destruction, loss, or degradation of wetlands,
2) preserve and enhance the natural and beneficial values of wetlands, and
3) avoid direct or indirect support of new construction in wetlands unless there are no practicable alternatives to such construction and the proposed action includes all practicable alternatives to minimize harm to wetlands in carrying out agency responsibilities .

For proposed new development or other activities, plans or programs either located in or which otherwise have the potential to affect wetlands, the NPS will:

- avoid adverse wetland impacts to the extent practicable;
- minimize impacts that cannot be avoided; and
- compensate for remaining unavoidable adverse wetland impacts by restoring wetlands that have been previously destroyed or degraded.

3. Policies

National Park Service Management Policies (2006)

Management Policies governs the way park managers make decisions on a wide range of issues that come before them. The following sections contained within *Management Policies* pertain specifically to the subject of this Environmental Assessment.

Section 4.3.4 National Wild and Scenic Rivers System

> . . . No management actions may be taken that could adversely affect the values that qualify a river for inclusion in the National Wild and Scenic Rivers System.

Section 4.6.4 Floodplains

> In managing floodplains on park lands, the National Park Service will (1) manage for the preservation of floodplain values; (2) minimize potentially hazardous conditions associated with flooding ; and (3) comply with the NPS Organic Act and all other federal laws related to the management of activities in flood-prone areas. . . Specifically, the Service will
>
> - protect, preserve, and restore the natural resources and functions of floodplains;
> - avoid the long- and short-term environmental effects associated with the occupancy and modification of floodplains; and
> - avoid direct and indirect support of floodplain development and actions that could adversely affect the natural resources and functions of floodplains or increase flood risks.
>
> When it is not practicable to locate or relocate development or inappropriate human activities in a site outside and not affecting the floodplain, the Service will
>
> - prepare and approve a statement of findings. . .;
> - use nonstructural measures as much as practicable to reduce hazards to human life and property while minimizing the impact to the natural resources of floodplains; and
> - ensure that structures and facilities are designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR Part 60).

Section 4.8.1.3 Geologic hazards

> Naturally occurring geologic processes, which the Park Service is charged to preserve unimpaired, can be hazardous to humans and park infrastructure. These include earthquakes, volcanic eruptions, mudflows, landslides, floods, shoreline processes, tsunamis, and avalanches.
>
> The Service will work closely with specialists at the U. S. Geological Survey and elsewhere, and with local, state, tribal, and federal disaster management officials, to devise effective geologic hazard identification and management strategies. Although the magnitude and timing of future geologic hazards are difficult to forecast, park managers will strive to understand future hazards and, once the hazards are understood, minimize their potential impact on visitors, staff, and developed areas. Before interfering with natural processes that are potentially hazardous, superintendents will consider other alternatives.

Section 9.2.1.1 Park Roads

> Park roads will be well constructed, sensitive to natural and cultural resources, reflect the highest principles of park design and enhance the visitor experience . . . For most parks, a road system is already in place. When plans for meeting the transportation needs of these parks are updated, a determination must be made as to whether the road system should be maintained as is, reduced, expanded, reoriented, eliminated or supplemented by other means of travel. . .
>
> Park road designs are subject to NPS Park Road Standards, which are adaptable to each park's unique character and resource limitations. Although some existing roads do not meet current engineering standards, they may be important cultural resources whose values can and should be preserved with attention to visitor safety.

Section 9.1.1.5 Siting Facilities to Avoid Natural Hazards

> The Service will strive to site facilities where they will not be damaged or destroyed by natural physical processes. . . Park development that is damaged or destroyed by a hazardous or catastrophic natural event will be thoroughly evaluated for relocation or replacement by new construction in a different location. . . In areas where dynamic natural processes cannot be avoided, such as seashores, developed facilities should be sustainably designed . . . When it has been determined that facilities must be located in such areas, their design and siting will be based on:
>
> - A thorough understanding of the nature of the physical processes; and
> - Avoiding or mitigating (1) the risks to human life and property, and (2) the effect of the facility on natural physical processes and the ecosystem.

(See also Chapter IV: *Affected Environment: Floodplains* for information associated with maintaining Mount Rainier National Park facilities in high hazard zones).

Section 9.2.2.4 Bicycle Trails

> Bicycle routes may be considered as an alternative to motor vehicle access. Bicycle travel may be integrated with park roads when determined to be safe and feasible. Bicycle trails may be paved or stabilized for resource protection and for the safety and convenience of travelers. In accordance with 36 CFR 4.30, bicycle use is allowed on park roads, in parking areas and on routes designated for bicycle use. The designation of bicycle routes is allowed in developed areas and in special use zones based on a written determination that such use is (1) consistent with the protection of a park's natural, cultural, scenic and esthetic values; (2) consistent with safety considerations; (3) consistent with management objectives; and (4) will not disturb wildlife or other park resources. A similar determination may be made to designate routes outside developed areas and special use zones; however, the designation must be made by promulgating a special regulation.

Natural Resources Management Guideline (NPS-77)

This comprehensive guideline directs the actions of park managers in natural resources protection so that natural resources activities planned and initiated within the national park system comply with federal law, regulations, and the Department of the Interior and NPS policies.

Cultural Resources Management Guideline (NPS-28)

This guideline identifies the authorities for cultural resources management as derived from federal laws, the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation that guide the implementation of cultural resources management in the national park system.

4. Mount Rainier National Park Plans

Mount Rainier National Park General Management Plan (NPS 2002)

The General Management Plan (GMP) established a vision for managing park resources over the next twenty years. As part of this vision, the GMP established a series of zones designating desired future conditions for park resources. The Carbon River Road is zoned *Roaded Multiuse* in summer and winter

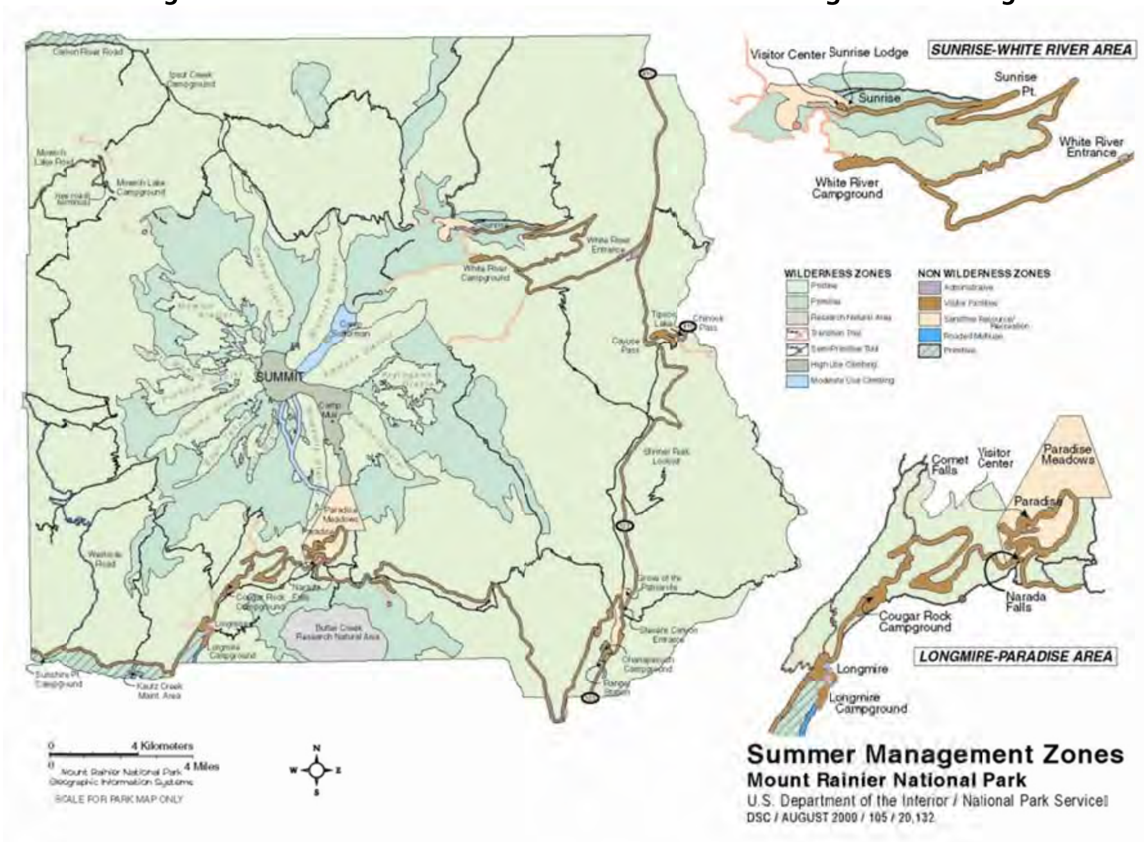
(Table 2: *Applicable Mount Rainier National Park General Management Plan Zones* and Figure 5: *Carbon River Area Management Zoning*). It is bordered on the south side by wilderness (100 feet from the centerline of the unpaved road) and on the north side by the nonwilderness *Primitive Zone* (NPS 2002: 332-333) up to near Chenuis and then by wilderness on both sides of the road, 100 feet from the centerline of the unpaved road. Areas away from the *Primitive* zone on the south side of the road (that would be affected under Alternative 5) are within the *Pristine* zone.

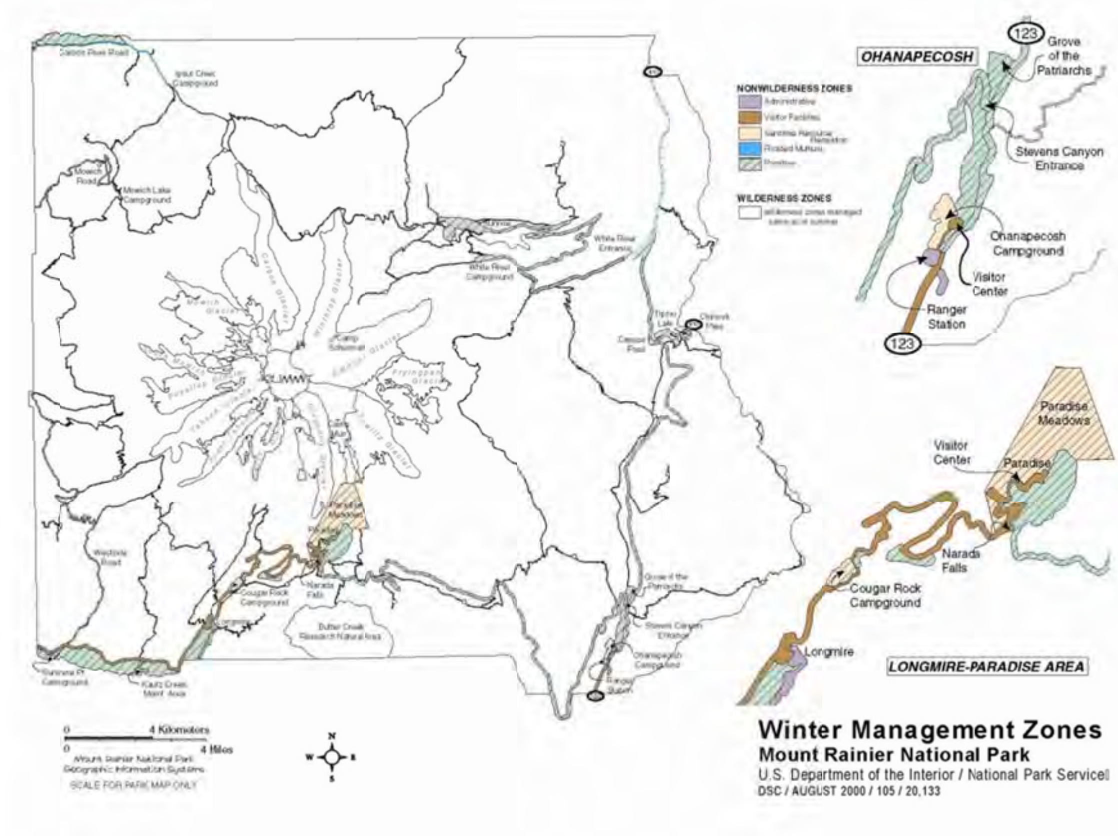
Table 2: Applicable Mount Rainier National Park General Management Plan Zones

Management Zone	Resource Condition	Visitor Experience	Facilities and Activities
WILDERNESS ZONES			
Pristine	Essentially untouched environment	The feeling of being alone	Very minimal signs of human use, no trails or designated campsites.
Primitive	Largely natural, unmodified landscape	Opportunities to experience solitude and quiet. The feeling of being apart, but not alone	Minimal signs of human use, except for a few primitive routes and designated campsites in alpine areas.
NON-WILDERNESS ZONES			
Primitive	Maintained in a natural state, similar to wilderness primitive zone, except trails may be provided.	Similar to the wilderness primitive zone.	Similar to the wilderness primitive zone, however overnight camping would not be permitted.
Roaded multiuse	Natural landscape modified by developed facilities.	High degree of social interaction; motorized vehicles limited to public shuttles, visitors with disabilities and park administration.	Gravel roads, trails, walk-in campgrounds and picnic areas, small buildings. Activities would include hiking and bicycling.
Sensitive Resource / Recreation	Natural landscape, with no human use visible outside designated trails and use areas.	Experience of park resources generally unimpeded by other visitors and relatively close to developed facilities. A high degree of social interaction.	Facilities and structures in localized areas. Hiking would be the primary activity.
Visitor Facilities	High modification to natural processes and the natural landscape.	Highly structured opportunities to enjoy and learn about park; access by foot, bicycle and motor vehicle; high degree of social interaction.	A wide array of visitor services and facilities, including roads, entrance stations, visitor centers, lodges, and campgrounds; activities would include bicycling, hiking, snow play, scenic driving, skiing, and camping.

(Source: NPS 2002: 59)

Figure 5: Carbon River Area Summer and Winter Management Zoning





The Record of Decision (ROD) for the GMP states:

> "Close the Carbon River road to private vehicles when there is a major washout of the road and convert the Ipsut Creek campground to a walk-in/bike-in camping area (NPS 2002:3)."

The proposed shuttles in the park also figure prominently associated with the Carbon River Road. As noted in the ROD for the GMP (NPS 2002:2):

> "Phase in shuttle services in coordination with elimination of overflow parking to reduce traffic congestion and ensure effective visitor transportation within the park; provide shuttle services to various locations in the park, such as . . .., and Carbon River."

The Final GMP, which is the basis for the information in the ROD contains the following statements related to the management of the Carbon River Road (emphasis added):

<u>Preferred Alternative Map</u>

- "Carbon River Road eventually would be converted to a multi-use, nonmotorized *trail*" (emphasis added) (NPS 2002:61).

<u>Alternative 2: Preferred Alternative</u>

- "In summer, the shuttles would operate from the following locations: . . .Carbon River Road. . ." (NPS 2002:74). "Alternative 2: Carbon River Road: Shuttles provided in summer until a *major washout* (emphasis added) of the road occurs" (NPS 2002:75).
- "The Carbon River road would be *kept open for personal vehicles as long as possible* (emphasis added)" (NPS 2002:84).
- "Private vehicles and shuttles would be permitted on the road until a major washout occurred. At that time, the *road* would be dedicated to nonmotorized uses (hiking and biking)" (NPS 2002: 84).
- "*Administrative vehicles* needed for preservation, maintenance and emergencies *would continue to be permitted* on the *road* (emphasis added)" (NPS 2002:84)
- "The *existing historic road corridor would be maintained* in a manner *consistent with the NHLD* (emphasis added) designation" (NPS 2002:84).
- "No pack stock would be allowed on the road" (NPS 2002:84).
- "Camping would continue as it is now until there was a *major washout* of the road, at which time the road would be closed to *visitor* (emphasis added) motorized vehicles."
- "The Ipsut Creek Campground would then be converted to a *walk-in/bike-in camping* area (emphasis added) consistent with the NHLD designation" (NPS 2002:84).

<u>Major Changes Made in the Final Plan</u>

- ". . .The Carbon River road would be *kept open for personal vehicles as long as possible* (emphasis added). A shuttle also would be made available. Although there would be no restrictions on personal vehicles, high-clearance vehicles would be recommended (NPS 2002:316)."
- ". . . The Carbon River boundary adjustment has been modified to better protect the river corridor and better define the boundary" (NPS 2002:317).

<u>Table 7: Summary of the Alternatives (Continued)</u>

- "Carbon River Area – Summer. . .Repair and maintain the road in a manner consistent with the National Historic Landmark District designation" (NPS 2002:113)"
- "Carbon River Area – Winter. . . When there is a major washout of the road, re-examine use" (NPS 2002:115).

<u>Comments and Responses</u>

- ". . .Carbon River. . . Response: *The National Park Service is committed to keeping the road open to the public as long as possible. The preferred alternative has been revised* to include establishing a shuttle on this road and *allowing private vehicles as long as possible* (emphasis added). At some time the Park Service may recommend that the public traveling on the road use high-clearance vehicles. An evaluation of the Carbon River Road determined that it was not feasible to maintain the road in (sic) cost-effective manner because of the frequency and intensity of flooding. . ." (NPS 2002:324) (See also *Alternatives Considered but Dismissed* for information regarding a north side reroute for the road.)

- ". . .Carbon River. . .Comment: The preferred alternative should consider a shuttle on the Carbon River Road, which would continue to allow visitors access to the Carbon River glacier (sic) (Source: G52, G75). Response: The preferred alternative has been revised to include shuttle service on the Carbon River Road" (NPS 2002:324).

Mount Rainier National Park Wilderness Management Plan (NPS 1989)
The park Wilderness Management Plan (WMP) established a system of cross-country and alpine areas across the Mount Rainier National Park landscape. At the same time, it established designated trailside camps and overnight limits on either the number of parties or number of people per camp or per zone. The limits of acceptable change established by this plan are still in effect, although over time, some have been modified slightly. This plan is expected to be revised within the next few years.

Carbon River Road Reconstruction Environmental Assessment (FONSI August 1998)
Under the proposed action in this Environmental Assessment, the National Park Service (NPS) repaired flood-related damage to the Carbon River Road in fall 1998. Restoration of the road was intended to provide vehicular access to Ipsut Creek Campground and to trailhead parking for backcountry hiking trails. Prior to the February 1996 flood, visitors had used the Carbon River Road to drive 4.9 miles from the park's entrance near the Carbon River Ranger Station to Ipsut Creek Campground. Here they could camp overnight in the campground or use the trailhead parking as a starting point to day hike to Mystic Lake and the Carbon Glacier or to take more extended hikes the along the Northern Loop and Wonderland trails. From February 1996 to November 1998, the Carbon River Road was closed at the Carbon River Ranger Station. Vehicles had to park near the ranger station and visitors hiked or biked along the road to reach the campground and the hiking trails beyond. Upon completion of the road repair in November 1998, vehicle traffic began again on the Carbon River Road. Flooding in December 1998 and January 1999 again closed the road. Subsequent minimal action repairs reopened the road in March 1999 to high clearance vehicles.

Carbon River Area (Ipsut Creek Campground and Carbon River Entrance) Rehabilitation Environmental Assessment (FONSI June 1999)
Under this Environmental Assessment, the Ipsut Creek Campground water system was replaced with three small hand pump wells equipped with disinfection systems. These were designed to blend with the National Historic Landmark District. The existing water system was removed and the iron pipe distribution system abandoned in place. Restrooms at the Campground were proposed for replacement and Carbon River Entrance restrooms were replaced. Minor improvements to the Campground, including repair of the amphitheater were also proposed.

Carbon River Wonderland Trail Environmental Assessment (FONSI 2008)
Under this EA, a reroute to the Carbon River portion of the Wonderland Trail washed out by flooding in November 2006 was approved.

D. Planning Process
Public involvement is a key component of the NEPA process. In this part of the process, the general public, federal, state, local agencies and organizations are provided an opportunity to identify concerns and issues regarding the potential effects of proposed federal actions.

For the Carbon River area planning process, internal scoping was used to engage professional staff of Mount Rainier National Park and other NPS offices (Pacific West Region) and other agencies such as the Federal Highway Administration (FHWA) and the U.S. Fish and Wildlife Service (USFWS) to provide information regarding proposed management actions, including the preliminary conceptual alternatives that may affect park resources.

Internal scoping began formally in November 2006 following major flood damage that occurred along the Carbon River Road and throughout Mount Rainier National Park. During flood briefing / planning meetings, a variety of concerns were identified from park staff in vegetation, wildlife, maintenance, water resources and planning disciplines through participation in flood damage internal scoping meetings.

Initial public comments were brought forth at a series of public meetings held in the vicinity of the park to discuss the temporary closure of the park, flood impacts and recovery following the November 2006 floods. These meetings included Enumclaw (November 16, 2006), Eatonville (November 16, 2006), and Packwood (November 20, 2006).

By April 2007 an interim planning team was identified for the Carbon River area. Comments continued to be solicited formally and informally from park and federal highways planning team members and from other agency staff. Internal scoping continued throughout the development of the EA.

Public Participation

Following internal scoping, the NPS sought public comments and other relevant information about the Carbon River area (public scoping). This was identified as a key step in the overall conservation planning and environmental impact analysis process necessary for achieving an interim management direction for the Carbon River area and to guide preparation of the EA.

Public scoping was formally conducted to publicize the preliminary conceptual alternatives through the following means: 1) a press release describing the intent to reinitiate the public involvement process through comments on the proposed preliminary conceptual alternatives was issued on June 23, 2008; and 2) it was announced via the park's planning website (http://parkplanning.nps.gov/mora) on the same day.

The public outreach called for by Section 106 of the National Historic Preservation Act NHPA was integrated into the NEPA process in accordance with the NPS Programmatic Agreement and NPS Management Policies (2006). Tribal consultation has included meetings with the Puyallup Tribe of Indians (July 21, 2008) and the Muckleshoot Indian Tribe (August 4, 2008).

Among the objectives of initial public scoping were to:

- Invite participation from federal, tribal, state, local governments and other interested parties;
- Inform all interested parties about the scope of the problem and the need to find solutions;
- Identify a preliminary range of management alternatives (in addition to a no-action alternative that will be used as a baseline of existing conditions from which to evaluate proposed changes in management);
- Identify substantive environmental (including natural, cultural, recreational and socioeconomic) issues which warrant detailed environmental impact analysis, and eliminate issues or topics which do not require analysis;
- Identify potential environmental consequences and suitable mitigation strategies.

The formal public scoping period for the *Carbon River Area Public Access Plan* began on June 23, 2008 and ended on July 30, 2008. During this time, Mount Rainier National Park held two open house public meetings in Enumclaw (June 30, 2008), and Tacoma (July 1, 2008). All parties wishing to express concerns or provide information about management issues to be addressed in the forthcoming conservation planning and environmental impact analysis process and/or to comment on the preliminary management alternatives were strongly encouraged to submit written comments.

Professional staff was available during the meetings to introduce the preliminary conceptual alternatives, give presentations, answer questions, and to accept comments. The public was encouraged to provide comments during the meetings and/or to submit written comments. The meetings were attended by approximately 47 people. There were 43 comments made at the Enumclaw Public Meeting by 17 people who signed in or were counted and 82 comments made at the Tacoma Public Meeting by 30 people who signed in or were counted. Approximately 125 comments were recorded on flip charts at the meetings.

Altogether 121 people participated in the public scoping comment process for the Carbon River Road, including public meeting participants and those who submitted written comments (not including duplicate comments or those who attended both a public meeting and submitted written comments). Of the 47 people who attended public meetings in Enumclaw or Tacoma, only seven submitted separate written comments.

In addition to public meeting participation, there were 80 public comment letters received: 76 from individuals, 3 (1 duplicate) from non-profit organizations (National Parks Conservation Association, Washington Trails Association), and one from a business (Tacoma News Tribune). Comment letters were received via the NPS Planning, Environment and Public Comment (PEPC) website (23 letters), U.S. mail (11), and/or email (38) and optional public comment forms (4). One was also recorded as a telephone message. Several were received both via email and U.S. mail and/or received via U.S. mail and fax. Four visitor comments about the area received after public scoping had formally closed have also been included. Altogether, these public comment letters included approximately 450 individual comments.

Comments were submitted directly to the park at the following address: Mount Rainier National Park 55210 238th Avenue East, Ashford, Washington 98304. Comments were also submitted via the park's portion of the PEPC website at *http://parkplanning.nps.gov/mora* or sent via e-mail to the superintendent (*mora_superintendent@nps.gov* or mora_carbon_river_comments@nps.gov). Information about the planning process was periodically updated and posted on the park's website: *http://www.nps.gov/mora/parkmgmt/planning* and on PEPC.

Summary of Public Concerns

The public comments from both the meetings and the letters (575) were sorted into 43 different categories, including a variety of subcategories. These ultimately resulted (from additional sorting and combining) in the 160 concern statements plus those *considered but dismissed* (19), or *outside the scope* of the proposed plan (8). Based on the public comments, the planning team developed approximately 63 questions to determine whether and/or how to modify the preliminary alternatives. The comments have become part of the public record.

Public comments during previous environmental analysis processes that considered the fate of the Carbon River Road were diverse and ranged from a strong desire to see the Carbon River Road fully open with access along its entire length to recommendations advocating permanent closure of the road to motorized vehicles, with about fifty percent of individuals and groups commenting preferring one or the other (NPS 2002).

Based on the written comments, public comments about the potential closure of the road during this process were more uneven (nearly 2:1 against closure), with approximately 45 individuals requesting that the park reconsider closure, 23 agreeing with closure, seven desiring access as far as possible (most referring to Chenuis as part of Preliminary Conceptual Alternative 3a). Five written public comments did not address whether or not the road should be closed.

1. Issues Addressed in this Document

All of the above issues and concerns were considered in the planning process or are addressed in this document except for those identified under the next heading. Although there were many comments that agreed or disagreed with the preliminary proposals, these are not recounted here. Rather, substantive comments that requested changes or identified impacts or pointed out key information are categorized below.

- Differential Treatment of Park Entrances (6 comments)
- Process (38 comments)
- Range of Alternatives (33 comments)
- Funding (11 comments)
- Boundary Expansion (12 comments)
- Facilities (27 comments)
- Partnerships (3 comments)
- Parking (15 comments)
- Suggested Alternative Components (32 comments)
- New Alternatives (not among the preliminary mix) (82 comments) (*see also Shuttle Access*)
- Affected Environment – Water Resources (3 comments)
- Affected Environment – National Historic Landmark District (3 comments)
- Affected Environment – Park Operations (7 comments) (see *Impacts – Park Operations* below)
- Affected Environment – Visitor Experience (19 comments)
- Impacts – NHLD (2 comments)
- Impacts – Park Operations (29 comments)
- Impacts – Socioeconomics (8 comments)
- Impacts –Threatened and Endangered Species (7 comments)
- Impacts – Vegetation (2 comments)
- Impacts – Visitor Experience (135 comments)
    - *Change in Type / Number of Visitors*
    - *Change in Type / Number of Vehicles*
    - *Reduced Environmental Impacts*
    - *Lengthier Trips*
    - *Wonderland Trail Circumnavigation Hikes*
    - *Change in Visitor Experience*
    - *Cumulative Effects*
- Impacts – Water Resources (7 comments)
- Impacts – Wilderness (25 comments)
- Alternatives
    - *Preliminary Conceptual Alternative1 (24 comments)*
    - *Preliminary Conceptual Alternative 2 (40 comments)*
    - *Preliminary Conceptual Alternative 3 (53 comments)*
    - *Modified Alternative Components (11 comments)*
- Bicycle Access (22 comments)
- Camping: Backcountry (8 comments)
- Camping: Frontcountry (20 comments)
- Sustainability (13 comments)
- Shuttle Access (9 comments)
- Global Climate Change (1 comment)
- Acknowledgement of Constraints (Engineering, Geology, Flooding, Politics, Threatened and Endangered Species, Wilderness) (31 comments)

2. Issues (and Actions) Not Addressed in this Document

Issues Outside the Scope

The following issues generated through public scoping are not within the scope of this project and are therefore not analyzed in detail in the document.

- The West Side Road and the Carbon River Road are the first glacial rivers to wash out roads. Will the NPS also close Highway 410 and the White River Road?

There were several comments about the proximity of other roads within Mount Rainier National Park to the floodplain and/or about flood damage to them. While 2006 flooding did affect these roads, separate planning processes were undergone or are currently taking place for them.

- Improve and pave the Mowich Lake Road.

Although improvements to the Mowich Lake area have been proposed, paving the road is not currently proposed. In addition, actions at Mowich Lake are outside the scope of the proposed plan, which includes only the Carbon River area. A separate planning process for improvements to the Mowich Lake area began approximately nine years ago but has since been delayed.

- Group camping / expedition hiking experiences should be available.

Although these activities would not be precluded by the proposed alternatives, providing these services is outside the scope of the proposed plan. Commercial services are part of the Commercial Services Plan (NPS 2004) and those provided by organizations are either part of that plan or allowed via a special use permit or existing group camping regulations.

- Maintain a trailhead at the top of the road (#7810) and also a second trailhead with adequate turn around for horse trailers where the Carbon River Road will end.

Road 7810 is not part of Mount Rainier National Park, but rather is part of the Mount Baker -Snoqualmie National Forest. Access for horses was eliminated from the Carbon River Road as part of the Mount Rainier National Park General Management Plan (NPS 2002).

- Consider building a trail to the snout of the Nisqually Glacier. It would be much shorter than the Carbon.

Although numerous comments requested potential alternative ways that visitors could experience the toe of a glacier if day hiking access to the Carbon Glacier is precluded, actions in areas outside the Carbon River are considered outside the scope of the current planning process.

- Seek public funding to restore access to Ipsut Creek Campground.

Although individuals or a park authorized non-profit friends group could seek funding for reconstructing the road or implementing portions of the eventual selected alternative, park staff cannot seek funding unless it is through an official friends group, such as the Washington National Parks Fund on the park's behalf.

Issues Considered But Dismissed

The following additional comments received during public scoping were initially considered by the planning team, but were eventually rejected for various reasons. Several of them would be part of future planning documents (including implementation of the proposed boundary expansion). See the *Alternatives (and Actions) Considered But Dismissed* section in *Chapter III* for reasoning.

- Consider a road on the north side of the Carbon River.
- Reroute the Carbon River Road away from the river / Reroute flood-prone sections of the Carbon River Road.

- Modify the Wilderness Boundary / Add new designated wilderness elsewhere to reconstruct the Carbon River Road and/or to allow for long-term bicycle access.
- Road Reconstruction Options. Individual comments included: a) reconstruct the road by placing a berm between the river channel and the road; b) incrementally raise sections of road over time; c) construct an Arizona crossing in the Falls Creek area to allow water to flow over the road; and d) locate bridges across the washouts.
- Reestablish frontcountry camping. Individual comments included: a) establish car camping at the new road terminus (either at the entrance or near Chenuis Falls); b) add a campground at the Carbon River Entrance – the proposed boundary expansion camping area at the Thompson property is too far; c) identify what facilities will be available in the boundary expansion camping area; d) consider a campground at Hucklechuck / Thompson property; e) work with the USFS to establish a campground across the Copley Lake Bridge (near the Carbon River Entrance); and f)there will be few places to go from the proposed boundary expansion area campground.
- Preserve a section of historic road and acknowledge its significance on the ground and in an interpretive display in the new boundary expansion visitor center.
- Allow the public to use electric bikes, motor bikes, scooters, and all terrain vehicles (ATVs) on the Carbon River Road.
- Provide vehicles on the other side of the washouts to facilitate access.
- Allow parking along the first mile of the road (up to the Old Mine Trailhead).

E. Impact Topics

Specific impact topics were developed to address potential natural, cultural, recreational, social and park operations impacts that might result from the proposed Alternatives as identified by the public, NPS, and other agencies, and to address federal laws, regulations and executive orders, and NPS policy. A brief rationale for the selection or non-selection of each impact topic is given in this section.

1. Impact Topics Analyzed

Analysis of impacts related to the following topics is presented in this Environmental Assessment.

PHYSICAL RESOURCES

Air Quality: Mount Rainier National Park is in a mandatory class I area under the Clean Air Act (1977). Class I areas are afforded the highest degree of protection under the Clean Air Act. This designation allows very little additional deterioration of air quality. The Clean Air Act states that park managers have an affirmative responsibility to protect park air quality related values (including visibility, plants, animals, soils, water quality, cultural resources and visitor health) from adverse air pollution impacts. Special visibility protection provisions of the Clean Air Act also apply to class I areas, including new national rules to prevent and remedy regional haze affecting these areas. Because the alternatives have the potential to affect air quality, this impact topic has been retained.

Geology / Geological Hazards: *Management Policies* (NPS 2006) call for analysis of geological hazards should they be relevant. The geologic and hydrologic characteristics of the Carbon River area have contributed to Carbon River Road damage throughout the road's existence. Concerns regarding the potential for future road damage have been expressed. Ongoing hazards comprise one of the reasons for this analysis.

Soils: *Management Policies* (NPS 2006) require the NPS to understand and preserve and to prevent, to the extent possible the unnatural erosion, physical removal, or contamination of the soil. Because the alternatives have the potential to affect soils, this impact topic has been retained.

Water Resources: The 1972 Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977, is a national policy to restore and maintain the chemical, physical, and biological integrity of the nation's waters, to enhance the quality of water resources, and to prevent, and control, and abate water pollution. *NPS Management Policies* (2006) provide direction for the preservation, use, and quality of water in national parks.

The Clean Water Act is a national policy aimed at restoring, maintaining, and enhancing the chemical, physical, and biological integrity of the nation's waters and to prevent, control, and abate water pollution.

> **Water Quality**: Section 401 of the *Clean Water Act* as well as NPS policy requires analysis of impacts on water quality. Because the alternatives have the potential to affect water quality, this impact topic has been retained.
> **Wetlands**: Executive Order 11990 requires that impacts to wetlands be addressed. Palustrine emergent wetlands occur on both sides of the Carbon River Road. Therefore this topic has been retained.

Floodplains: Executive Order 11988 (Floodplain Management) requires an examination of impacts to floodplains and potential risk involved in placing facilities within floodplains. NPS Management Policies, DO-2 (Planning Guidelines), and DO-12 (Conservation Planning, Environmental Impact Analysis, and Decision Making) provide guidelines for proposals in floodplains. Executive Order 11988 requires that impacts to floodplains be addressed. Road reconstruction within a pre-existing road alignment is considered an excepted action in the Floodplain Management Guideline (NPS 1993). Other actions, however, may not be considered excepted actions. Therefore this topic has been retained.

BIOLOGICAL RESOURCES

Vegetation: The *National Environmental Policy Act* (NEPA) calls for examination of the impacts on the components of affected ecosystems. *NPS Management Policies* (2006) call for protecting the natural abundance and diversity of park native species and communities, including avoiding, minimizing or mitigating potential impacts from proposed projects. The Carbon River Road crosses one of the few examples in the lower 48 states of an inland, temperate rain forest. Vegetation would be affected by the proposed work.

Wildlife: The *National Environmental Policy Act* (NEPA) calls for examination of the impacts on the components of affected ecosystems. NPS policy is to protect the natural abundance and diversity of park native species and communities, including avoiding, minimizing or mitigating potential impacts from proposed projects. Repairing the Carbon River Road would affect wildlife. Therefore this topic has been retained.

Special Status Species: The *Endangered Species Act* (ESA) requires an examination of impacts to all federally listed threatened or endangered species. *NPS Management Policies* (2006) call for an analysis of impacts to state-listed threatened or endangered species and federal candidate species and species of special concern. Under the ESA, the NPS is mandated to promote the conservation of all federal threatened and endangered species and their critical habitats within the park boundary. Management Policies include the additional stipulation to conserve and manage species proposed for listing. Actions proposed in the alternatives would affect listed and proposed special status species. Therefore this topic has been retained.

CULTURAL RESOURCES

Prehistoric and Historic Archeological Resources: Conformance with the *Archeological Resources Protection Act* in protecting known or undiscovered archeological resources is necessary. *NPS Management Policies* (2006) call for ongoing inventory and analysis of the significance of archeological resources found within parks. Archeological resources have been found in the vicinity of the Carbon River Road that could potentially be affected by actions associated with the proposed alternatives. Therefore this topic has been retained.

Ethnography: Mount Rainier National Park and the surrounding area have a long history of use by prehistoric and contemporary Native Americans. Analysis of impacts to known resources is important under the *National Historic Preservation Act* and other laws. The National Park Service defines ethnographic resources as any "site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it" (DO-28, *Cultural Resource Management Guideline*, p. 181). Actions proposed in the alternatives could affect ethnographic resources, therefore this topic has been retained.

Historic Structures/Cultural Landscapes: Consideration of the impacts to cultural resources is required under provisions of Section 106 of the *National Historic Preservation Act of 1966*, as amended, and the 2008 *Programmatic agreement among the National Park Service, the National Conference of State Historic Preservation Officers, and the Advisory Council on Historic Preservation*. It is also required under *NPS Management Policies*. Federal land managing agencies are required to consider the effects proposed actions have on properties listed in, or eligible for inclusion in, the National Register of Historic Places (i.e., Historic Properties), and allow the Advisory Council on Historic Preservation a reasonable opportunity to comment. Agencies are required to consult with Federal, state, local, and tribal governments/organizations, identify historic properties, assess adverse effects to historic properties, and negate, minimize, or mitigate adverse effects to historic properties while engaged in any Federal or federally assisted undertaking (36 CFR Part 800). Established in 1997, the Mount Rainier National Historic Landmark District (NHLD) includes approximately three percent of the park. The Carbon River Road is part of the NHLD, which includes a boundary that extends 30 feet from the edge of pavement along the length of the road. Because the Carbon River Road is identified as a structure contributing to the significance of the National Historic Landmark District, preservation of the road's character-defining features is of particular concern. Similarly, protection of other historic properties and archeological resources within the area of project effects (whether presently identified or undiscovered) is an important project consideration. Therefore this topic has been retained.

RECREATIONAL / SOCIAL RESOURCES

Visitor Experience: Depending on the selected alternative, a variety of impacts to visitor use may occur. Based on *NPS Management Policies* (2006), impacts to visitors are considered with respect to park undertakings. Among the impacts that are considered in this section are visitor access and transportation, visitor use opportunities, visitor use information and interpretation, and visitor safety. Park visitors who regularly accessed the Ipsut Creek Campground and backcountry trails via motor vehicles prior to the closure are currently unable to use these areas without walking or bicycling the length of the road. This may limit the number of individuals that can access the area because of the increased hiking distance (4.9 miles). Visitor experience for some, however, may be enhanced by the addition of biking and increased hiking trails and the absence of motor vehicles.

Wilderness: Approximately 97 percent of Mount Rainier National Park is designated wilderness. Congress designated this area in 1988. NPS wilderness management policies are based on provisions of the 1916 NPS Organic Act, the 1964 Wilderness Act, and legislation establishing individual units of the national park system. These policies establish consistent service-wide direction for the preservation, management, and use of wilderness and prohibit the construction of roads, buildings and other man-made improvements and the use of mechanized transportation in wilderness, including bicycles. All park management activities proposed within wilderness are subject to review following the minimum requirement concept and decision guidelines. The public purpose of wilderness in national parks includes the preservation of wilderness character and wilderness resources in an unimpaired condition, as well as for the purposes of recreational, scenic, scientific, education, conservation, and historical use. Designated wilderness is located on the southern edge of the Carbon River Road from park entrance to west of Chenuis and then on both sides of the road east of Chenuis, with the boundary beginning 100 feet from the centerline of the road. There would be indirect effects under four alternatives and direct effects under one alternative.

Wild and Scenic Rivers: Although the Carbon River is considered to be eligible for Wild and Scenic River status, a formal suitability study has not been completed (NPS 2002). Therefore proposed actions must be evaluated to determine whether they would affect this eligibility. No additional determinations are necessary.

Park Operations: Impacts to park operations and visitor services are often considered in Environmental Assessments to disclose the degree to which proposed actions would change park management strategies and methods and what additional costs (including staffing) are associated with the proposal. Because the alternatives would change park operations in the Carbon River area, this topic has been retained.

Socioeconomics: Socioeconomic impact analysis is required, as appropriate, under NEPA and *NPS Management Policie*s (2006) pertaining to gateway communities. The local and regional economy and most business of the communities surrounding the park are based on tourism and resource use. Manufacturing, professional services, and education also contribute to regional economies. The alternatives would likely affect regional or gateway communities from changes in visitor attendance or visitor spending patterns as a result of the implementation of the proposed alternatives. Therefore this topic has been retained.

2. Impact Topics Dismissed From Further Analysis

The topics listed below either would not be affected or would be affected only negligibly by the alternatives evaluated in this Environmental Assessment. Negligible effects are localized effects that would not be detectable over existing conditions. Therefore, these topics have been dismissed from further analysis.

Water Quantity: There would be no increased/decreased use of water from the alternatives. Therefore, this impact topic has been dismissed.

Museum Collections: *NPS Management Policies* (2006) and other cultural resources laws identify the need to evaluate effects on National Park Service Collections if applicable. Requirements for proper management of museum objects are defined in 36 CFR 79. The collections at Mount Rainier National Park would not be affected by the proposed project, except by the potential addition of material for the collections if any is found (see mitigation measures under *Archeological Resources* in the *Environmental Consequences* section). Therefore this topic has been dismissed.

Prime and Unique Farmlands: No unique agricultural soils are known from the Carbon River Road due to recent glacial activity and ongoing damage by flooding. Therefore this topic has been dismissed.

Energy Consumption: Implementation of the proposed actions would not cause measurable increases or decreases in the overall consumption of electricity, propane, wood, fuel oil, gas or diesel associated with visitation or for park operations and maintenance. Therefore this topic has been dismissed.

Land Use: Land use would not change as a result of the implementation of the alternatives described herein. The overriding land use would remain as parklands. Therefore this topic has been dismissed.

Environmental Justice: Executive Order 12898 requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. This Executive Order does not apply to the subject of this Environmental Assessment. The actions evaluated in this Environmental Assessment would not adversely affect socially or economically disadvantaged populations. Therefore this topic has been dismissed.

Soundscape: "Sounds that visitors encounter affect their recreational and/or educational experience. Many park visitors have certain expectations regarding the sounds they will hear as part of their experience. The type of park unit (for example national battlefield, national seashore, national recreation area, national park) and its specific features often help shape those expectations. In addition to expectations of muted to loud sounds associated with nature (such as wind rustling leaves, elk bugling, waves crashing on a beach), park visitors also expect sounds reflecting out cultural heritage (such as cannons firing, native drumming, music) and sounds associated with people visiting their parks (such as children laughing, park interpretive talks, motors in cars and motor boats)" (NPS 2006).

Park managers, therefore, identify what levels and types of sounds contribute to or hinder visitor enjoyment and monitor parks for unwanted sounds that may adversely affect visitor opportunities to enjoy natural park soundscapes.

Baseline soundscape measurements have been documented for the Carbon area "moist forest acoustic zone." In the summer and winter 2006 and summer 2007, six acoustical monitoring systems were deployed, including one near Green Lake in the Carbon River watershed. The purpose of this monitoring was to characterize current existing sound levels and estimate natural ambient sound levels in these areas, as well as to identify audible sound sources. During analysis, Natural Sounds Program (NSP) staff discovered recordings of numerous species such as red-tailed hawks at Green Lake. NSP staff also collected recordings of a rock slide at Green Lake. These sounds, along with wind and flowing water, are just a few of the many natural sounds which join to create the acoustical environment in Mount Rainier National Park. Overall, this study found that human-caused sounds are heard a moderate amount of the time in the park. Natural ambient levels in the park, however, are inherently high due to the presence of flowing water and wind.

The alternatives would have only temporary intermittent increases in sound levels in the Carbon River area as facilities were constructed or removed that would last throughout construction and as administrative use of all-terrain or utility vehicles occurred to maintain the trail or road and for emergency use. Because noise levels would be similar to those that occurred when the road was open (such as from motorcycle or grader use) this topic was dismissed from additional analysis.

F. List of Federal, State and Local Permits and Other Consultation Requirements

Depending on which of the alternatives is selected, the following additional permits or consultation would occur:

- U.S. Army Corps of Engineers (Clean Water Act, Section 404 permit),
- U.S. Environmental Protection Agency (Clean Water Act, Section 401 permit),
- U.S. Fish and Wildlife Service (Endangered Species Act, Section 7 consultation – Biological Opinion),
- Washington State Historic Preservation Office (National Historic Preservation Act consultation – Memorandum of Agreement),
- Washington State Water Quality Control Board (non-point source discharge [NPDES] permit),
- Washington Department of Fish and Wildlife (associated with Clean Water Act permitting), and
- National Marine Fisheries Service (Endangered Species Act, Section 7 consultation – Biological Opinion).

G. Additional Public Review

This Environmental Assessment is being made available through press releases to the public, federal, state and local agencies and organizations, a wide variety of news media, and the Park's mailing list. The document is also available electronically on the park's website, and hard copies or compact discs are available in local public libraries (Eatonville, Packwood, Orting, Sumner, Graham, Puyallup, Enumclaw, Seattle, Tacoma). Copies of the document may also be obtained from:

Mail: Mount Rainier National Park
55210 238th Avenue East
Ashford, Washington 98304
Fax: 360-569-2187
Internet: http://parkplanning.nps.gov/mora Planning, Environment and Public Comment (PEPC) website
Email: mora_carbon_river_comments@nps.gov

Responses to substantive comments on the Environmental Assessment will be addressed in the proposed Finding of No Significant Impact (FONSI) or will be used to prepare an Environmental Impact Statement (if appropriate).

(For more information about specific agency and staff consultation, see Chapter VI: *Consultation and Coordination*: *List of Persons and Agencies Consulted / Preparers*)

Chapter III: Alternatives

A. Introduction

The Alternatives were developed from collaborative interdisciplinary analysis based on the expertise of interdisciplinary planning team members, as well as from internal and external scoping with Native American Tribes, federal, state and local agencies, interested organizations and individuals.

Eventually, the overall project goal, "preserve year round public access to the northwest corner of the park and to the unique and popular natural, historical and recreational features of the Carbon River Valley," guided development of the Alternatives.

In addition to the No Action (Continue Current Management) Alternative, there are four action alternatives. Other alternatives considered during the alternative development phase, are described in the *Alternatives Considered but Dismissed* section near the end of this chapter).

The five alternatives are:

- Alternative 1: No Action (Continue Current Management);
- Alternative 2: Hiking and Bicycling Trail in Historic Carbon River Road Corridor;
- Alternative 3: Public Vehicle Access to Chenuis (3.6 miles): Hiking and Bicycling Trail Beyond;
- Alternative 4: Seasonal / Weekend Shuttle Access for 4.4 Miles: Hiking and Bicycling Trail Beyond; and
- Alternative 5: Wilderness Hiking Trail Reroute.

Photo 15: Falls Creek Washout

The alternatives primarily differ in the following components:
the type of public access; the type of road or trail facility (including its tread composition); what user groups would be provided for; what facilities would remain or be added; where parking would occur; how far it is to primary trailheads; what camping opportunities (including facilities) would be provided; where picnicking would occur; and what erosion protection measures would be employed to retain the road or trail.

The following list of elements would be common to all action alternatives (2-5). These elements are explained following the description of Alternative 1.

- Retain the existing Carbon River Road (20 feet wide) between the Carbon River Entrance and the Old Mine Trailhead (1.2 miles).
- Add up to four engineered logjams (ELJs) near the Carbon River Entrance and former maintenance area to aid in maintaining the Carbon River Entrance parking and facilities. Depending on timing, equipment and materials, two of these ELJs would likely first be constructed as rock barbs and then later converted as rock ballast for the logjams.
- Remove buildings and add parking at the Carbon River Maintenance Area.
- Allow private vehicles on the first 1.2 miles of the Carbon River Road up to a turnaround at the Old Mine Trailhead. The Old Mine Trailhead parking area would be converted to a turnaround to allow passenger drop-off / pick-up (in Alternatives 2-4, there could also be limited accessible parking).
- Add parking via agreement with partners at locations to be determined outside the Carbon River Entrance to supplement limited parking at the Carbon River Entrance.
- Beyond Old Mine Trailhead, remove (Alternative 5) or replace intermittent and perennial stream culverts with fish-friendly (open bottom or box) culverts (Alternatives 3 and 4) and/or trail bridges (Alternatives 2-4).
- Reconstruct the historic Carbon River Entrance Arch.
- Remove some infrastructure from Ipsut Creek Campground (vault toilets, asphalt, bumper stops, signs, and amphitheater and chlorinator buildings).
- Add suitable backcountry toilets (likely composting) to Ipsut Creek Campground.
- Add picnicking near the Carbon River Entrance and in the former maintenance area.
- Add a river-view interpretive exhibit at the former Carbon River Maintenance Area and interpretive exhibits at the entrance to explain changes that have occurred in the area.
- Add bicycle racks at Carbon River Entrance and Carbon River Maintenance Area.
- Upon completion of acquisition of boundary expansion lands, initiate comprehensive planning for facilities and services within those lands.

The following list of elements would also be common to all action alternatives (2-4) but would only apply to Alternative 5 in its short-term [interim] condition because of conflicts with wilderness in later implementation. These elements are also explained following the description of Alternative 1.

- Add bear-resistant food storage lockers at Ipsut Creek Campground;
- Add bicycle racks at trailheads; and
- Allow for administrative access as possible via ATV-type vehicles to expedite trail maintenance, law enforcement and emergency access.

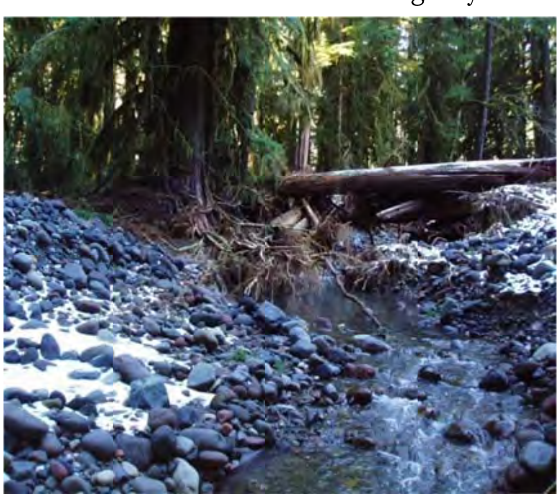


Photo 16: Falls Creek Channel

A more detailed description of each of the alternatives follows this introduction. A summary of the differences among the alternatives is found at the end of this Chapter (Table 17: *Alternative Comparison Chart*).

All of the alternatives meet all or a portion of the primary management direction found in the Mount Rainier National Park General Management Plan (GMP), including conversion of the road to a hike and bike trail, preservation of the Carbon River Road corridor and its contribution to the Mount Rainier National Historic Landmark District (NHLD), creating trail access to the features of the Carbon River area, allowing for shuttle use of the road, or maintaining public vehicle access as long as possible. Although some alternatives would not fully meet the intent of the GMP, such as creating a wilderness trail outside the Carbon River Road corridor that would not preserve the NHLD or allow for bicycle use, these are included below to allow for consideration and analysis of a wide range of options for the area.

Alternative 5 would have modifications not anticipated by the general analysis in the GMP by eliminating bicycle use in the Carbon River area and adding a new trail within the pristine zone (in Wilderness). All alternatives – even the GMP recommended action, Alternative 2 – have been determined to have an *adverse effect* on the contribution of the Carbon River Road to the Mount Rainier National Historic Landmark District.

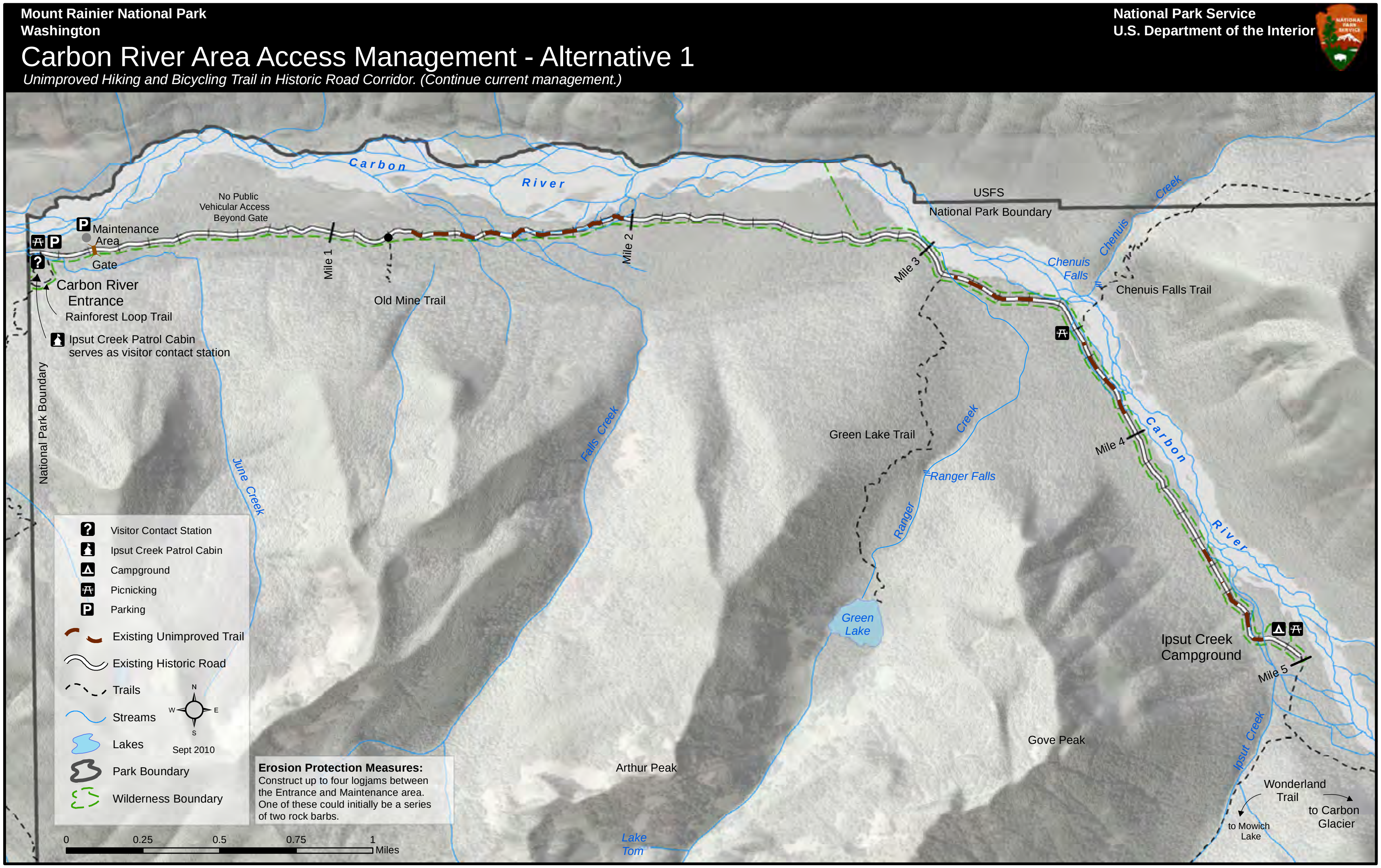
B. Alternative 1: No Action (Continue Current Management)

1. Alternative 1 Public Access Summary

As has been the case since November 2006, when the most recent major flood occurred, public access would continue to be via the current unimproved hiking / bicycling trail (4-6 feet wide) within the Carbon River Road historic corridor between the Old Mine Trailhead and Wonderland Trailhead (5.0 miles). The road would continue to be gated just beyond the maintenance area. Parking would be allowed at the entrance and along the road up to the maintenance area. Informal and non-NPS sanctioned parking would also likely continue to occur on county easement and USFS land outside the entrance. The Carbon River Road between the Carbon River Entrance and the Old Mine Trailhead (1.2 miles) would be retained to protect entrance area facilities. As called for by the GMP, upon completion of acquisition of boundary expansion lands, planning for relocation of camping and administrative facilities outside the Carbon River Entrance would occur.

There would be no major repair of the damaged sections on the Carbon River Road. Instead, the current unimproved hiking / bicycling trail (4-6 feet wide) within the Carbon River Road historic corridor between the Old Mine Trailhead and Wonderland Trailhead (5.0 miles) would be maintained and reconstructed as necessary following flood damage to a similar condition. The Ipsut Creek Road Bridge would be retained for hiking access. No public vehicle access would be permitted beyond the gate at the maintenance area.

Figure 6: Alternative 1: No Action (Continue Current Management)



2. Alternative 1 Components

a. Parking, Road and Trail

Parking: Visitors could continue to park their vehicles in the small entrance parking area (which contains parking for approximately 12 vehicles) and in overflow areas along the road (parallel parking) up to the Carbon River Maintenance Area for approximately 0.15 miles on one side of the road (where approximately 30 vehicles can be accommodated). Parking would also likely continue to occur in undesignated road shoulder areas outside the current Carbon River Entrance (where approximately 50 vehicles have been counted).

Because of the limited parking availability and the added length of roundtrip trail distances due to the closure of the road just beyond the maintenance area, it is likely that fewer people would continue to take advantage of facilities in the Carbon River area. Despite this, parking needs would likely continue to exceed capacity. Therefore, in Alternative 1, because of limited parking availability at the Carbon River Entrance, there would also be ongoing efforts to develop parking in cooperation with partners, or later, as part of the proposed boundary expansion facilities.

Photo 17: Log Hump

Road: The Carbon River Road would continue to be closed to private vehicle traffic beginning at the gate near the Maintenance Facility past the Carbon River Ranger Station. Altogether nearly five miles of roadway would be closed to motor vehicles, including access to the former drive-in Ipsut Creek Campground at the end of the road. Routine maintenance of the road, such as culvert cleaning and clearing downed trees, would continue to occur in the first 1.2 miles. Elsewhere this would occur less frequently and would be more difficult because of the lack of ability to access the area using heavy equipment.

Trail: An unimproved hiking and bicycling trail (4-6 feet wide) using native soil, rock and native or imported wood would continue to be maintained within and/or adjacent to the Carbon River Road corridor. Bridge crossings would be provided where needed and would likely continue to accommodate administrative all-terrain vehicle (ATV) use.

Routine maintenance in and alongside the washout area would continue to occur to provide for hiking and bicycling access and visitor safety. Given the unstable nature of the corridor, this would likely include annual reconstruction of the trail as the riverbank continues to erode, large trees fall, and new river channels, including the roadway itself, continue to be used. Repairing winter damage would also become more difficult because of difficulty in accessing the area and in obtaining and moving needed equipment. As more of the road washed out, the short sections of road and trail would become harder to maintain. Trail maintenance would be especially difficult near Falls Creek, due to the limited availability of dry ground between the road and the wetlands in the area, and near Milepost 4.4, due to the deeply incised area and increasingly steep surrounding terrain.

b. Buildings and Structures

Carbon River Entrance: The facilities at the Carbon River Entrance, including the vault toilets and paved parking area would be retained until damaged by flooding or until their replacement occurs within the boundary expansion area. (The former entrance booth was removed in 2009.) As implementation proceeded, the non-historic buildings and structures (including the ranger station) at the Carbon River Entrance would be removed (per the GMP and subsequent *Carbon River Area Rehabilitation Environmental Assessment* [NPS 1999]). The area occupied by these structures would then be converted to additional parking and picnicking.

Ipsut Creek Patrol Cabin: During the November 2006 flooding, the Ipsut Creek Patrol Cabin, an historic structure listed on the National Register of Historic Places was undermined and water flowed underneath it through summer 2007. In fall 2007, following an MOA developed with the Washington State Historic Preservation Officer (SHPO) and the Advisory Council for Historic Preservation (ACHP), the cabin was dismantled and moved to temporary storage at park headquarters near Ashford (Tahoma Woods) pending the completion of this Plan / Environmental Assessment and a decision about where to relocate the cabin based on future use of the Carbon River area. In this Alternative, the Ipsut Creek Patrol Cabin would be relocated to the Carbon River Entrance. It would be placed on the south side of the road, in the vicinity of the former fee booth, to serve as a visitor contact facility.

Carbon River Maintenance Area: In 2008, additional flooding destroyed the former bunkhouse located in the maintenance area. The non-historic laundry building from this area was removed in 2009. This area would be converted to additional parking (for approximately 20 cars) and picnicking in conformance with the Carbon River Area Rehabilitation EA and the GMP. If the weather station and radio tower / shed were retained, a security fence would be installed those facilities. Non-historic buildings and structures and those damaged by flooding would be removed. The historic CCC garage would remain unless it was threatened by flooding.

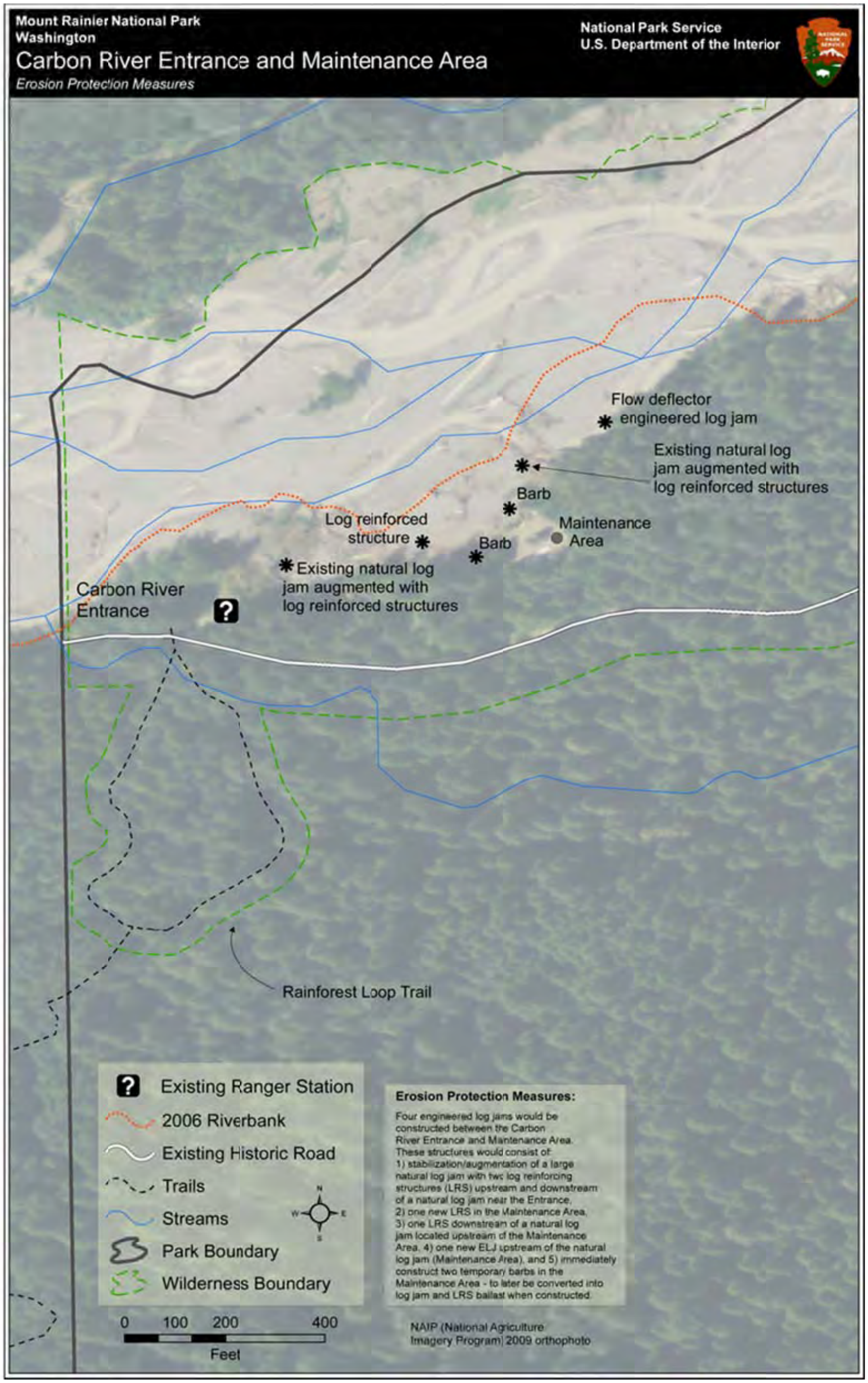
c. Erosion Protection Measures

To maintain the remaining entrance portion of the historic Carbon River Road, up to four engineered logjams (ELJs) would be constructed between the entrance and the maintenance area (Milepost 0 to Milepost 0.152)(Figure 7: *Carbon River Entrance and Maintenance Area Erosion Protection Measures)*. Depending on timing, equipment and materials, two of the ELJs near the maintenance area would first be constructed as rock barbs and then converted to logjams (with rock ballast).

Carbon River Entrance (Milepost 0): To protect the Carbon River Entrance from additional bank erosion that could threaten the vault toilets, parking and other facilities, the edge of the river nearest the Carbon River Entrance facilities would be stabilized to minimize future erosion. In this area, which has been protected by placed riprap and a natural logjam, the natural logjam would be augmented by two log reinforcing structures, upstream and downstream of the natural log jam – creating **one** large log jam.

Approximately 10 logs, with intact root-wads if possible, would be added and would be anchored to the bank (acquired from the riverbed if possible or imported if needed). The logjam would be approximately 40-60 feet long by 20 feet wide and four feet high above the riverbed. Below the riverbed it would extend approximately 10-15 feet to the point of maximum scour, as determined by an engineer, to survive future flood flows. Approximately 20 cubic yards of river cobble would also be used as ballast. Another logjam could also be constructed in this area or upstream, closer to the maintenance area.

Figure 7: Proposed Carbon River Entrance and Maintenance Area Erosion Protection Measures



Carbon River Maintenance Area (Milepost 0.152): To protect the maintenance area from additional bank erosion threatening buildings and parking, approximately three additional logjams would be constructed:

1) **One** new log reinforced structure and **one** temporary rock groin (barb) – to be converted to ELJ ballast;
2) **One** temporary rock groin (barb) – to be converted to ELJ ballast and one log reinforcing structure downstream of the natural log jam, currently upstream of the maintenance area – creating one large log jam; and
3) **One** new flow deflection ELJ upstream of the natural log jam. (Figure 8: *Typical Design Flow Deflection Engineered Logjam)*.

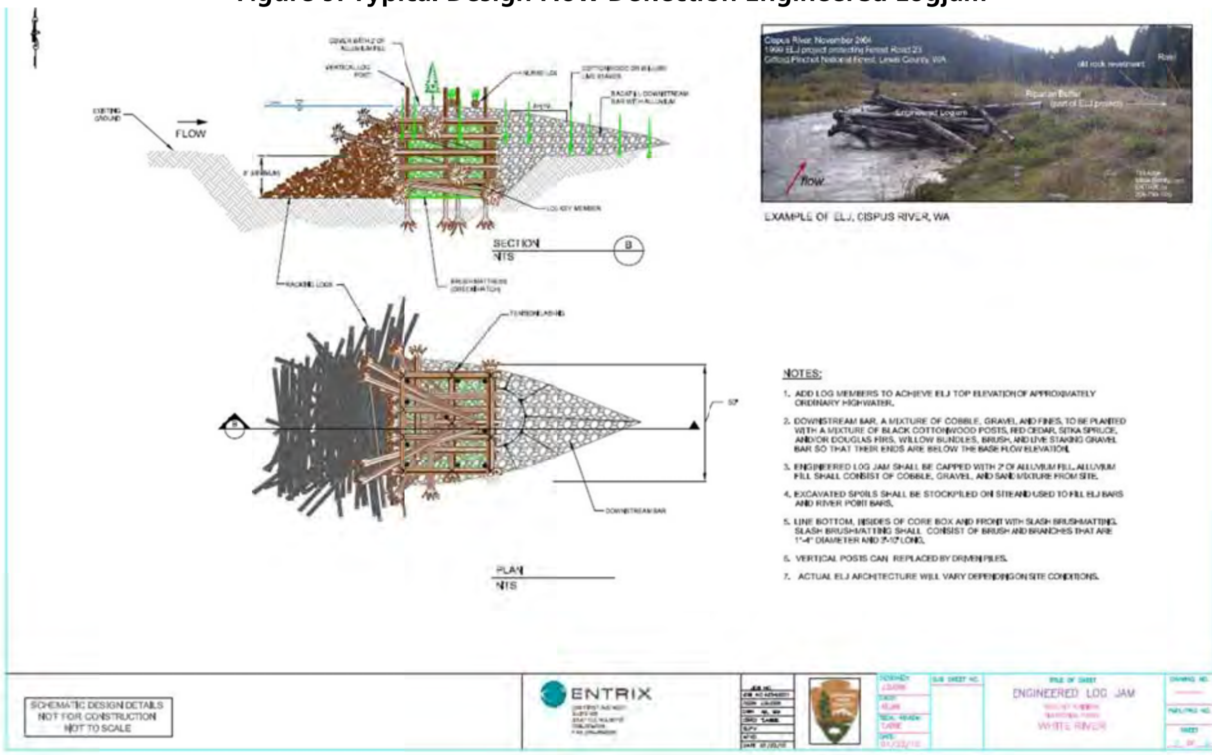
In 2008, flooding eroded between five and 75 feet of the bank, including the former bunkhouse. Each logjam would require approximately 104 logs ranging in length from 8-45 feet long and with diameters of 8-24 inches, including some logs with root-wads attached (acquired from the riverbed if possible or imported if needed). Each would also require approximately 30 cubic yards of slash for infill and 50-100 cubic yards of river cobble and soil per logjam for ballast and topping material.

Construction of two temporary rock barbs and four ELJs would enhance the deposition of sediment and debris in front of the barbs or logjam and effectively deflect flow away from the eroding riverbank. Water flowing into and around the structures would create an eddy in front of them (if it was connected to the bank) or on the downstream side of the structure, enhancing fish habitat (in the long-term) by providing areas of rest from otherwise strong currents in the river and overhanging wood for cover. These structures would also be enhanced with bioengineering (native woody plant cuttings) to improve their habitat value and survivability.

d. User Groups Accommodated

Public Access: Private vehicles could continue to drive into the park, where limited parking would be available at the entrance, along the road to the former maintenance area, and in the maintenance area. Hikers and bicyclists would begin their trips from the entrance. Although the road and reroute trail are suitable for bicycles, some portions of the trail may need to be walked with some bicycles (such as through deep, sandy areas).

Figure 9: Typical Design Flow Deflection Engineered Logjam



Accessibility: There is currently no Architectural Barriers Act (ABA is the federal standard) accessibility to Ipsut Creek Campground and this condition would continue under Alternative 1. The first 1.2 miles of the Carbon River Road and portions of the Carbon River Rainforest Trail (boardwalk areas) would continue to be suitable for assisted wheelchair access.

Emergency / Administrative Access: It is currently possible to traverse the primitive trail to Ipsut Creek via administrative ATVs. As a result, initially it would be possible to use ATVs to transport materials and supplies for trail repair and to use ATVs for emergency operations beyond the entrance up to Ipsut Creek. Over time, however, this ability would likely diminish as the road continued to deteriorate. Because it is not possible to get to the washout areas with heavy equipment for ongoing stabilization, repairs must be done with hand tools. As a result, access to some areas could eventually be precluded or could be delayed for a few days to a few weeks or months when additional damage occurs.

e. Visitor Use Activities

Hiking: Access to all Carbon River visitor use areas would continue to be open to foot-traffic. Table 3: *Alternative 1 Hiking Distances to Primary Trailheads* shows the hiking distances to primary trailheads and destinations in the Carbon River area. As noted above, access to some areas may be delayed for a few days to a few weeks or months when damage occurs. The Chenuis Falls foot-logs across the Carbon River are routinely washed out once to several times each summer during normal high snowmelt runoff and therefore, as in the past, this area would continue to be occasionally inaccessible.

Table 3: Alternative 1 Hiking Distances to Primary Trailheads / Destinations from Carbon River Entrance

Location	Distance (One-Way)	Distance (Round-Trip)	Destination Trail Length (one way)	Notes
Carbon River Rainforest Loop Trailhead	0 miles	0 miles	0.03 miles (Rainforest Boardwalk Trail)	Trailhead located at entrance
Old Mine Trailhead	1.2 miles	2.4 miles	0.25 miles (Old Mine Trail)	Unimproved trail
Green Lake Trailhead	3.1 miles	6.2 miles	1.8 miles (Green Lake Trail)	
Chenuis Falls Trailhead	3.6 miles	7.2 miles	0.4 miles (Chenuis Falls Trail)	
Ipsut Creek Campground	4.8 miles	9.6 miles	N/A	
Ipsut Creek Trailhead	5.0 miles	10.0 miles	variable	Trailhead for Wonderland, Northern Loop Trails, (including to Carbon Glacier)
Carbon Glacier	8.4 miles	16.8 miles	3.4 miles (Carbon Glacier Trail)	This trail length is included in the total noted.

Ipsut Creek Camping: Ipsut Creek Campground would continue to be a hike-in / bike-in backcountry camp with 21 individual sites and one group site (8 individual sites and one group site have been closed due to the presence of high rated hazard trees and one site is now occupied by the well). Although a well with a hand-pump is available, it has not been functional for several years. Non-potable water is available from the nearby Carbon River and Ipsut Creek.

As called for by the GMP (NPS 2002), minor changes to the campground would be made to accommodate the change in type of camping use. These changes could include restoration of some of the campsites, removal of the water treatment system infrastructure and rehabilitation of the current toilet facility areas (if not reused). Eventually, as picnic tables deteriorated, they would likely be removed. Fire grates would also be removed. Based on the size of the reduced campground and number of group sites, suitable backcountry toilets would be added and the vault toilets removed. Although, in the short-term, the well could be repaired, it is likely that eventual closure of the well would also occur as its mechanical pump deteriorated. Actual implementation would vary somewhat, given changes in the area not anticipated by the GMP.

The campground area currently contains a damaged water treatment chlorinator building, a amphitheater storage shed, two sets of vault toilets, picnic tables, elevated charcoal grills or fire grates, parking bumper stops (concrete, log or creosote), degraded asphalt parking area, "No Parking" signs, etc. These existing extant features associated with the former road corridor would be removed or dismantled in stages. The road corridor between Chenuis and Ipsut also contains displaced and obsolete culverts, roadway bumper stops and other remnant features from the drivable road. These buildings and structures would either be broken into pieces small enough to transport on an all-terrain vehicle trailer or would be removed over time via helicopter sling loads and staged at the boundary expansion area (two miles west of the Carbon River Entrance), before being salvaged for reuse in another park area or disposed of.

Picnicking: There would continue to be three picnic tables available at the Carbon River Entrance and three tables available near the Chenuis Falls Trailhead as well as picnicking at Ipsut Creek Campground. Additional picnicking could also be provided at the Carbon River Maintenance Area, as called for by the GMP.

f. Orientation / Fee Collection / Interpretation

Orientation: Visitor orientation would be provided at the Carbon River Entrance area, or at the replacement Carbon River Ranger Station within the boundary expansion area. In this alternative, visitor orientation at the Entrance would occur from the Ipsut Creek Patrol Cabin (see b. *Buildings and Structures* above).

Fee Collection: Entrance fees would continue to be collected at the entrance or at the replacement Carbon River Ranger Station. Fee collection would either be in person using a cash register when a Park Ranger is on duty or via a self-pay fee collection canister (similar to the self-pay fee collection at the Paul Peak trailhead on the road to Mowich Lake).

Interpretation: Additional interpretive exhibits would be added at the Carbon River Entrance to highlight the changes to the road / visitor experience in the area.

g. Carbon River Road and Facility Obliteration / Restoration

There would be passive restoration on the washed out portions of the unused road surface (14-16 feet) not occupied by the trail between the Old Mine Trailhead and Ipsut Creek. Over time, vegetation would begin to establish on the unused portions of the road. Most restoration would occur passively as areas of former roadway experienced less use.

h. Link to Future Use

Upon completion of acquisition of boundary expansion lands, the park would begin planning for the GMP provisions calling for relocation of camping and administrative facilities outside the Carbon River Entrance. At that time, additional plans to link these disconnected areas would also commence.

i. Impact Avoidance, Minimization and/or Mitigation Measures

See applicable measures listed under each resource section in Chapter V: *Environmental Consequences* and in Appendix 1.

C. Elements Common to All Action Alternatives (2-5)

1. Parking and Road

Parking: As in Alternative 1, parking would be available at the Carbon River Entrance and the former Carbon River Maintenance Area. Approximately 68 cars could be accommodated (expanded parking for 18 at entrance, 30 along the road, and 20 in the former maintenance area). Non-sanctioned overflow parking that currently occurs outside the entrance would be discouraged. If possible, a new parking area would be identified and constructed outside the Carbon River Entrance on land intended for the boundary expansion or parking would be accommodated via agreement with park partners.

Road: The historic Carbon River Road would be retained between the entrance and the Old Mine Trailhead (a distance of 1.2 miles). Public vehicles would be allowed to drive this section of road up to a turnaround, however, public vehicles would not be able to park at this location or along the narrow, winding road back toward the entrance because of safety concerns, including poor sight distance and problems with space for visitors to exit vehicles and walk along the roadway (without road widening) and potential root or other damage to large, old growth trees.

As in Alternative 1, road culverts between the entrance and the Old Mine Trailhead would be maintained (including periodic cleaning). To protect native char and salmon that occur, or potentially occur within the area, road culverts that have been exposed or would be disturbed by the project area would be removed where they link intermittent or perennial streams. These culverts would be removed (Alternative 5) and/or replaced with larger fish-friendly (open-bottom or box) culverts (Alternatives 3-4) or trail bridges (Alternative 2-5).

Old Mine Trailhead Vehicle Turnaround: The Old Mine Trailhead parking area, which currently contains parking for five vehicles, would be converted to a vehicle turnaround area. The turnaround area would accommodate passenger vehicles and would include a designated passenger drop-off / pick-up area and very limited accessible parking. Although this would immediately become the turnaround in Alternatives 2, 4 and 5, limited trailhead parking would be allowed in Alternative 3 (unless the road was closed by flooding or flood damage), when it could also function as a vehicle turnaround. The turnaround would allow drop-off and pick-up of passengers but the driver would need to return to the maintenance area, entrance or beyond to park before rejoining their group.

2. Buildings and Structures

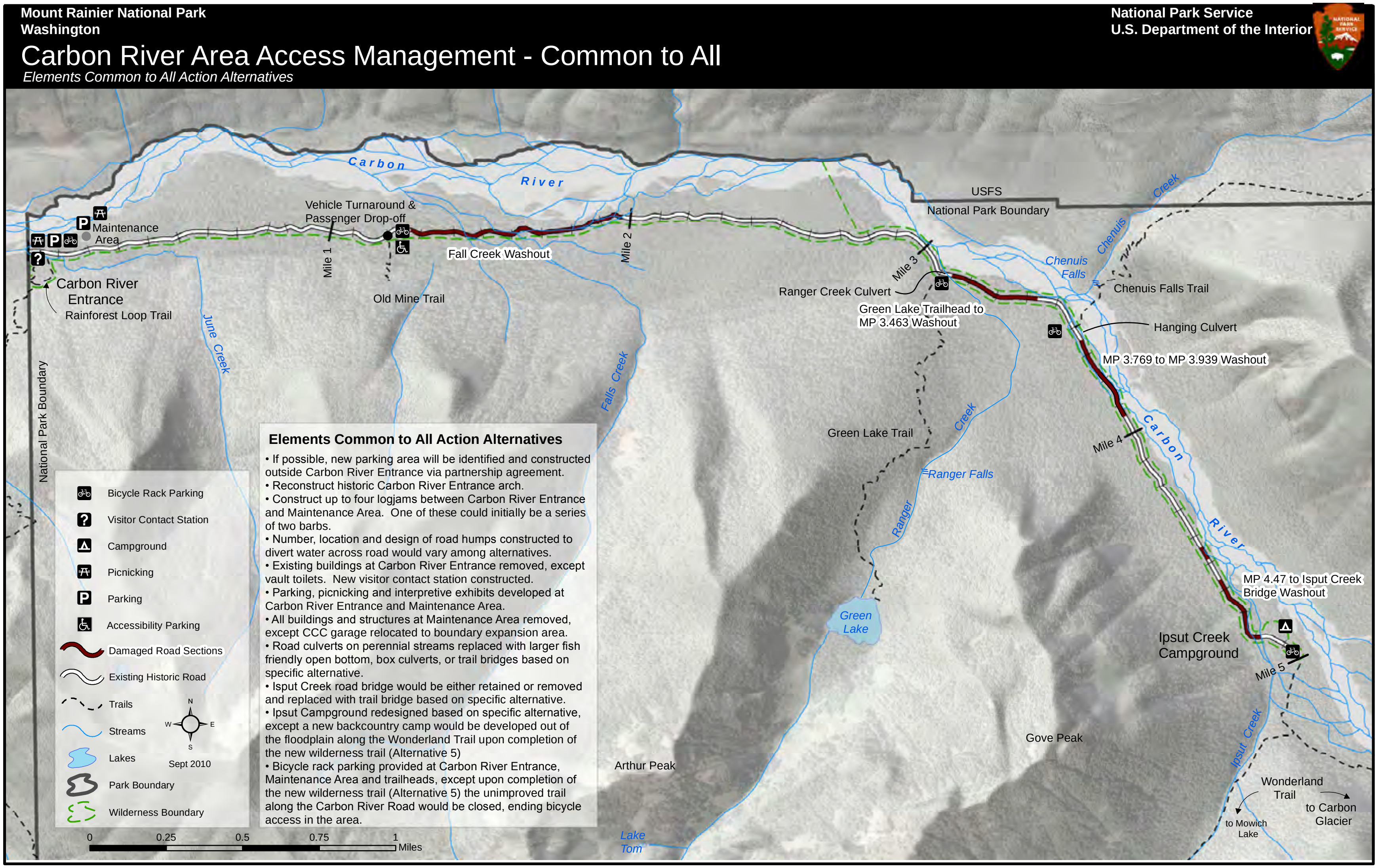
Carbon River Entrance: Existing buildings, except vault toilets, would be removed. The area formerly occupied by these buildings would be reconfigured and replaced with formal parking and picnicking. A one-room visitor contact station would be constructed on the south side of the road. The Carbon River Entrance Arch would also be reconstructed.

Carbon River Maintenance Area: All buildings and structures (with the possible exceptions of the weather station and radio tower/shed) would be removed and replaced with formal parking and picnicking. If the radio tower / shed and weather station are retained, a security fence would be constructed around these facilities. The historic CCC garage would be relocated to boundary expansion lands (two miles west of the entrance). Its exact location would be determined by future planning.

Photo 18: Scour Near Culvert on Carbon River Road

Ipsut Creek Campground Area: Both vault toilets would be removed and replaced with suitable backcountry (likely composting) toilets. All asphalt, bumper-stops, buildings, some picnic tables and campsites, and most signs would be removed. The former chlorinator building and amphitheater storage shed would also be removed. The campground would be reduced in size and configuration in all action alternatives, but the size and configuration would differ based on the alternative. The campground would continue to contain designated sites and toilets. Bear-proof food storage lockers would be added (including initially in Alternative 5).

Figure 10: Elements Common to All Action Alternatives



3. Erosion Protection Measures

ELJs at Entrance and Maintenance Area: As in Alternative 1, erosion protection structures (a series of two rock barbs / four engineered logjams) would be constructed along the riverbank at or near the Carbon River Entrance and former maintenance area (logs acquired from the riverbed and/or imported).

Road Humps (rock-cored log cribs with and without pilings, rock-cored humps, and gravel covered log humps): All action alternatives would include road humps (Figures 10-12) and grade control structures (Figure 12), though the number, location and design of the road humps would vary among alternatives.

The road humps would be built within the existing road to transport flood water from tributaries of creeks that run across the road and to channel snowmelt. Road humps would be constructed of rock or wood or both and would be placed across the road at an angle or perpendicular to the direction of flow and would stop head-cutting erosion of the road surface. This head-cutting erosion has occurred where tributary streams combine with Carbon River flow during flooding down or alongside the road surface.

The road humps would capture water flowing down the road and direct it across the road. Each rock-cored hump would require imported large rock (2-3 foot diameter) and native soil; amounts would depend on size and location. Log humps would require 1-2 logs covered with native cobble rock and gravel; amounts would depend on size and location.

As noted above, although road humps would be constructed in Alternatives 2-5, these would not be constructed in the same locations in all alternatives. In Alternatives 2 and 5, a series of 5-9 road humps would be constructed between the entrance and the Old Mine Trailhead in locations to be determined. In Alternative 2, approximately an additional 15 road humps would be constructed up to Milepost 4.4. In Alternative 3, there would be approximately six additional road humps (between Milepost 3.182 and Milepost 4.232) and in Alternative 4, there would likely be just two road humps (near Milepost 3.182 and 3.769).

Figure 11: Rock-cored Log-crib (with Pilings)

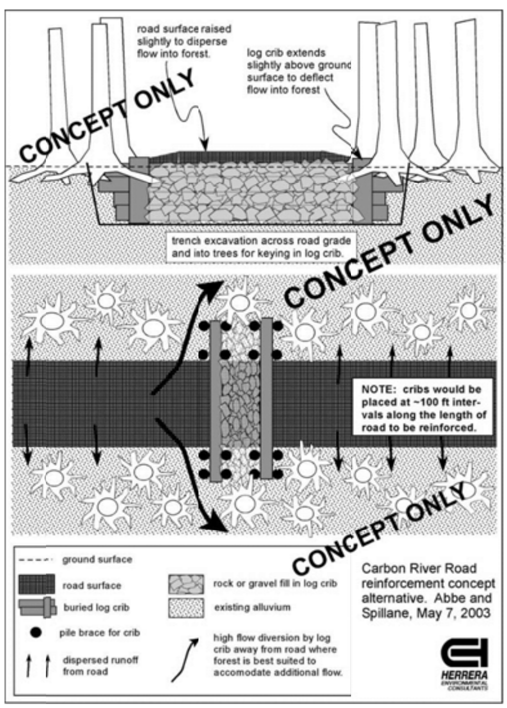


Figure 12: Rock-cored Log-crib (no pilings)

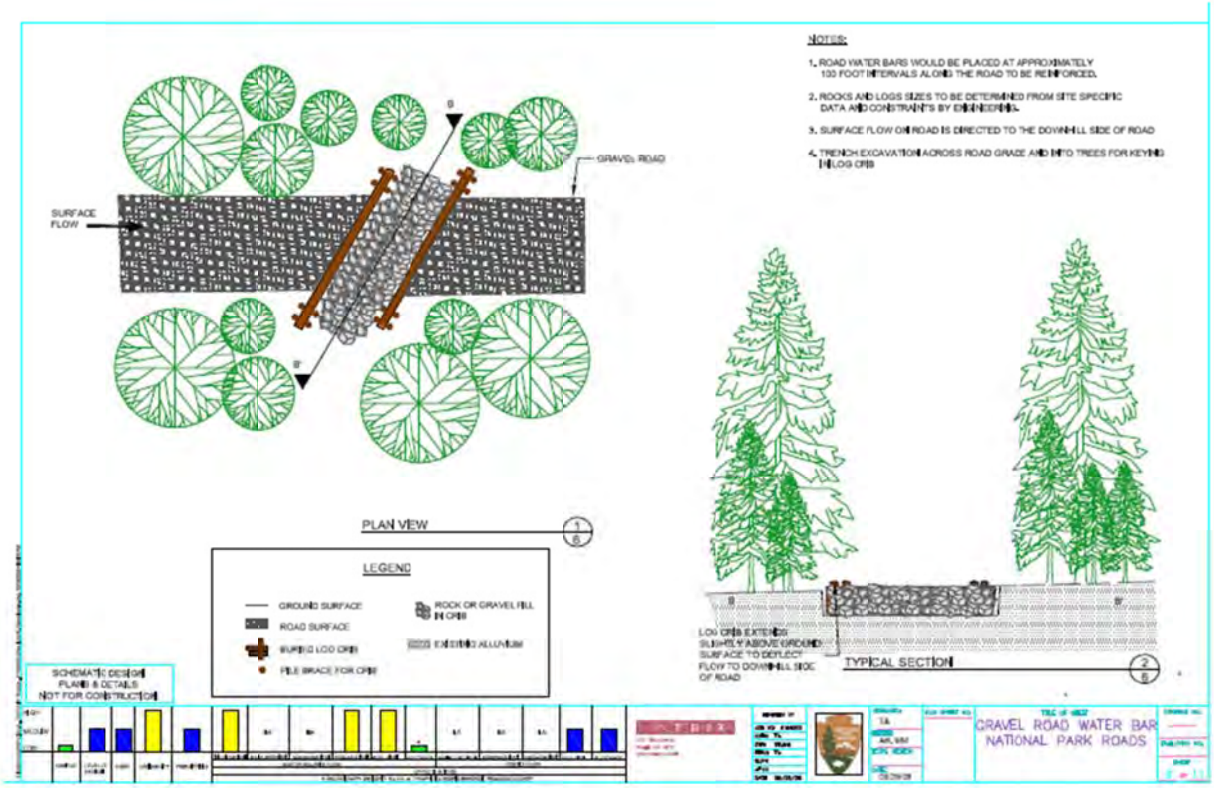


Figure 13: Rock-cored Road Hump

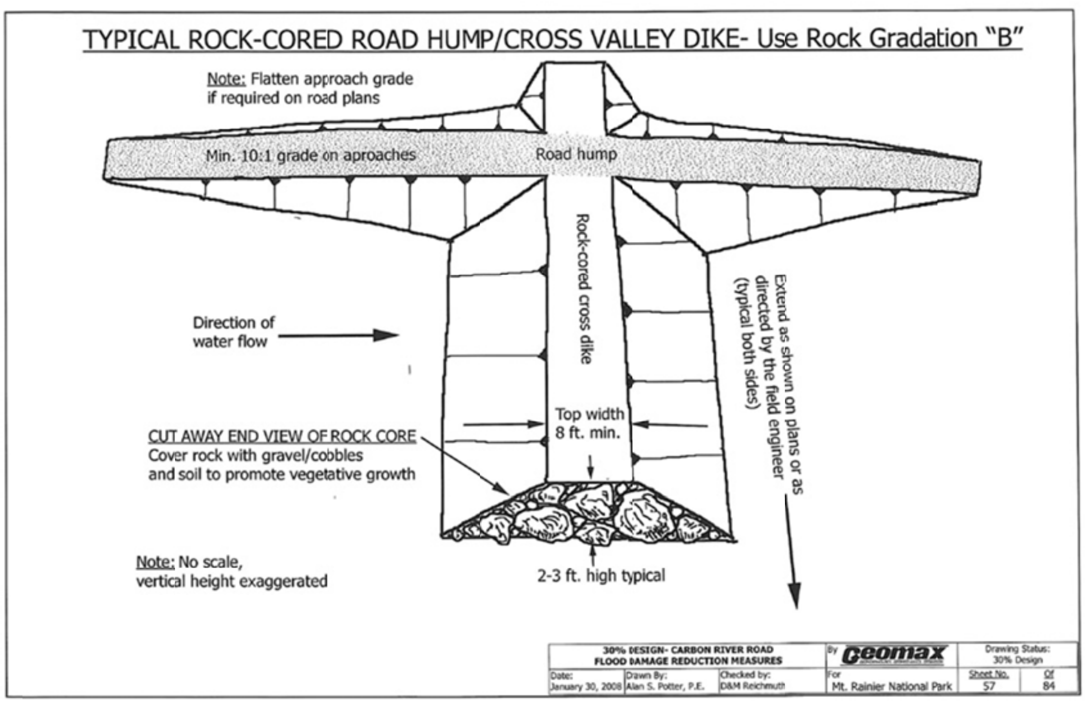
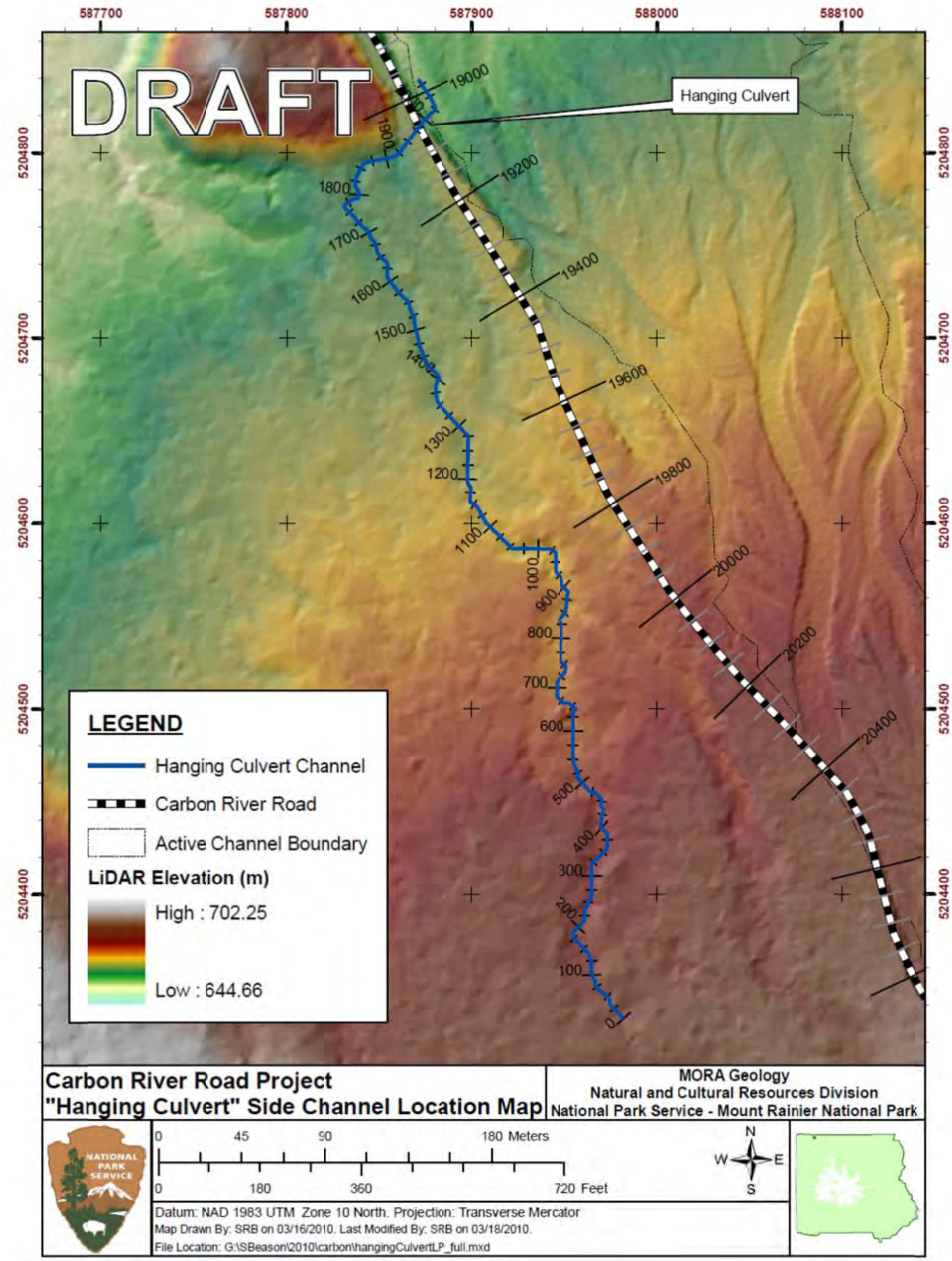


Photo 19: Log Hump

Grade Control Structures (Drop Structures): These would consist of emplaced logs with notches for fish passage and would effectively prevent head-cutting erosion from the release of stored sediment on creeks where large culvert removal is planned. Alternatives 2-5 call for the removal of two very large culverts and their replacement with either trail bridges (Alternatives 2 and 5) or improved fish passage structures (Alternatives 3-4), an undertaking that would potentially release a large amount of sediment into the stream channels where these culverts are located. Road fill removed from these locations would be staged nearby and would be used to create road humps. To minimize the potential effects of this release of sediment a series of approximately 2-3 grade control structures would be constructed in Ranger Creek and on an unnamed tributary to the Carbon River near Chenuis Falls (hanging culvert location) Figure 13: *Unnamed Channel Intersection with Road Upstream of Knob (near Chenuis Falls Trail)*, upstream of the culverts prior to their removal. In Alternative 2, there is also the potential for these grade control structures to be constructed on a Falls Creek tributary to minimize the effects of the same kind of erosion release.

Prior to removal of the hanging culvert in the unnamed tributary, two grade control structures would be constructed upstream to prevent future head-cutting. The unnamed tributary channel is located toward Ipsut from Ranger Creek, west of the Chenuis Picnic Area. If head-cut erosion causes the tributary culvert to capture upper Ranger Creek flow after the culvert is removed, this may eliminate the need for one of the check dams. The proposed check dams would consist of a series of three logs. As with the log-span check dams in the Falls Creek channel (see Alternative 2) these would have off-set notches, as necessary to accommodate fish passage.

Figure 14: Unnamed Channel Intersection with Road Upstream of Knob (near Chenuis Falls Trail)



Use of Logs from Ipsut Creek Road Bridge: Some consideration would also be given to removing logs from the logjam at the Ipsut Creek Bridge to reduce the importation of logs for the erosion protection measures proposed in Alternatives 2-5.

4. User Groups Accommodated

Accessibility: The first 1.2 miles of the Carbon River Road and portions of the Carbon River Rainforest Trail (boardwalk areas) would continue to be suitable for assisted wheelchair access for as long as possible. Use of small electric motorized wheelchairs along the first 1.2 miles would be available subject to existing conditions.

5. Visitor Use Activities

Hiking: All alternatives would continue to accommodate hiking. The Chenuis Falls footlogs across the Carbon River would continue to be periodically unavailable because they are routinely washed out once to several times each year during normal high spring runoff.

Bicycling: Under all alternatives (including Alternative 5 in its interim condition) visitors could bicycle along a trail or road to Ipsut Creek Campground. All action alternatives (including Alternative 5 in its interim condition) would also have bicycle racks placed at Carbon River Entrance and Carbon River Maintenance Area. Alternatives 2-4 would also include racks at trailheads to facilitate this existing use.

Picnicking: Picnic tables would be available under all alternatives at both the entrance and the former maintenance area.

Camping: All alternatives would accommodate walk-in camping; however, the size and configuration of the campground would differ under the alternatives.

Hazard trees identified through field surveys at Ipsut Creek Campground would be treated through implementation of the Hazard Tree Management Plan Environmental Assessment and Finding of No Significant Impact (NPS 2010) based on evaluating tree failure potential and risk to campsites retained or developed under the alternatives.

6. Administration / Orientation / Fee Collection / Interpretation

Orientation: Some visitor orientation functions would continue to be provided at the Carbon River Entrance area because this site is not connected to the boundary expansion lands and it is highly likely that many visitors would arrive at the Carbon River Entrance without stopping at the boundary expansion area. Remaining visitor orientation functions would be provided at the new Carbon River Ranger Station (to be developed) in the boundary expansion area. Visitor orientation at the entrance would occur from the newly constructed visitor contact station (see 2. *Buildings and Structures* above).

Fee Collection: Entrance fees would continue to be collected at the entrance. As in Alternative 1, this would occur either in person when a Park Ranger is on duty or via a self-pay fee collection canister (similar to the self-pay fee collection at the Paul Peak trailhead on the road to Mowich Lake). Entrance fees could also be collected at the new Carbon River Ranger Station (formerly the Thompson home) along the main road within the nearby boundary expansion area.

Interpretation: In addition to interpretive signs at the entrance to highlight the condition of the Carbon River Road / Trail, there would be exhibits at a new overlook in the former maintenance area, where erosion protection measures and Carbon River changes would be highlighted. All alternatives also call for minimal visitor facilities to be located at the Carbon River Entrance due to its ongoing vulnerability to flood damage. As in Alternative 1, the facilities would provide visitor information because this site is not connected to boundary expansion lands.

Administrative / Emergency Access: To the extent possible, the alternatives would allow for administrative vehicle (ATV with trailer or equivalent) access in the non-wilderness corridor for law enforcement, trail crew materials and supplies and emergencies. This administrative access would also initially be part of Alternative 5. (*Note*: All administrative operations would initially or eventually include more use of helicopters than has occurred in the past, particularly for emergencies.)

7. Link to Future Use

Upon completion of acquisition of boundary expansion lands, the park would begin planning for reestablishment of frontcountry (drive-in) camping and administrative facilities outside the Carbon River Entrance, as called for by the GMP. As in Alternative 1, access to these facilities and the existing Carbon River area would then be linked.

8. Impact Avoidance, Minimization and/or Mitigation and Construction Measures

Mitigation measures are found in applicable resource sections in Chapter V: *Environmental Consequences* and are summarized in Appendix 1.

D. Alternative 2: Improved Hiking and Bicycling Trail in Historic Carbon River Road Corridor (Preferred)

1. Alternative 2 Public Access Summary

As noted above under *Elements Common to All Action Alternatives (2-5)*, the Carbon River Road would be reopened to private vehicles as far as a turnaround at the Old Mine Trailhead (1.2 miles). Between the Old Mine Trailhead and Ipsut Creek Campground, intact sections of the road would be used as improved trail and new formal improved trail would be constructed through or around flood damaged sections. Instead of a narrow, unimproved trail surfaced with native materials as in Alternative 1, the improved trail in Alternative 2 would be constructed 10 feet wide and would have a firm base with good sight distance to accommodate hikers and bicyclists. The sections of improved trail between the intact sections of road would follow the Carbon River Road, rehabilitating either the existing unimproved trail, rerouting sections to improve sight distance or following the existing intact sections of road up to the Ipsut Creek Trailhead (5.0 miles). The trail would therefore be located within or adjacent to the historic road corridor.

As future flooding occurs and additional sections of the roadway are damaged, more reroute trail would be constructed around the newly damaged sections. Where the historic Carbon River Road remains intact (between washout sections), the road would be retained until damage occurred. The formal trail would be built and maintained to provide public access for 10-15 years or until a formal trail can no longer be maintained due to future flooding, cost, engineering limitations, and/or unacceptable environmental impacts.

Unlike in Alternative 1, the width of the trail would safely accommodate hikers and bicyclists and occasional administrative ATVs (including a small trailer to transport supplies and materials). Depending on the width and capacity of trail bridges, other small administrative vehicles could potentially also be accommodated. Because the road and trail sections would continue to be affected periodically by flooding, it is likely that access would not be continuously available.

Over time, the two lane roadway now extant in some sections would be converted to formal hiking and bicycling trail as additional flood damage occurs. There would be no formal conversion of undamaged sections of roadway to a trail. Where flood damage has occurred, any remaining roadway would be scarified (broken up) to allow for a 10-foot-wide trail. For some time to come, the Carbon River corridor would include sections of former roadway connected by new sections of improved hiking and bicycling trail. As additional portions of the Carbon River Road washed out in subsequent flooding, they too would be modified and reconstructed as part of the proposed formal trail if feasible. If formal trail could not be constructed, informal trail with similar characteristics would be constructed around or through the new flood-damaged area(s).

Although it is anticipated that new trail sections could continue to be constructed and maintained within 100 feet of the center line of the existing road corridor for the short-term (i.e. out of designated wilderness), there is a possibility that the trail in Alternative 2 could no longer be maintained as a formal trail, at which time it would become unimproved, similar to the existing trail in Alternative 1. It is anticipated that future movement of the Carbon River could also eventually preclude bicycle use if, to maintain access, trail sections around washed-out areas needed to be constructed in wilderness. Bicycles are not permitted in Wilderness.

2. Alternative 2 Components

1. Parking, Road and Trail

Parking: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*.

Road : The intact section of two-lane road between the entrance and Old Mine Trailhead (1.2 miles) would be reconstructed (where needed) and maintained to historic road standards, with a crown and side ditches. Surfacing between the entrance and the Old Mine Trailhead would be compacted, crushed gravel. Over time it is likely that road characteristics, such as the crown and side-ditches would be lost in other currently intact sections of roadway beyond the Old Mine Trailhead, because the heavy equipment needed to maintain these would not be able to access the area.

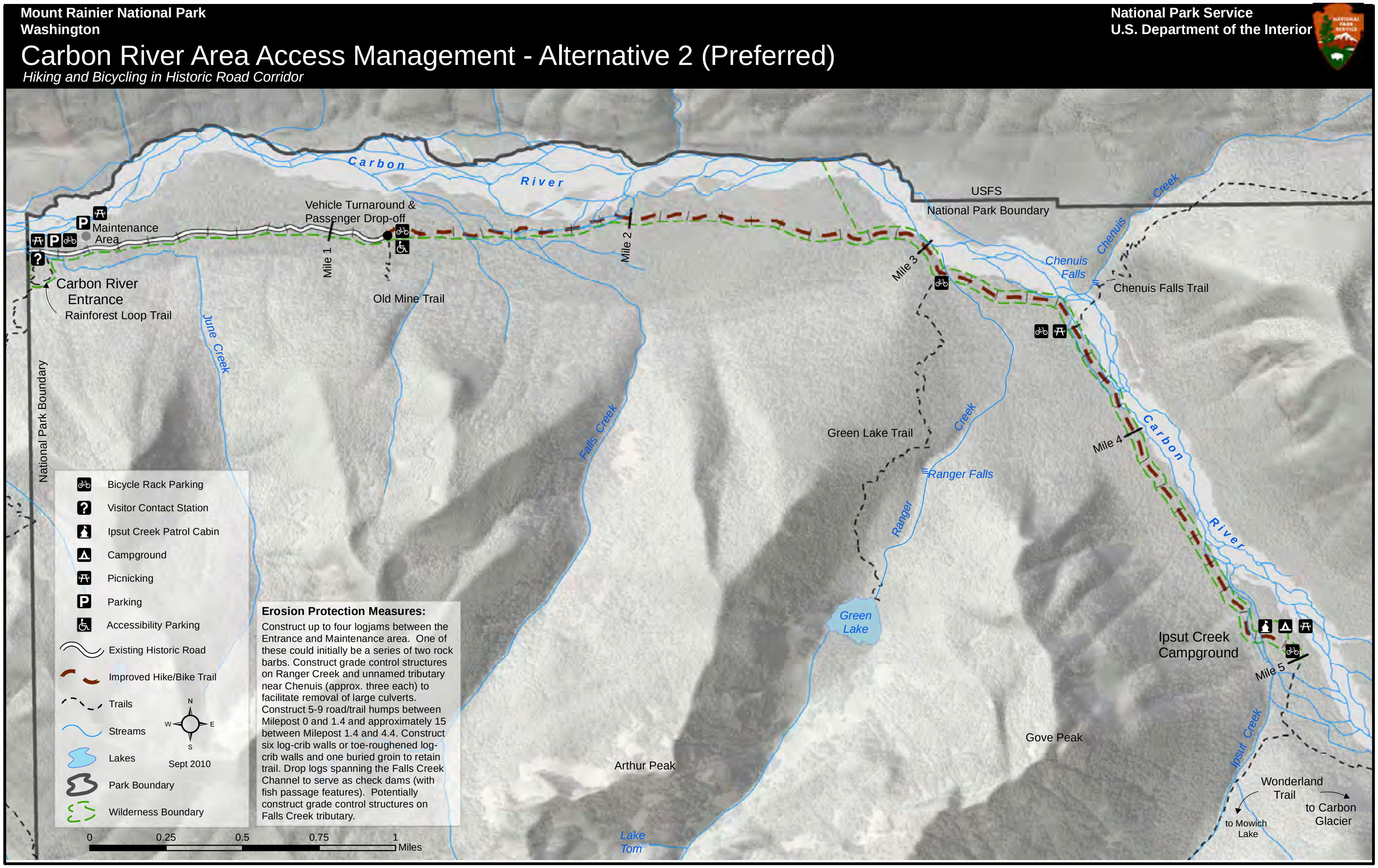
Trail: Public access beyond the Old Mine Trailhead turnaround on an improved formal hiking/bicycling trail surface would be within or adjacent to the Carbon River Road historic corridor up to the Wonderland Trailhead (5.0 miles). Initially sections of this trail would replace the washed out sections of the Carbon River Road but there would be long-stretches of intact roadway between the sections of new trail. (Approximately one mile of the five miles of roadway is currently heavily damaged by flooding.)

As needed, when more sections of trail or historic road are damaged by flooding, these would be gradually replaced with improved hiking and bicycling trail (10 feet wide). The intent would be to maintain a formal improved trail as long as possible. As noted above, replacement of the trail sections, however, would be dependent on the severity of flood damage, cost, engineering limitations, and/or unacceptable environmental impacts to maintain access within or adjacent to the historic road corridor and outside wilderness. Because the wilderness boundary is 100 feet from the centerline of the unpaved road, there is room to implement minor reroutes in problem areas.

Instead of an unimproved trail surfaced with native materials as in Alternative 1, the formal improved multiuse (hiking and bicycling) trail (10 feet wide) would have a constructed base and surface. Appropriate erosion control, drainage and other features, including erosion protection measures, such as grade control structures and check dams created by hanging logs spanning the former road channel would be used where needed. In addition a series of other erosion protection measures, including log crib walls, would help to retain the remaining portions of old road and proposed newly constructed formal trail.

Constructing the reroute trail sections 10 feet wide is consistent with recommended guidelines from the American Association of Safety and Highway Transportation Officials (AASHTO) for hiking/bicycling trails. Initially constructed reroute trail around washed-out sections would be similar in width to the Foothills Trail but would not be paved. Instead the tread would be comprised of compacted crushed gravel, suitable for hiking and most bicyclists.

Figure 15: Alternative 2: Hiking and Bicycling in Historic Carbon River Road Corridor



To minimize hiker / bicyclist conflicts and safety issues, design considerations would reduce blind curves and/or abrupt turns in the reroute trail sections as much as possible. The composition of the trail through or around washout sections would have a substantial base constructed of large native rock and/or gabion mattresses. New trail bridges, some with rock-filled gabion basket abutments, would be built over streams and low spots prone to future flooding (Table 4). Approximately 60 cubic yards of fill from nearby gravel bars of the Carbon River would be needed to construct the trail through or around washout sections (in gabion mattress, turnpike and low areas). Additional fill (imported and/or taken from nearby gravel bars) would be needed to construct the road humps, log crib walls, toe-roughened structures and the buried groin (see erosion protection measures section).

Table 4: Proposed Locations of Trail Bridges

Milepost	Type of Trail Bridge	Length of Trail Bridge	Notes
1.396	4-stringer	30 feet	Replaces hump
1.457	4-stringer	15 feet	Replaces culvert
1.483	4-stringer	35 feet	Replaces existing bridge Gabion mattress abutments
1.498	4-stringer	35 feet	Replaces existing bridge Gabion mattress abutments
1.644	4-stringer	35 feet	Replaces existing bridge Gabion mattress abutments
1.871	4-stringer	40 feet	Replaces culvert Gabion mattress abutments
3.142	Steel I-beam	10 x 40 feet (minimum)	Replaces Ranger Creek culvert Concrete footings
3.586	Steel I-beam	30 feet	Replaces 8-foot culvert Concrete footings
4.802	Log bridge	8 feet x 50 feet	Replaces existing log bridge over Ipsut Creek / Carbon River Log crib to protect west end approach
4.82	Concrete Road Bridge (existing)	62 feet	Retain concrete railings

*Note: Mileage taken from hand survey of proposed improvements based on linear feet from entrance.

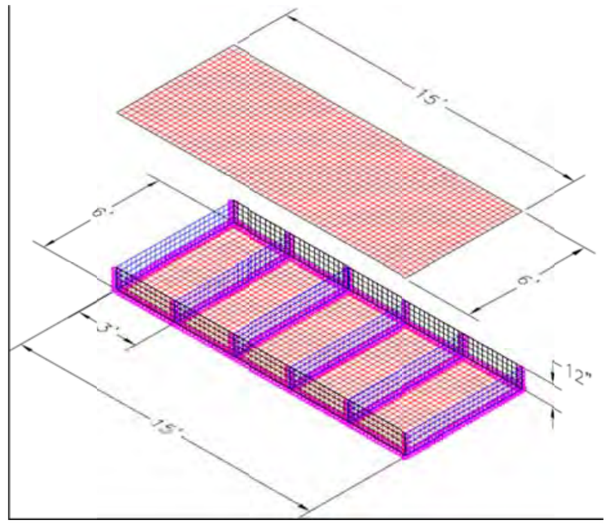
There are three washed-out sections in the Falls Creek area where the trail substrate is currently mostly made up of silt and sand with very little native rock with which to build the trail base. In these areas, wide, flat rock filled gabion mattresses would be built (Table 5). The permeable design structure of the gabion mattresses would both allow for a more substantial trail surface and would allow water to flow within it (Figure 15: *Proposed Gabion Mattress Design*).

Table 5: Proposed Locations for Gabion Mattress Trail Base

Milepost	Length	Cubic Yards Fill	Notes
1.561 – 1.649	440 feet		Silty sandy trail area
1.730 – 1.740	50 feet		Same as above
1.777 – 1.896	630 feet		Same as above
4.189	50 feet		Consider hardening road hump with gabion mattress

Periodic maintenance of the trail would require fixing and replacing tread when additional washouts occurred and during normal operations.

Figure 16: Proposed Gabion Mattress Design



Turnpikes are used to elevate the trail above wet ground (Table 4). The technique uses fill material from parallel side ditches and from offsite to elevate the trail above the surrounding water table and to allow water to flow underneath the trail. Turnpike construction is used to provide a stable trail base in areas of high water table and moderately- to well-drained soils.

Table 4: Proposed Locations of Turnpike and Fill Areas

Milepost	Length	Feature	Cubic Yards Fill	Size
1.503 – 1.539	212 feet	Turnpike		Needed to achieve 4-foot elevation gain
1.539 – 1.561	105 feet	Turnpike		Needed to achieve 2-foot elevation gain
3.184 – 3.265	430 feet	Fill Area		430 x 6 x 1 feet
3.413 – 3.440	130 feet	Fill area		130 x 6 x 0.5 feet
4.549	50 feet	Fill area	10	
4.568	50 feet	Fill area	20	
various	various	gabion mattress bridge abutments	16 cubic yards each for 4 bridges	(See Table 4: *Proposed Locations of Trail Bridges*)

2. Buildings and Structures

Carbon River Entrance: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*.

Carbon River Maintenance Area: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*.

Ipsut Creek Campground Area: Actions to remove facilities would be the same as in *Elements Common to All Action Alternatives (2-5)*. The Ipsut Creek Bridge, constructed in 1979-1980 and measuring 62 feet by 17.5 feet would be retained as long as it is viable for public trail use and doesn't impede hydrological conditions. If either of these two exceptions occurred, it would be removed and replaced with a suitable trail bridge.

Ipsut Creek Patrol Cabin: Ipsut Creek Patrol Cabin would be reconstructed on higher ground in one of the two former parking areas at Ipsut Creek (to be determined).

3. Erosion Protection Measures

Erosion protection measures initially recommended by Geomax Engineering, Inc. consultants (Appendix 3) and ENTRIX, Inc. consultants (Appendix 4) have evolved as additional information about the Carbon River corridor and its susceptibility to flooding has become available. Proposed erosion protection measures are not intended to provide protection from flooding, which will continue to occur. Some measures are intended to change the character of the flooding that occurs from deep scouring and head-cutting to sheet flow, quickly diverted off the road. Other measures would correct or minimize wide-scale riverbank erosion along the edge of the road.

In addition to those erosion protection measures described in *Elements Common to All Action Alternatives (2-5)*, the following types of erosion protection measures would be used: additional road humps (Table 5), span-log check dams(Figure 16: *Construction of Log Spanner*), toe-roughened crib walls or toe-roughened gabions (Figure 17: *Toe-roughened Log-crib / Gabion*), and a buried groin[Figure 20: *Launchable (Buried) Groin*]. These are described in sequence below.

Milepost 0 to Milepost 1.4 Carbon River Road and Milepost 1.379 – 4.252: A portion of the Carbon River Road between the entrance and the Old Mine Trailhead (1.2 miles) would be maintained to protect entrance area facilities and preserve an intact section of the Carbon River Road. To protect this area between the entrance parking area and the Old Mine Trailhead, a series of five to nine rock-cored road humps (see Figure 12 under Alternative 1) would be added to divert water flow off the road and to avoid increased damage to this section. This part of the road would also be repaired by reestablishing drainage ditches along both sides of the road. Another approximately 15 road humps would be constructed between Milepost 1.379 and Milepost 4.252 (Table 5). Each road hump would require 5-10 logs and would be designed in the field. It is possible that up to 500-1,000 cubic yards of rock could also be needed, depending on the location.

Table 5: Potential Locations for Road Humps between Entrance and Ipsut Creek

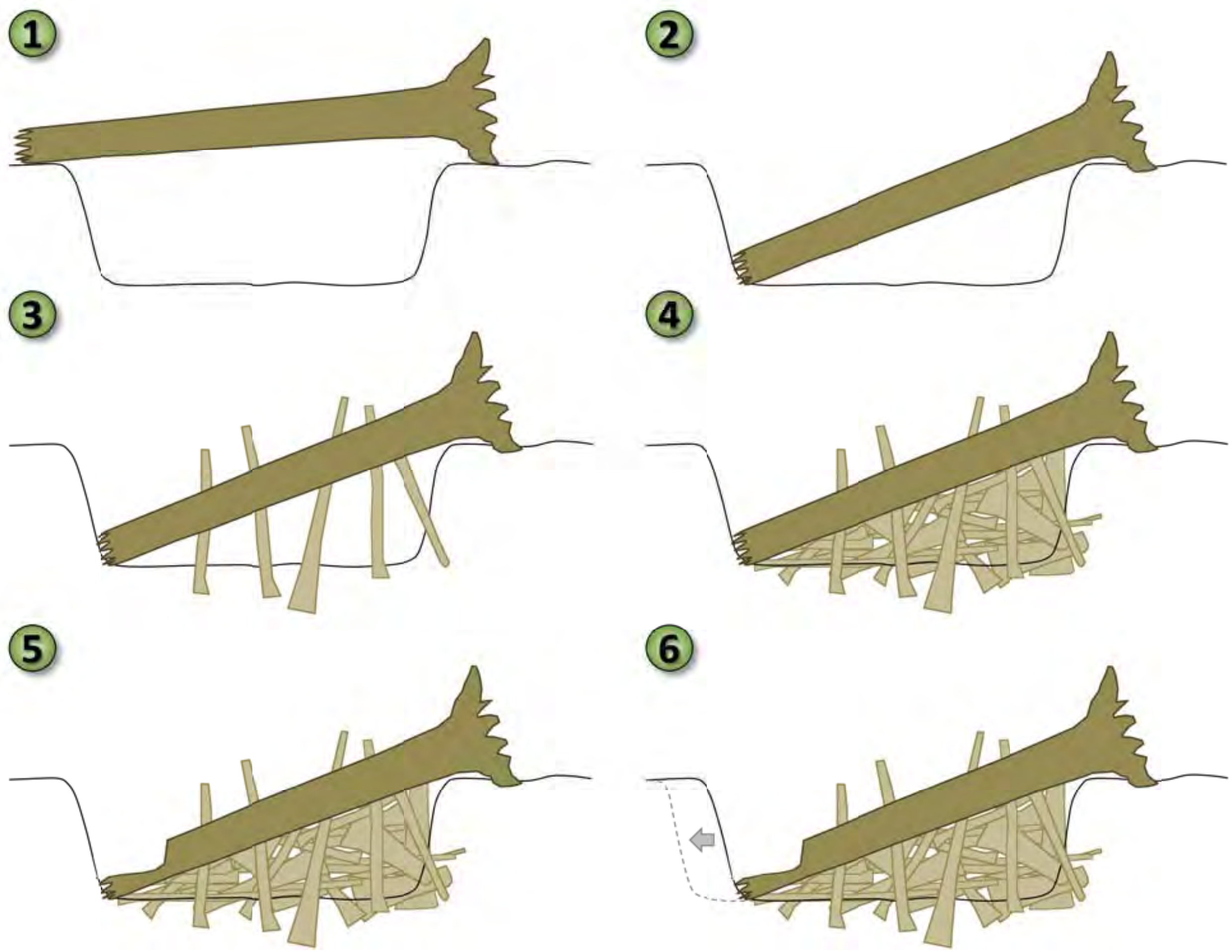
Milepost	Action
0.0 – 1.44	5-9 road humps
1.379	Potential site for road hump
1.396	Potential site for road hump
1.447	Potential site for road hump
1.539	Improve accessibility of existing hump
1.561	Replace hump with improved accessible hump.
1.591	Potential site for road hump
3.242	Construct road hump
3.267	Construct road hump
3.331	Potential site for road hump
3.387	Potential site for road hump
3.433	Potential site for road hump
3.765	Potential site for road hump
3.769	Potential site for road hump
4.189	Construct road hump
4.252	Potential site for road hump

Additional Potential Log Humps: In the future, as large trees fall over the intact road or sections of reroute trail, leaving the tree in place may occur. Gravel would be brought in and used to create a gradual ramp up and over the log, thereby creating a log hump in the road/trail. These log humps would function as a flood damage protection feature to reduce the velocity of future floods, to divert floodwater from the road/trail corridor, and to minimize flood damage from scouring and over-topping. These ramps would be designed to comply with accessibility standards to the greatest extent possible to allow for ongoing use of hiking, bicycling, and administrative ATV access, but may not be fully accessible.

Falls Creek (Milepost 1.457 – 1.959) Span-log Check Dams: Neither Geomax Engineering, Inc or ENTRIX, Inc. had recommendations that could alter the character of flooding in the Falls Creek washout area over the long-term because this area is up to 16 feet lower than the river and there are numerous points of entry from the river channel toward the road. Both consultant firms recommended rerouting the road (see *Alternatives and Actions Considered but Dismissed*). ENTRIX consultants, however, also suggested that some protection and possible refilling of the channel, could potentially be provided by creating check dams from existing downed trees (logs) spanning the road in locations where the road is now an active channel of the Carbon River. Log check dams within the gully may reduce additional head-cutting and trailside bank erosion and promote sediment deposition.

To implement this measure, fallen trees spanning the channel would be trimmed to a width larger than the channel and the cut end pulled upstream and then chocked or anchored into the stream bank (root wad side) from the confluence of this side channel of the Carbon River to the avulsion of the main stem of the Carbon River (Figure 16: *Construction of Log Spanner*).

Figure 17: Construction of Log Spanner



(1) Original spanning tree, diagram facing upstream. (2) Spanning tree is trimmed to a width larger than the channel and the cut end is pulled upstream. (3-4) Large woody debris or rock is chocked into the root-wad side of the channel. (5) If necessary as directed by aquatic biologists, the cut end of the spanning tree will be

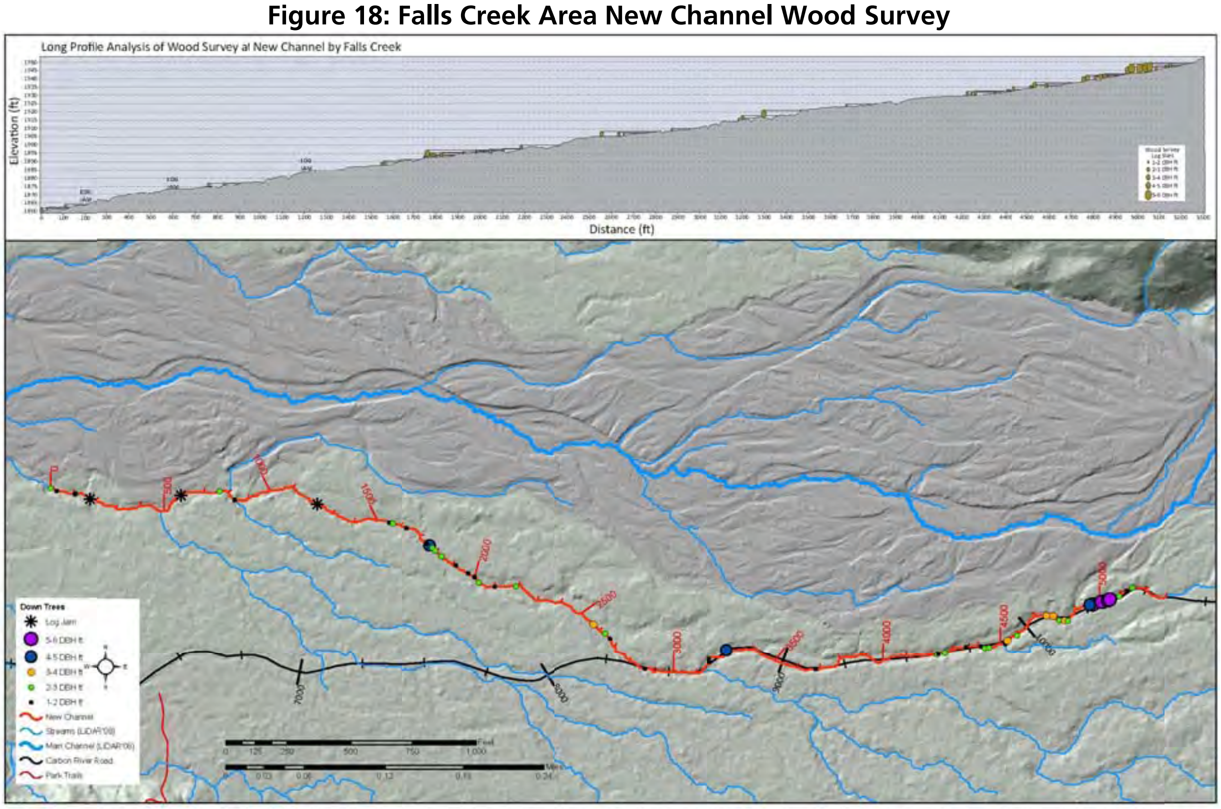
notched to allow fish passage. (6) Future flows in the channel may erode the right bank of the channel, widening it and preventing damage to the left bank.

This gully, which is up to 10 feet deep in places, was caused by the Carbon River flowing down the road and eroding it away. Approximately 29 existing logs span the old roadway in the Falls Creek area. The logs vary from 1-foot-dbh to 5-6 feet dbh (Figure 17: *Falls Creek Area New Channel Wood Survey*). These logs would be cut to lie across the new channel but would allow for fish passage by cutting a notch in the span log. Log ends with root wads still on or embedded in the river bank would be moved to lie across the channel leaving the root wad in place if possible. Cut ends of the logs would be set into the bank or wedged into the bank with machinery to prevent them from washing down the channel. Gaps under logs would be filled with wood and or larger rock on the upstream side of the log. Logs would be placed at intervals to allow natural aggregate from river flows to accumulate behind the logs. Log placement would help to dissipate flood water energy at check dams and, ideally to deposit material between the dams to reduce river bank erosion within the gully and ongoing erosion of the former road. Equipment would be limited to use in the new channel from July 16 – August 15, unless the channel is dry. It is also possible that future flows in the channel may erode the north bank of the channel, widening it and preventing damage to the south bank.

Photo 20: Natural Log Spanner

Because of bull trout presence, construction of these check dams would be modified to allow fish passage at the lower end of the spanning log. According to the USFWS, eight inches is the maximum drop for the span log to enable fish passage.

Figure 18: Falls Creek Area New Channel Wood Survey



Toe-roughened Gabion or Toe-roughened Log-crib Wall: There are four sections where a portion of the road (either one lane or two) has been eroded away between Milepost 3.463 and 4.470. At three of these locations (Milepost 3.463, Milepost 3.939, and Milepost 4.470), erosion protection structures would be constructed (Figure 19: *Toe-roughened Log-crib / Gabion*). At the fourth location (Milepost 3.769) where the road and the river are at the same level, a hump would be constructed to redirect flow back to the Carbon River and/or away from the road.

The three log-crib walls or toe-roughened log-crib walls would span the washed out sections of road ("bites") that are experiencing continuous bank erosion. They would be constructed lengthwise through the washouts and would then be filled with rock and soil to form the foundation for the new trail, while providing bank protection. The three bite locations are intermittently dry during the year.

Figure 19: Bank Erosion Bites above Chenuis
(From left to right Milepost 3.463, Milepost 3.939 and Milepost 4.470)

These structures, which are somewhat interchangeable, would be constructed as shown below and in Table 6: *Alternative 2 Summary of Proposed Erosion Protection Measures*. Quantities of rock and log are estimated. For the log-crib wall, the number and size of logs would depend on length and height of the structure but would be approximately 542 cubic yards. This would be taken from nearby gravel bars on the Carbon River (above the ordinary high water mark). More than 400 feet of logs would also be needed for the cribbing for a 100-foot long structure. Although some logs would be secured locally, others would be imported.

Proposed log-crib wall:

- Milepost 3.459 (250 feet long x 15 feet wide) (1500 cubic yards rock) (95 logs)
- Milepost 3.463 (240 feet long x 15 feet wide) (1,300 cubic yards rock) (90 logs)
- Milepost 4.470 (380 feet long x 15 feet wide) (2,060 cubic yards rock) (150 logs)

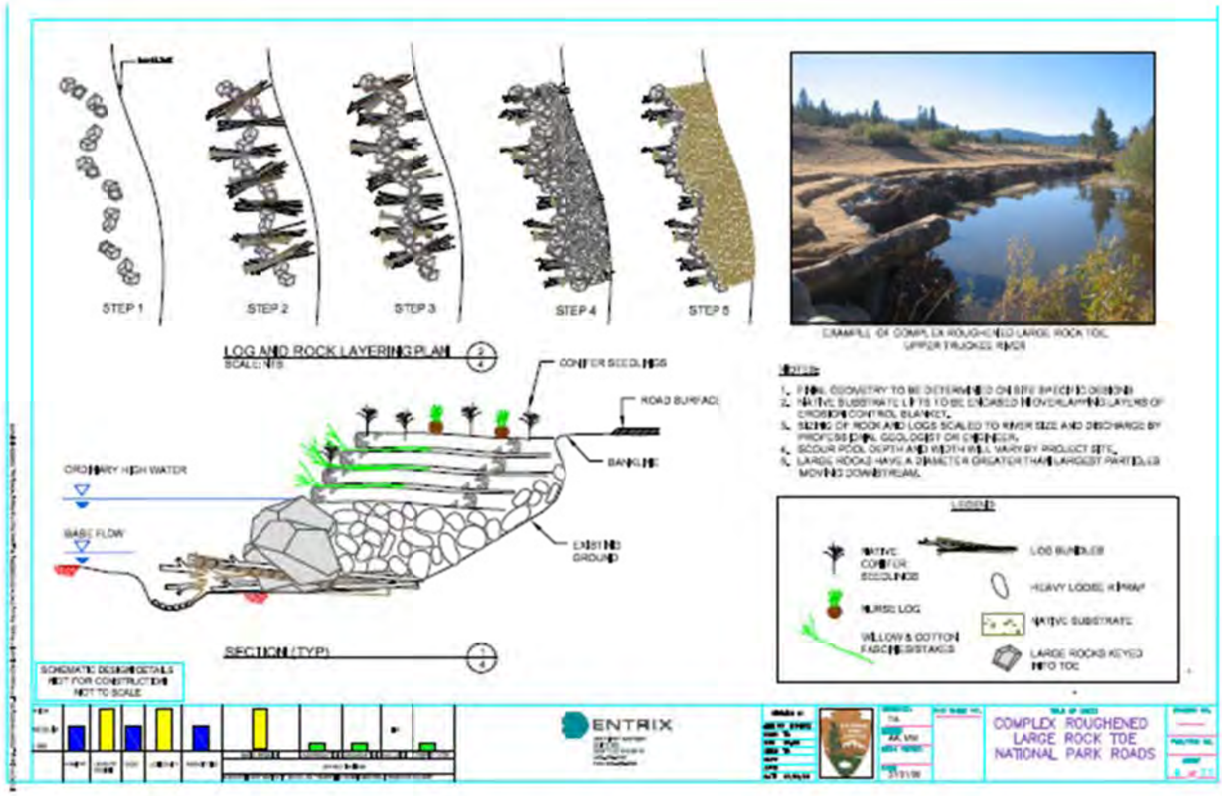
Proposed log crib wall or toe-roughened crib:

- Milepost 3.939 (200 feet long x 15 feet wide) (1,084 cubic yards rock) (75 logs)
- Milepost 4.802 (100 feet long x 15 feet wide) (542 cubic yards rock) (40 logs)

Proposed complex log-crib wall or toe-roughened log-crib wall:

- Milepost 4.658 (50 feet long x 15 feet wide) (704 cubic yards rock) (20 logs)

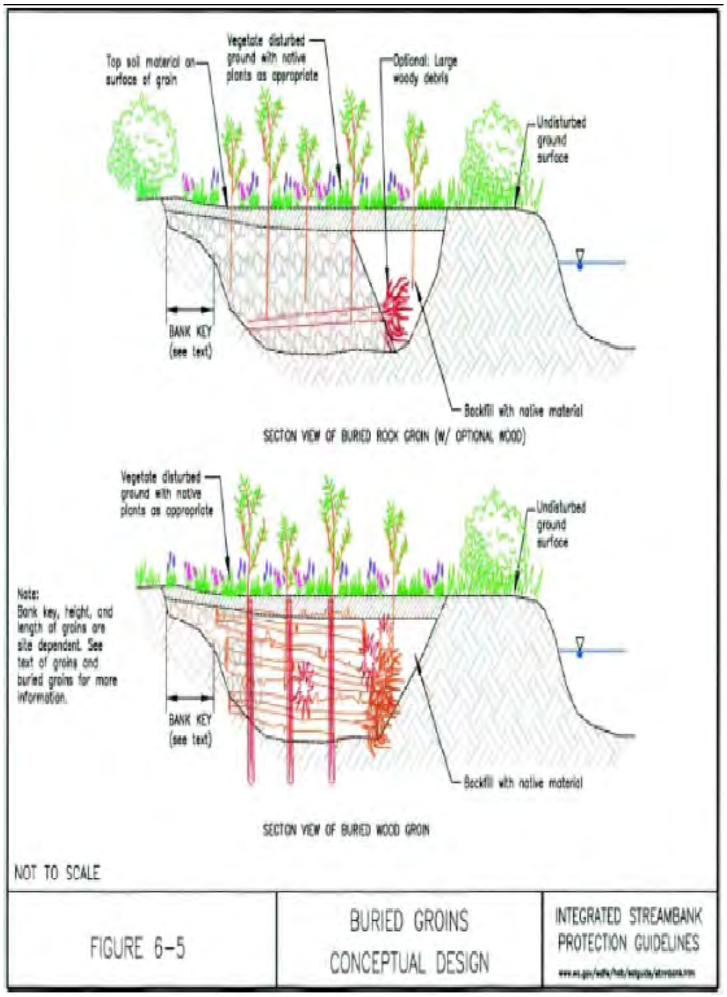
Figure 20: Toe-roughened Log-crib / Gabion



Note: In Toe-roughened gabion design, a gabion basket filled with river cobble would fill above the structure.

Launchable (Buried) Groin (Milepost 4.621): This structure (Figure 20: *Launchable (Buried) Groin*) would be constructed in a dry area approximately 60 feet from the Carbon River. Because it is anticipated that the Carbon River would eventually erode the area between where it is now and the proposed structure, the groins would be buried in the existing (dry) road, and would likely later be exhumed by floodwaters. The buried groins would protect approximately 590 feet of trail / road and would not require diversion of the Carbon River to construct.

Figure 21: Launchable (Buried) Groin



Together the erosion protection measures in Alternative 2 (including engineered logjams, road humps, span log check dams, log crib walls or toe-roughened crib walls, and a buried groin) are intended to retain the formal improved trail; however these types of structures implemented to this degree have not been tested in a dynamic environment. Nonetheless, it is likely that the character of the damage from future flooding would be reduced by implementation of these measures.

Table 6: Alternative 2 Summary of Proposed Erosion Protection Structures

Location	Proposed Erosion Protection Structure(s)					
	Engineered Logjam (ELJ) and/or Rock Barb	Log Spanning Check Dams	Toe-roughened gabions or toe-roughened log crib wall	Launchable (buried) groin	Road humps and dips	Grade control structures
Milepost 0.0 entrance (60 feet each)	1 logjam					
Milepost 0.152 maintenance area (60 feet each)	2 barbs converted as ballast for logjam, plus 3 log jams					
Milepost 0.2 – 1.4 to Old Mine Trailhead					approx. 5-9	
Milepost 1.539 – 4.423					approx. 15	
Milepost 1.457 to Milepost 1.959 Falls Creek		approx. 29				approx. 2
Milepost 3.142 Ranger Creek						approx. 3
Milepost 3.459			1 log crib			
Milepost 3.463 Road washout near knob (240 feet)			1 log crib wall			
Milepost 3.586 Unnamed channel behind hanging culvert						approx. 3
Milepost 3.939 (200 feet)			1 complex crib wall or toe-roughened crib			
Milepost 4.470 (380 feet)			1 log crib wall			
Milepost 4.621 (100 feet)				1 buried groin		
Milepost 4.658 (50 feet)			1 complex crib wall or toe-roughened crib			
Milepost 4.802 (40 feet)			1 log crib wall to protect bridge approach			

4. User Groups Accommodated

Public Access: As in Alternative 1, private vehicles could continue to drive to the Carbon River Entrance, where expanded parking would be available. As in other action alternatives, however, private vehicles could also continue to drive to a turnaround at Milepost 1.2 to pick-up or drop-off passengers. From there, hikers and bicyclists would access an improved hiking and bicycling trail to Ipsut Creek Campground.

Accessibility: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*. In addition, trail construction and maintenance is intended to comply with the federal Architectural Barriers Act standards to the greatest extent possible up to Ipsut Creek Campground, but may not fully meet these standards. Over time, however, as more flooding occurred and conditions changed in the corridor, accessibility would likely gradually worsen. Although the intent would be to maintain a formal improved trail throughout the corridor for as long as possible, over time some reroute sections may become informal unimproved trail, making these more difficult to traverse by people with impaired mobility.

Emergency / Administrative Access: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*.

5. Visitor Use Activities

Hiking: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*. Distances, to facilities and attractions would vary. Table 7 below shows the hiking distances from the proposed Old Mine Trailhead Vehicle Turnaround to primary trailheads and destinations in the Carbon River area. Without drop-off / pick-up at the turnaround, distances would be the same as in Alternative 1. As in Alternative 1, access to some areas may be delayed for a few days to a few weeks or months during future flood damage.

Table 7: Alternative 2 Hiking Distances to Primary Trailheads / Destinations from Proposed Old Mine Trailhead Vehicle Turnaround

Location	Distance (One-Way)	Distance (Round-Trip)	Destination Trail Length (one way)	Notes
Carbon River Rainforest Loop Trailhead	N/A	N/A	0.03 miles (Rainforest Boardwalk Trail)	Trailhead at entrance
Old Mine Trailhead	0 miles	0 miles	0.25 miles (Old Mine Trail)	Trailhead at Milepost 1.2
Green Lake Trailhead	1.9 miles	3.8 miles	1.8 miles (Green Lake Trail)	
Chenuis Falls Trailhead	2.4 miles	4.8 miles	0.4 miles (Chenuis Falls Trail)	
Ipsut Creek Campground	3.6 miles	7.2 miles	N/A	
Ipsut Creek Trailhead	3.8 miles	7.6 miles	variable	Launching Point for Wonderland, Northern Loop Trails, including to Carbon Glacier)
Carbon Glacier	7.2 miles	14.4 miles	3.4 miles (Carbon Glacier Trail)	This trail length is included in the total noted.

Camping: To accommodate ongoing camping, Ipsut Creek Campground would be converted to a hike-in / bike-in backcountry camp, with 15 individual sites and three group sites. Approximately 15 individual sites and one group site would be removed and restored. The group sites would be created either by combining former individual sites or by establishing new sites in former parking areas.

Picnicking: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)* plus picnicking would be retained near the Chenuis Falls Trailhead and at Ipsut Creek Campground.

6. Orientation / Fee Collection / Interpretation / Administration

Orientation: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*, plus additional orientation in the campground area would be available at the Ipsut Creek Patrol Cabin through seasonal use by employees and volunteers.

Fee Collection: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*.

Interpretation: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*. In addition, there would be new interpretive exhibits at the Chenuis Falls Picnic Area and at Ipsut Creek Campground.

Emergency / Administrative Access: The improved trail could be used for all-terrain vehicle access to transport materials and supplies for trail repair and for emergency access. Over time, however, this ability could diminish as additional washouts occurred or because of the inability to effectively maintain the sections of improved trail.

7. Carbon River Road and Facility Maintenance / Restoration

The width of the historic road corridor would be retained where possible, including the existing canopy width and roadside vegetation, however to facilitate restoration, scarification of approximately 10 feet within the remaining 20-foot wide sections of roadway would occur in areas of flood damage. Where needed, cross-ditch culverts would be retained and intermittent and perennial stream culverts would be replaced with trail bridges as described (Table 8). Other road characteristics, including the crown and side ditches would likely be lost over time due to the inability to get heavy equipment into the area to maintain these. The Green Lake, Chenuis and Ipsut Creek trailhead parking areas would retain space for bicycle racks and administrative ATV parking. Remaining portions of these areas would be obliterated.

Table 8: Existing Culverts to be Retained and Proposed New Culverts

Milepost	Size (in.)	Existing or New	Notes
1.334	unknown	Existing	Retain drain ditch culvert
4.49*	24 x 30	New	Culvert in ditch line
4.57*	24 x 30	New	Culvert in ditch line
4.76*	30 x 30	New	To accommodate seasonal or intermittent flows

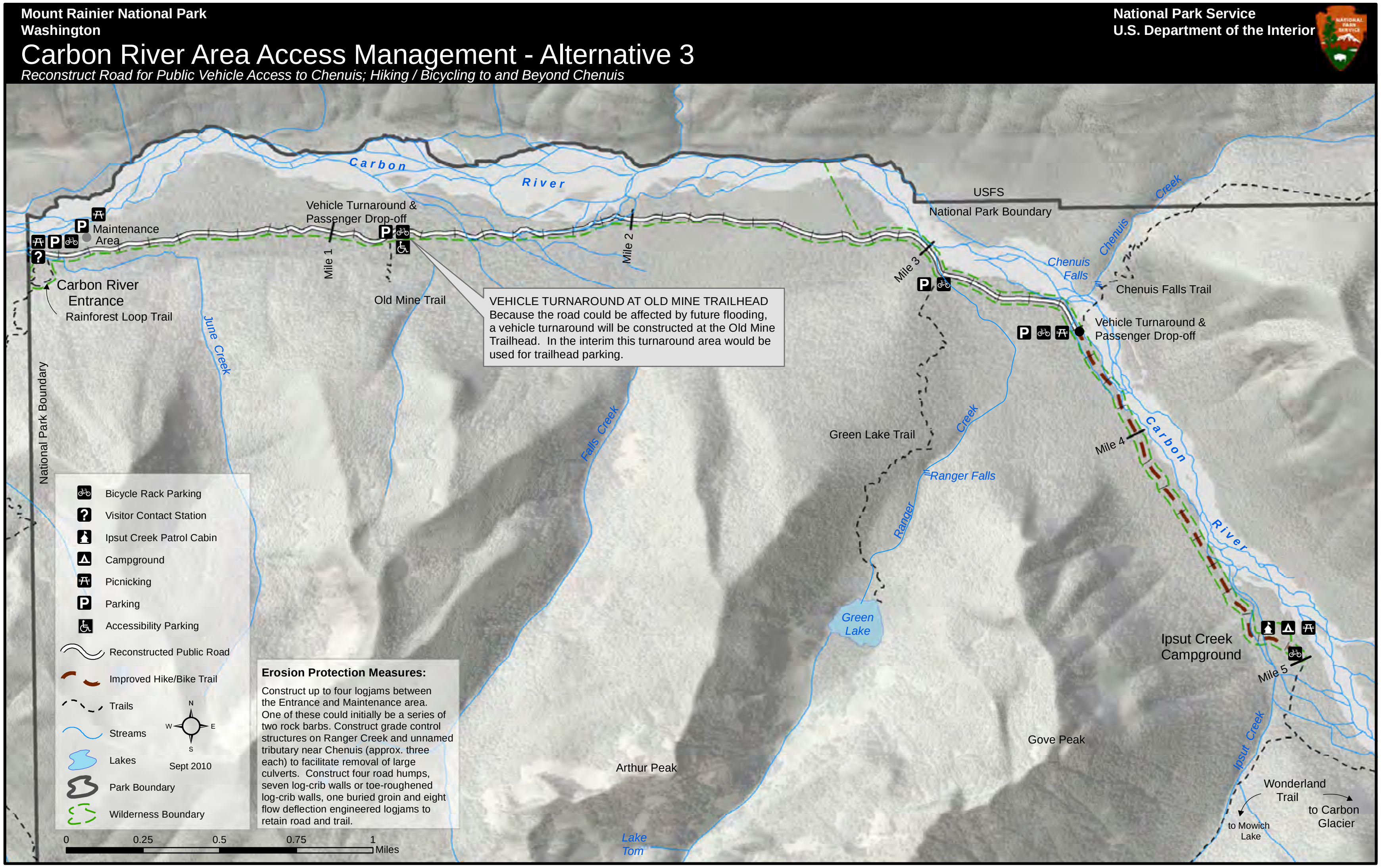
*Mileage taken from hand survey of proposed improvements based on linear feet from entrance

E. Alternative 3: Public Vehicle Access on Carbon River Road to Chenuis: Hiking and Bicycling Trail Beyond

1. Alternative 3 Public Access Summary

The Carbon River Road would be reopened to public vehicles up to Chenuis (3.6 miles). Beyond Chenuis, there would be an improved trail up to Ipsut Creek Trailhead (1.4 miles). The trail between Chenuis and the Ipsut Creek Trailhead would be the same as in Alternative 2. Also as in Alternative 2, because the road could be affected by future flooding, a public vehicle turnaround at the Old Mine Trailhead (1.2 miles) would also be constructed. In the interim, however, this area could be used for trailhead parking.

Figure 22: Alternative 3: Public Vehicle Access on Carbon River Road to Chenuis, Hiking and Bicycling Trail Beyond



The road and trail corridor would be open to and would accommodate hikers and bicyclists to its end and public vehicles up to Chenuis. Washed out sections of road would be reconstructed as a one-lane road (12 feet wide) with turnouts (between the Old Mine Trailhead turnaround and Chenuis). Beyond Chenuis, the formal hiking and bicycling trail (10 feet wide) would be constructed within or adjacent to the historic Carbon River Road corridor. To allow for future modifications to the road below Chenuis, where the road is intact between washout sections, the full-width of the historic road corridor (20 feet) would be retained where it exists. Above Chenuis, only approximately 300-400 feet of road is intact and this would be reconstructed as trail. Because this alternative would allow heavy equipment to reach the Ipsut Creek Bridge, the bridge would be demolished and removed.

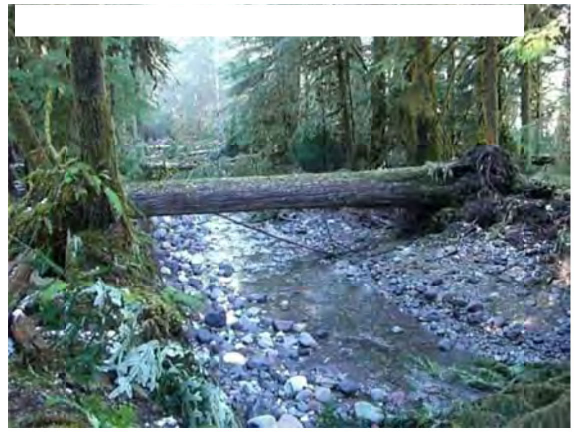


Photo 21: Potential Span Log

As in other alternatives, because the road and trail sections would continue to be affected periodically by flooding, it is likely that, as in the past, private vehicle access would not be continuously available. Over time, the two lane roadway would be converted to one lane road with turnouts as additional sections washed out. There would be no conversion of the intact portions of roadway unless current or future damage precluded maintaining them.

Although the intent would be to maintain a drivable road corridor up to Chenuis for as long as possible, if future damage occurred that precluded this, the road could revert to a trail, similar to Alternative 2.

2. Alternative 3 Components

a. Parking, Road and Trail

Parking: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*. In addition, there would be limited parking at the Old Mine Trailhead, Green Lake Trailhead and Chenuis.

Old Mine Trailhead Parking / Turnaround: As in other action alternatives, because the road could be affected by future flooding, a public vehicle turnaround at the Old Mine Trailhead (1.2 miles) would also be constructed. In the interim, however, this area could be used for trailhead parking as it has been in the past.

Chenuis Turnaround: A turnaround / parking area would be constructed at Chenuis to accommodate approximately 30 vehicles.

Road: Reconstructed portions of the Carbon River Road would meet historic road standards, with a crown and side ditches but would retain only one lane (12 feet wide) with turnouts, instead of two lanes (20 feet wide). The road base would be constructed from imported angular rock mixed with native rock and would be topped with gravel.

Proposed Falls Creek Area Repairs (Milepost 0.8 – 2.0): To construct the one lane road, new road sections would replace washed out sections in the historic road corridor. Approximately 7,480 cubic yards of class III riprap (angular rock) as called for by the 1996 WFLHD hydraulic report would be imported to fill the Falls Creek channel (WFLHD 2006) (Table 9). This would be mixed with 4-inch minus cobble (1,000 cubic yards) and 5/8-inch minus gravel (1,080 cubic yards).

In addition, downed timber would be removed from the road prism and two large culverts (46 inches and 72 inches) would be excavated and one of these replaced. For the Falls Creek culvert, the inlet basin would be excavated two feet below the surface and debris would be cleaned out of the culvert to restore its function. The buried Falls Creek channel would also be excavated and connected to the existing channel. Approximately 1,000 square feet of material would be removed above the inlet to provide for a sediment trap. This material would be reused for general fill.

Once complete, the road portion of the access route would accommodate private vehicles and other user groups, while the trail portion, as in Alternative 2, would accommodate hikers, bicyclists and administrative ATVs. The one-lane section at Falls Creek (2,600 feet) would have turnouts, constructed typically every 500 feet, but these would be more frequent before and after curves to improve safety associated with sight distance. Approximately eight turnouts would be constructed. Other one lane sections would also be constructed near Milepost 3.4 (see below) and in future wherever the road would be too narrow (because of erosion) to accommodate two-way traffic.

Proposed Green Lake Area Repairs (Milepost 3.1 – 3.4): Fill erosion would be repaired around the downstream end of the Ranger Creek culvert; fill erosion would be repaired between Milepost 3.1-3.4; and the failing bank at Milepost 3.4 would be rip rapped (WFLHD 2007) (Table 9). Approximately 550 feet of bank and road erosion 18 or more inches deep and approximately 1,300 feet of scoured roadway would be repaired. This would require approximately 380 cubic yards of Class 5 riprap, 780 cubic yards of additional fill, and 300 cubic yards of 5/8-inch minus gravel topping. Again, as called for by the 1996 WFLHD hydraulic report, Class III riprap would be used where possible to fill eroded areas (WFLHD 2007).

Photo 22: Ranger Creek Culvert

Photo 23: Sloughing Along Edge of Road

Proposed Chenuis Falls Area Repairs (Milepost 3.6 – 3.7): Eroded fill and surface scour in this area would be repaired (Table 9). This would require approximately 50 cubic yards of road fill and 150 cubic yards of 5/8-inch minus gravel topping. As in other areas, fill would be comprised of Class III riprap.


Photo 24: Washout Area Above Chenuis   **Photo 25: Section of Washed Out Road**

The new one-lane sections of road would link current two-way sections of road, where the road remains minimally damaged or undamaged. As in Alternative 2, the facility (road and trail) would be constructed using appropriate drainage and other features, including erosion protection measures, such as grade control structures and crib walls (approximately 280 linear feet of log crib wall, toe-roughened crib wall, a buried groin and twelve logjams) would be constructed (see c. *Erosion Protection Measures*).

Table 9: Proposed Fill Areas on Road (Alternatives 3 and 4)

Milepost	Amount of Fill (cubic yards)
Milepost 1.457 to Milepost 1.959 Falls Creek Washout (2,600 feet)	7,480 cy Class 3 riprap 1000 cy river cobble 1,080 cy 5/8-inch minus gravel
Milepost 3.1 – 3.4 (550 feet)	380 cy Class 5 riprap 780 cy other fill 300 cy 5/8-inch minus gravel
Milepost 3.6 – 3.7	50 cy fill 150 cy 5/8-inch minus gravel

Trail: As in Alternative 2, an improved formal multiuse (hiking and bicycling) trail would be constructed, except that the trail would begin at the Chenuis Falls Turnaround (rather than the Old Mine Trailhead) and continue to Ipsut Creek Campground. As a result, fewer trail bridges would be needed (Table 10). As in Alternative 2, the trail would be comprised of native soil and rock, compacted to create a firm trail surface, and then overlain with imported crushed gravel. As needed, when more trail was damaged by flooding, it would gradually be replaced as improved hiking and bicycling trail (10 feet wide). As in Alternative 2, the formal improved trail would be maintained as long as possible, however future damage could mean replacing formal trail with informal trail or replacing trail within or adjacent to the road corridor with trail located in wilderness. Actions to maintain the shorter length of trail would be the same as in Alternative 2.

Because it is likely that future washouts would occur, there would be an ongoing need to import material to maintain the road and trail.

Table 10: Proposed Locations of Trail Bridges (Alternatives 3 and 4)

Milepost	Type of Trail Bridge	Length of Trail Bridge	Notes
4.802	Log bridge	8 feet x 50 feet	Replaces existing log bridge over Ipsut Creek / Carbon River Log crib to protect west end approach
4.823	Concrete Road Bridge (existing)		Replace with log bridge

b. Buildings and Structures

Carbon River Entrance: Actions would be the same as described in *Elements Common to All Action Alternatives (2-5)*.

Carbon River Maintenance Area: Actions would be the same as described in *Elements Common to All Action Alternatives (2-5)*.

Ipsut Creek Campground Area: Actions to remove facilities would be the same as in *Elements Common to All Action Alternatives (2-5)*. In addition, the Ipsut Creek road bridge would be demolished by heavy equipment and then hauled out via all-terrain vehicle trailer to Chenuis and then by truck from Chenuis. Approximately 50 dump truck loads (250 cubic yards) would be required to remove it. The bridge would be replaced with a suitable trail bridge (Table 10).

Ipsut Creek Patrol Cabin: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*. The Ipsut Creek Patrol Cabin would be reconstructed on higher ground in one of the two parking areas at Ipsut Creek (to be determined).

c. Erosion Protection Measures

Road and Trail Protection: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)* with four log jams and initially two rock barbs at the entrance and maintenance area, approximately six road humps and five of the same log-crib or toe-roughened log crib structures at the same locations identified in Alternative 2 (no structure at Milepost 3.459). In addition, there would be eight additional flow deflection logjams, and two additional log-crib structures (at Milepost 1.457 and Milepost 2.955) (Table 11).

Falls Creek Improvements (Milepost 1.457 – 1.959): Instead of the improved trail in Alternative 2, erosion protection measures for the one lane road in Alternative 3 using the existing washed-out section of roadway would include either 2,600 feet of a complex log-crib wall or buried log-rock toe structures to provide continuous bank protection. To accommodate this bank protection, the road would be moved south. As in Alternative 2, a series of span-log check dams would be created in the gully between the structure and the Carbon River.

The two options for erosion protection along the roadway would be different:
Option 1: Log-crib wall: This structure would require approximately 15 trees per 40 feet of log-crib wall construction (Figure 19: *Toe-roughened Log-crib / Gabion*). Of these, four would need root wads attached, and 11-14 could be without. A total of approximately 1,312 trees would be required for the 2,600 feet.

Option 2: Complex Roughened Large Rock Toe Structure: This structure would require approximately 350-400 trees with and without root wads (Figure 22: *Buried Log-Rock Toe Cross-section View*) and large rock.

Neither option would allow for roadside aggradation to occur. As a result the structure could become perched and the Carbon River could cut around the end of the structure and cause its failure. Both designs would need to be keyed into pre-existing stable bank. Of the two methods, the first would likely have the most opportunity for success because the Carbon River could move into the pre-2006 road prism. The river is currently located approximately 16 feet above the eroded road prism and the eroded road prism is not wide enough to support the Carbon during bank-full conditions should it move into this channel. Therefore if the river moves into this channel, the ensuing channel equilibrium and sedimentation which would occur could erode both banks, regardless of the manner of bank stabilization. Neither of these bank stabilization methods has been tested in an area like Falls Creek and there is a high likelihood that the Carbon River channel could continue to migrate toward this area.

In addition to the log-crib structures proposed at Milepost 3.463, 3.939, 4.470, 4.658, and 4.802 in Alternative 2, the launchable (buried) groin at Milepost 4.621 and the complex crib wall or other structure at Falls Creek, Alternative 3 would also include a new log-crib structure at Milepost 1.457 and 2.955 and eight flow deflection ELJs.

Flow deflection logjams (60 feet x 60 feet x 20-30 feet) would be constructed west of Green Lake Trailhead at

- Milepost 2.992,
- Milepost 3.030,
- Milepost 3.068, and
- Milepost 3.106.

Additional flow deflection logjams (60 feet x 60 feet x 20-30 feet) would be constructed

- Milepost 3.523,
- Milepost 3.561,
- Milepost 3.598, and
- Milepost 3.636.

Figure 23: Buried Log-Rock Toe Cross-section View

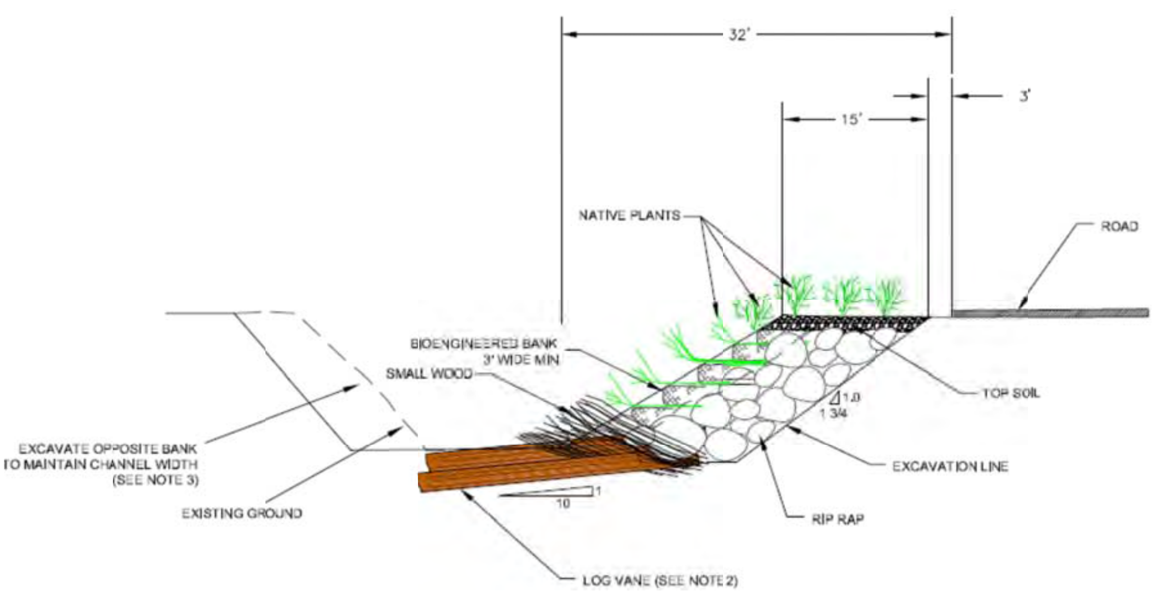


Table 11: Summary of Alternatives 3 and 4 Proposed Erosion Protection Structures**

Note: All structures pertain to Alternatives 3 and 4. In addition, Alternative 4 could have structures indicated by **. Logjams would generally be 60 x 60 feet

Location	Proposed Erosion Protection Structure(s)				
	Engineered Logjam (ELJ) and/or Rock Barb	Log Spanning Check Dams	Toe-roughened gabions or toe-roughened log crib wall	Launchable (buried) groins	Grade control structures
Milepost 0.0 entrance	1-2 logjams				
Milepost 0.152 maintenance area	2 barbs converted to ballast for 1 logjam plus 3 logjams				
Milepost 1.457 to Milepost 1.959 Falls Creek (2,600 feet)			1 complex crib wall or complex roughened large rock toe		approx. 2
Milepost 2.955 West of Green Lake Trailhead			1 rock-filled log crib wall		
Milepost 2.992	1 logjam				
Milepost 3.030	1 logjam				
Milepost 3.063	1 logjam				
Milepost 3.106	1 logjam				
Milepost 3.142 Ranger Creek					approx. 3
Milepost 3.463 Road washout near knob (240 feet)			1 log crib wall		
Milepost 3.523	1 logjam				
Milepost 3.561	1 logjam				
Milepost 3.586 Unnamed channel behind hanging culvert					approx. 3
Milepost 3.598	1 logjam				
Milepost 3.636	1 logjam**				
Milepost 3.674	1 logjam**				
Milepost 3.712	1 logjam**				
Milepost 3.750 (240 feet)			1 log crib wall**		
Milepost 3.939 (200 feet)	1 logjam**		1complex crib wall or toe-roughened crib Alt 3 or 1 cribwall**		
Milepost 4.470 (380 feet)			1 log crib wall		
Milepost 4.621				1 buried groin	

Milepost 4.658 **(50 feet)**			1 complex crib wall or toe-roughened crib		
Milepost 4.802 (240 feet)			1 log crib wall to protect west bridge abutment		

Table 12: Proposed Road Humps (Alternatives 3 and 4)

Milepost	Alternative 3	Alternative 4
3.765	x	
3.769	x	x
4.189	x	
4.252	x	

d. User Groups Accommodated

Public Access: Private vehicles could continue to drive to Chenuis (Milepost 3.6), where passengers could be dropped off or picked up at a turnaround. Limited parking (space for approximately 30 vehicles) would also be available in this area. From Chenuis, there would be an improved hiking and bicycling trail that would continue to Ipsut Creek Campground (1.4 miles).

Accessibility: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*. In addition, private vehicle travel to Chenuis (Milepost 3.6), instead of just to the Old Mine Trailhead (Milepost 1.2) would improve accessibility but would not reach the campground. Accessibility from Chenuis to Ipsut Creek Campground via trail would be the same as in Alternative 2.

e. Visitor Use Activities

Hiking: As in Alternatives 1 and 2, access to all visitor use areas within the Carbon River area would be open to foot-traffic. Table 13: *Alternative 3 Hiking Distances to Primary Trailheads* shows the hiking distances from the proposed Chenuis turnaround. Without drop-off / pick-up at the turnaround, distances would be the same as in Alternative 1 (from the entrance) or Alternative 2 (from the Old Mine Trailhead Turnaround). As in Alternatives 1 and 2, access to some areas may be delayed for a few days to a few weeks or months when damage occurs.

Table 13: Alternative 3 Hiking Distances to Primary Trailheads / Destinations from Chenuis Turnaround

Location	Distance (One-Way)	Distance (Round-Trip)	Destination Trail Length (one way)	Notes
Carbon River Rainforest Loop Trailhead	N/A	N/A	0.03 miles (Rainforest Boardwalk Trail)	Trailhead located at entrance
Old Mine Trailhead	0 miles	0 miles	0.25 miles (Old Mine Trail)	Trailhead located at Milepost 1.2
Green Lake Trailhead	0 miles	0 miles	1.8 miles (Green Lake Trail)	
Chenuis Falls Trailhead	0 miles	0 miles	0.4 miles (Chenuis Falls Trail)	

Ipsut Creek Campground	1.2 miles	2.4 miles	N/A	
Ipsut Creek Trailhead	1.4 miles	2.8 miles	variable	Launching Point for Wonderland, Northern Loop Trails, including to Carbon Glacier)
Carbon Glacier	4.8 miles	9.6 miles	3.4 miles (Carbon Glacier Trail)	This trail length is included in the total noted.

Ipsut Creek Camping: As in Alternative 2, Ipsut Creek Campground would be converted to a hike-in / bike-in backcountry camp with 15 individual sites and three group sites. Fifteen individual sites and one group site would be removed and restored. The group sites would be created either be by combining former individual sites or by establishing new sites in former parking areas.

Picnicking: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)* plus picnicking would be retained near the Chenuis Falls Trailhead (if possible, given expanded parking) and at Ipsut Creek Campground.

f. Orientation / Fee Collection / Interpretation / Administration

Orientation: Actions would be the same as in Alternative 2.

Fee Collection: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*.

Interpretation: Actions would be the same as in Alternative 2, with new exhibits at the maintenance area river overlook, Chenuis Falls Picnic Area, and Ipsut Creek Campground.

Emergency / Administrative Access: There would be improved vehicle travel on the road and, as in Alternative 2, the improved trail could be used for all-terrain vehicle access to transport materials and supplies for trail repair and for emergency access. Over time, however, this ability could diminish as additional washouts occurred or because of the inability to effectively maintain the sections of improved trail beyond Chenuis.

g. Carbon River Road and Facility Maintenance / Restoration

The width of the historic road corridor would be retained where possible within the first 3.6 miles to allow flexibility to convert two lane sections of road to one lane sections when additional damage occurs. Actions to maintain the road would be the same as in Alternative 3 but because the road would be longer, these would require more work. Beyond Chenuis, however, where much of the road has been lost, 10-feet width of the remaining 300-400 feet would be scarified (as in Alternative 2) to facilitate restoration. The Ipsut Creek Trailhead parking area would provide space for bicycle rack parking and administrative ATV parking while the remainder would be partially obliterated.

F. Alternative 4: Seasonal / Weekend Shuttle Access on Carbon River Road for 4.4 Miles: Hiking and Bicycling Trail Beyond

1. Alternative 4 Public Access Summary

Public access from the Old Mine Trailhead turnaround would be via a road open to seasonal / weekend shuttles up to Milepost 4.4 and then via an improved trail between Milepost 4.4 and Wonderland Trailhead (0.6 miles). As in Alternatives 1-3, the corridor would continue to be open to hikers and bicyclists year-round. As in *Elements Common to All Action Alternatives (2-5)*, the first 1.2 miles of the Carbon River Road would be used to allow seasonal passenger drop-off / pick-up at a turnaround constructed near the Old Mine Trailhead for hiking and bicycling. As in Alternatives 2 and 3, the trail portion of the access route would accommodate hiking and bicycling and administrative ATVs as long as possible.

In washout sections, a one-lane road (10 feet wide) would be constructed within the historic Carbon River Road corridor up to Milepost 4.4. Beyond Milepost 4.4, the formal hiking and bicycling trail (10 feet wide) would be constructed within or adjacent to the historic Carbon River Road corridor up to Ipsut Creek. Its construction would be the same as in Alternative 2. As in Alternative 3, where the road is intact between washout sections, the full-width of the historic road corridor (20 feet) would be retained. As in Alternative 3, this would allow for future modifications to the road. Remaining road above Milepost 4.4 would be reconstructed as 10-foot wide trail, including scarification (mixing of the top 6-8 inches of gravel and soil) of any remaining sections of 20-foot wide roadway to facilitate revegetation.

Approximately 10,000 cubic yards of fill would be required to reconstruct the one lane road to Milepost 4.4. As in Alternatives 2 and 3, the facility (road and trail) would be constructed with appropriate erosion control, drainage and other features, including erosion protection measures, such as grade control structures and rock barbs where needed (see *Elements Common to All Action Alternatives*).

As in Alternative 3, over time, the two lane roadway would be converted to one lane access road as additional sections washed out. There would be no conversion of the roadway unless current or future damage precluded maintaining it. Although the intent would be to maintain a shuttle access road corridor up to Milepost 4.4 for as long as possible, if future damage occurred that precluded this, the road could revert to a trail, similar to Alternative 2. As in other alternatives, because the road and trail sections would continue to be affected periodically by flooding, it is likely that, as in the past, vehicle access would not be continuously available. As in Alternative 3, the Ipsut Creek Bridge would be demolished and removed.

2. Alternative 4 Components

a. Parking, Road and Trail

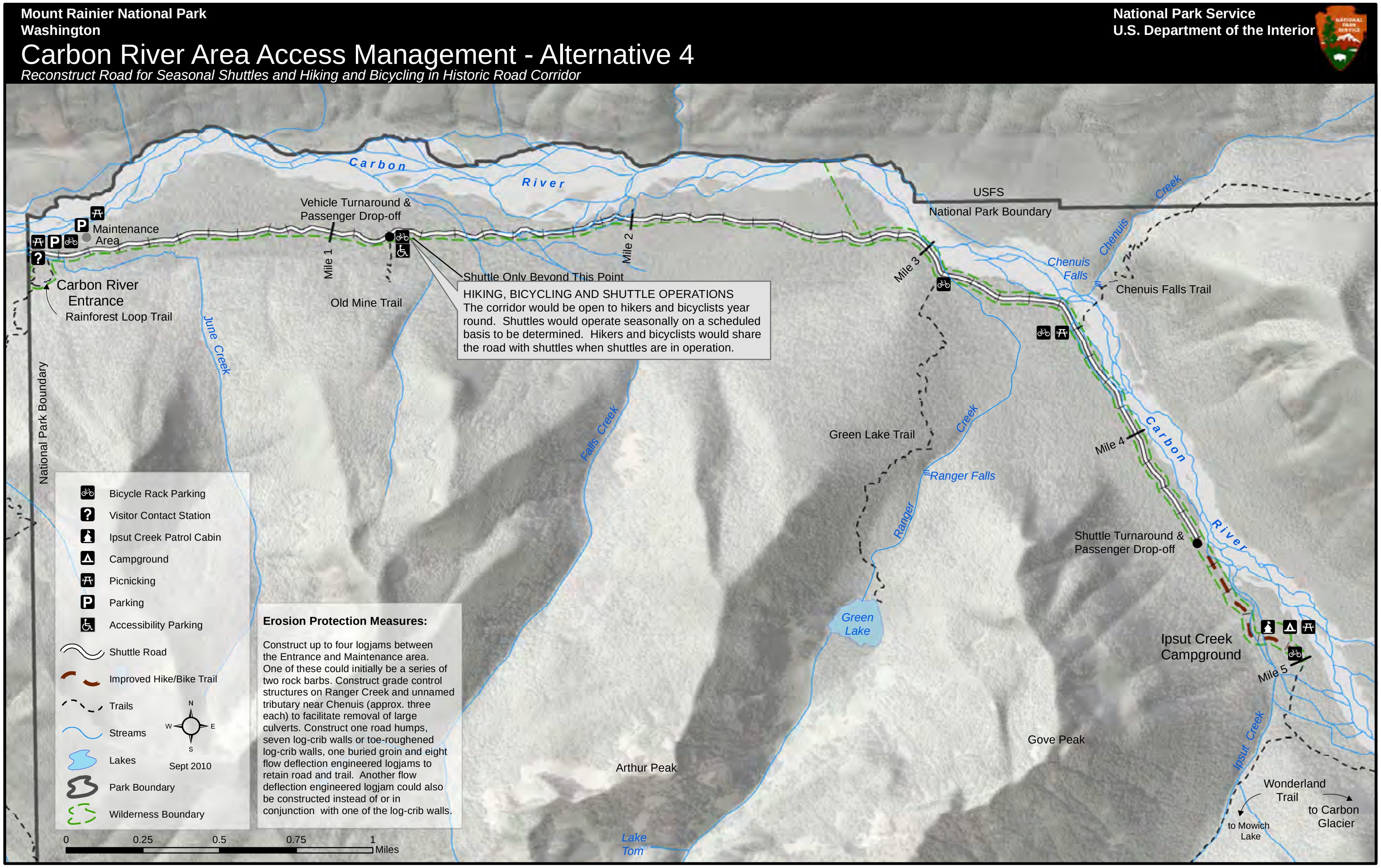
Parking: Actions would be the same as in Alternative 2. There would be parking at the entrance, maintenance area and at a location outside the entrance in conjunction with partners, if possible. Initially, parking would be similar to Alternative 1. As implementation proceeded, and as in Alternatives 2 and 3, non-historic buildings and structures at the Carbon River Entrance would be removed. Their footprint would be converted to additional parking area. The Green Lake, Chenuis and Ipsut trailhead parking areas would be obliterated except for new functions (such as bicycle racks and administrative ATV parking).

Road: As in Alternative 3, washed out sections of the Carbon River Road would be reconstructed to historic road standards, with a crown and side ditches but would accommodate only one lane instead of two. The road base would be constructed from imported angular rock mixed with native rock. Maintenance of the road would be the same as in Alternatives 2 and 3.

Old Mine Trailhead Turnaround: As in other action alternatives, a public vehicle turnaround at the Old Mine Trailhead (1.2 miles) would also be constructed.

<u>Proposed Milepost 4.4 Washout Repairs</u>: In addition to repairs to the Falls Creek, Green Lake and Chenuis areas as described in Alternative 3, the road would be reconstructed in the Milepost 4.4 area. This would require an additional 600 cubic yards of Class 5 riprap, 3,100 cubic yards of additional fill, and 70 cubic yards of 5/8-inch minus gravel topping (WFLHD 2007).

Figure 24: Alternative 4: Seasonal / Weekend Shuttle Access on Carbon River Road for 4.4 miles; Hiking and Bicycling Trail Beyond



Trail: As in Alternatives 2 and 3, the improved hiking and bicycling trail (10 feet wide) between Milepost 4.4 and Ipsut Creek would be constructed of native soil and rock, compacted to create a sub base, and overlain with imported 5/8 inch crushed gravel, suitable for hiking and most bicycles. Maintenance of the trail would be the same as in Alternatives 2 and 3.

Photo 26: Milepost 4.4 (Looking Southwest)

Photo 27: Milepost 4.4 (Looking Northeast)

b. Buildings and Structures

Carbon River Entrance: Actions would be the same as described in *Elements Common to All Action Alternatives (2-5)*.

Ipsut Creek Campground Area: Actions to remove facilities would be the same as in *Elements Common to All Action Alternatives (2-5)*. Ipsut Creek Bridge would be demolished using heavy equipment then removed using small trailer and dump truck loads similar to Alternative 3. As in Alternative 3, it would be replaced with a suitable trail bridge.

Ipsut Creek Patrol Cabin: Reconstruction of the cabin would be the same as in Alternatives 2 and 3.

c. Erosion Protection Measures

Actions would be the same as in *Elements Common to All Action Alternatives (2-5)* and Alternative 3 (see Table 11: *Summary of Alternatives 3 and 4 Proposed Erosion Protection Structures*, except that the proposed complex crib wall or toe-roughened crib wall at Milepost 3.939 could be a cribwall and/or a flow deflection logjam, and there would be the following additional erosion protection measures:

- Milepost 3.674: engineered logjam,
- Milepost 3.712: engineered logjam, and
- Milepost 3.750: log crib wall.

There would also be slight differences in the number of humps as indicated in *Elements Common to All Action Alternatives (2-5)* and Table 12: *Alternatives 3 and 4 Proposed Road Humps*, with fewer humps constructed in this alternative. Maintenance, however, would be similar to Alternatives 2 and 3.

d. User Groups Accommodated

Public Access: As in Alternative 2, private vehicles could continue to drive to Milepost 1.2, where passengers could be dropped off or picked up at a turnaround located near the Old Mine Trailhead. From there, in Alternative 4, there would be seasonal shuttle access to Milepost 4.4 and year-round hiking and bicycling on the reconstructed one lane road and improved trail to Ipsut Creek Campground. Initially sections of one lane road would be constructed to replace the washed out sections of the Carbon River Road but there would be long-stretches of intact roadway between the sections of new one lane road.

Accessibility: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*. In addition, shuttle access would improve accessibility to Milepost 4.4, instead of just to the Old Mine Trailhead (Milepost 1.2). When shuttles were unavailable, accessibility would be the same as in Alternative 2.

e. Visitor Use Activities

Hiking: As in other alternatives, access to all visitor use areas within the Carbon River area would be open to foot-traffic. Table 14: *Alternative 4 Shuttle-Assisted Hiking Distances to Primary Trailheads* shows the hiking distances from the proposed shuttle access extension to Milepost 4.4. Without shuttle access, distances would be the same as in Alternative 1 (from the entrance) or Alternative 2 (from the Old Mine Trailhead turnaround). As in other alternatives, access to some areas may be delayed for a few days to a few weeks or months when damage occurs.

Table 14: Alternative 4 Shuttle-Assisted Hiking Distances to Primary Trailheads / Destinations from Milepost 4.4

Location	Distance (One-Way)	Distance (Round-Trip)	Destination Trail Length (one way)	Notes
Carbon River Rainforest Loop Trailhead	0 miles	0 miles	0.03 miles (Rainforest Boardwalk Trail)	Starts from entrance
Old Mine Trailhead	0 miles	0 miles	0.25 miles (Old Mine Trail)	Starts from Turnaround
Green Lake Trailhead	0 miles	0 miles	1.8 miles (Green Lake Trail)	Starts before Chenuis Parking Area
Chenuis Falls Trailhead	0 miles	0 miles	0.4 miles (Chenuis Falls Trail)	Starts at Chenuis Parking Area
Ipsut Creek Campground	0.4 miles	0.8 miles	N/A	
Ipsut Creek Trailhead	0.6 miles	1.2 miles	variable	Launching Point for Wonderland, Northern Loop Trails, including to Carbon Glacier)
Carbon Glacier	4.0 miles	8.0 miles	3.4 miles (Carbon Glacier Trail)	This trail length is included in the total noted.

Ipsut Creek Camping: Actions associated with protecting facilities at the Carbon River Entrance and modifying Ipsut Creek Campground from a drive-in campground to a backcountry campground would be similar to Alternatives 2 and 3, except that the campground would be larger in Alternative 4. Ipsut Creek Campground would be rehabilitated as a hike-in / bike-in backcountry camp with 20 individual sites and three group sites. Ten individual sites and one group site would be removed and restored. The group sites would be created either be by combining former individual sites or by establishing new sites in former parking areas.

Ipsut Creek Patrol Cabin: As in Alternatives 2 and 3, Ipsut Creek Cabin would be rebuilt in a former parking area within Ipsut Creek Campground according to notes made when it was dismantled.

Picnicking: Actions would be the same as in Alternative 2, with picnicking at the entrance, Chenuis, and Ipsut.

f. Orientation / Fee Collection / Interpretation / Administration

Orientation: Actions would be the same as in Alternative 2.

Fee Collection: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*.

Interpretation: Actions would be the same as in Alternative 2, with new exhibits at the maintenance area barb overlook, Chenuis Falls Picnic Area, and Ipsut Creek Campground.

Emergency / Administrative Access: There would be improved vehicle travel on the road and, as in Alternative 2, the improved trail could be used for all-terrain vehicle access to transport materials and supplies for trail repair and for emergency access. Over time, however, this ability could diminish as additional washouts occurred or because of the inability to effectively maintain the sections of improved trail.

g. Carbon River Road and Facility Maintenance / Restoration

The width of the historic road corridor would be retained where possible within the first 4.4 miles to allow flexibility to convert two lane sections of road to one lane sections when additional damage occurs. Beyond Milepost 4.4, however, where most of the road has been lost, 10-feet width of the remaining intact roadway would be scarified (as in Alternative 2) to facilitate restoration. Parking areas at the Green Lake, Chenuis and Ipsut Creek Trailhead parking areas would provide space for bicycle rack parking and administrative ATV parking while the remaining areas would be partially obliterated.

G. Alternative 5: Wilderness Hiking Trail Reroute

1. Alternative 5 Public Access Summary

Long-term public access would be via a wilderness hiking reroute trail (36-inches wide) from the Carbon Rainforest Loop Trail to the Ipsut Creek Trailhead (approximately 5.14 miles). While the wilderness reroute trail was under construction, the existing Carbon River Road unimproved trail (4-6 feet wide) would continue to provide interim access to Ipsut Creek (5.0 miles) and would continue to be used for hiking and bicycling. Until the reroute trail was complete, this unimproved trail would continue to be repaired as necessary following winter storms or future flood damage. Once the wilderness reroute trail is complete the unimproved trail would be closed, ending bicycle access in the area.

Until the wilderness trail was constructed, the Old Mine Trailhead turnaround could be used for access to the unimproved trail. Later, this turnaround could be used for access to the wilderness trail via the Old Mine Trail between the road and the wilderness trail. Following construction of the wilderness reroute trail; use of the unimproved hiking and bicycling trail would be discontinued pending future damage. Eventually, a new backcountry camp would be planned and developed and the use of Ipsut Creek Campground would be discontinued as a backcountry camp.

The wilderness reroute trail would offer a new loop trail opportunity from the entrance to the Old Mine Trail and then back on the new wilderness reroute trail. It would also offer spur trail hiking opportunities on intact sections of road, such as the section from beyond Falls Creek up to the Chenuis Falls Trailhead. As with the road, it would continue to offer access to the Old Mine Trailhead, Green Lake Trailhead, Chenuis Falls Trailhead and Ipsut Creek Trailhead. A small portion of the reroute trail (0.25 miles) would follow existing road (narrowed to trail width) around the bedrock knob below Chenuis.

2. Alternative 5 Components

a. Parking, Road and Trail

Parking: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*. As implementation proceeded, non-historic buildings and structures at the Carbon River Entrance would be removed and their footprints converted to additional parking and picnicking.

Road: For the road up to the Old Mine Trailhead actions would be the same as in *Elements Common to All Action Alternatives (2-5)*.

Old Mine Trailhead Turnaround: As in other action alternatives, a public vehicle turnaround at the Old Mine Trailhead (1.2 miles) would also be constructed.

Trail: The wilderness hiking trail would be constructed of native soil and rock, excavated to bare mineral soil and would be approximately 36-inches wide. Where needed sections of raised trail or boardwalk could also be constructed. It is likely that the trail would be constructed in phases. The first phase would begin with construction of the section from the Green Lake Trailhead to Ipsut. This would be followed by construction of the section from the Old Mine Trail to the Green Lake Trail and lastly by the section from the Rainforest Loop Trail to the Old Mine Trail.

The interim unimproved trail in the Carbon River corridor would be the same as in Alternative 1 and therefore would continue to contain abrupt jags and blind corners and would generally not be wide enough to allow two hikers or bicyclists to pass without slowing. In addition there would continue to be deep sandy sections, impassable to some bikes. Accessibility would end at the Old Mine Trailhead turnaround. Minimal improvements to retain the trail or to improve safety would be made while the reroute trail was under construction. Maintenance of the trail would be the same as in Alternative 1.

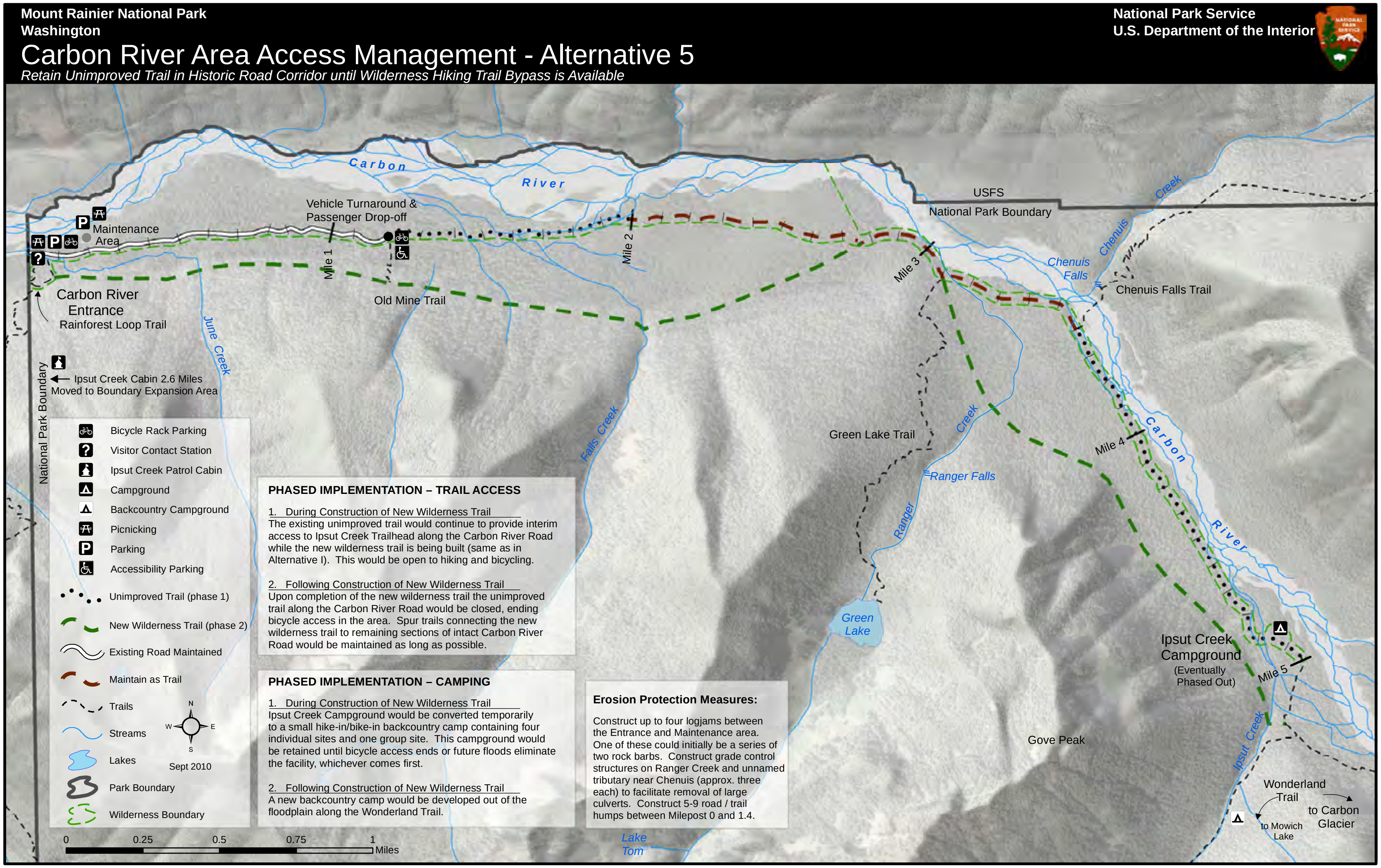
b. Buildings and Structures

Carbon River Entrance / Carbon River Maintenance Area: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*.

Ipsut Creek Campground Area: Actions to remove facilities would be the same as in *Elements Common to All Action Alternatives (2-5)*. The Ipsut Creek Road Bridge would be removed by saw-cutting and jackhammering, then either hauling by all-terrain vehicle trailer (3,000 trips) or via 15,000 lb. helicopter loads (approximately 45 trips). As in Alternatives 3 and 4, the bridge would be replaced, but in different location with suitable trail bridge.

Ipsut Creek Patrol Cabin: Unlike in other action alternatives, the cabin would be rebuilt in a location yet to be determined on one of two newly acquired boundary expansion parcels (outside the Carbon River Entrance) according to notes made when it was dismantled. Because of this location, it would be unavailable to Carbon River area visitors for some time.

Figure 25: Alternative 5: Wilderness Hiking Trail Reroute



c. User Groups Accommodated

Public Access: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*. Visitors could park at the entrance or drive to the Old Mine Trailhead turnaround to drop off passengers before returning to park. The turnaround would initially provide access to the unimproved trail in the Carbon River Road corridor. Later, it would provide access to the reroute trail from the Old Mine Trailhead.

Accessibility: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*.

d. Erosion Protection Measures

Actions would be the same as in *Elements Common to All Action Alternatives (2-5)* with flood protection structures constructed along the riverbank at or near the Carbon River Entrance and former maintenance area. As in Alternative 2, a series of road humps would also be constructed in the road corridor from the entrance to the Old Mine Trailhead and check dams would be constructed to dampen the sediment movement resulting from removing large culverts at Ranger Creek and on the unnamed tributary near Chenuis. (Table 15: *Summary of Alternative 5 Erosion Protection Measures*).

Table 15: Summary of Alternative 5 Erosion Protection Measures

Location	Proposed Erosion Protection Structure(s)					
	Engineered Logjam (ELJ) and/or Rock Barb	Log Spanning Check Dams	Toe-roughened gabions or toe-roughened log crib wall	Launchable (buried) groins	Road humps and dips	Grade control structures
Milepost 0.0 entrance (60 feet each)	1 logjam					
Milepost 0.152 maintenance area (60 feet each)	2 barbs convert to ballast, plus 3 logjams					
Milepost 0.2 – 1.4 to Old Mine Trailhead					approx. 5-9	
Milepost 3.142 **Ranger Creek**						approx. 3
Milepost 3.150 – 3.433 (240 feet)					unknown # (Allow road to narrow down to trail width. Use fallen logs for trail humps.)	
Milepost 3.459	None The trail would be routinely rerouted as damage occurs.					
Milepost 3.586 **Unnamed channel behind hanging culvert**						approx. 3

e. Visitor Use Activities

Hiking: As in other alternatives, access to all visitor use areas within the Carbon River area would be open to foot-traffic. Table 16: *Alternative 5 Hiking Distances to Primary Trailheads* shows the availability of destinations in the Carbon River area from the proposed new wilderness reroute trail.

Initially, hiking would be the same as in Alternative 1, on an unimproved trail through the washout areas along and beside the former Carbon River Road. Distances from the entrance would be the same as in Alternative 1. Distances from the Old Mine Trailhead would be the same as in Alternative 2. Hiking opportunities would be expanded with the construction of the reroute trail. Unlike in other alternatives, most of this hiking would not be along or beside the former roadway. Instead it would be through a forested area distant from the Carbon River. There would also be new opportunities to traverse back to the former Carbon River Road corridor via spur trails.

Table 16: Alternative 5 Hiking Distances to Primary Trailheads / Destinations from Wilderness Reroute Trail (estimated)

Location	Distance One-Way (Round Trip)	Destination Trail Length (one way)	Notes
Carbon River Rainforest Loop Trailhead	0 miles	0.03 miles (Rainforest Boardwalk Trail)	Trailhead located at entrance
Old Mine Trailhead	1.24 (2.48) miles	0.25 miles (Old Mine Trail)	Wilderness Trailhead located at Milepost 1.2
Green Lake Trail Intersection	3.27 (6.54) miles	1.8 miles (Green Lake Trail)	Starts before Chenuis Parking Area
Chenuis Falls Trailhead	3.77 (7.54) miles	0.4 miles (Chenuis Falls Trail)	Starts at Chenuis Parking Area
Ipsut Creek Campground	5.0 (10.0) miles	N/A	
Ipsut Creek Trailhead Intersection	5.2 (10.4) miles	variable	Launching Point for Wonderland, Northern Loop Trails, including to Carbon Glacier)
Carbon Glacier	8.6 (17.2) miles	3.4 miles (Carbon Glacier Trail)	Total includes new wilderness trail and Carbon Glacier Trail.

Ipsut Creek Camping: Ipsut Creek Campground would be converted temporarily to a small hike-in / bike-in backcountry camp containing four individual sites and one group site. All 31 current campsites would eventually be removed and restored. Later, a small backcountry camp of the same size would be located along the Wonderland Trail toward Mowich Lake (one-mile from Ipsut Creek Campground).

Picnicking: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*. Picnicking would occur at the Carbon River Entrance and in the former maintenance area.

f. Orientation / Fee Collection / Interpretation / Administration

Orientation / Fee Collection / Interpretation: Actions would be the same as in *Elements Common to All Action Alternatives (2-5)*.

Emergency / Administrative Access: Initially, it would continue to be possible to use all-terrain vehicles to transport materials and supplies for trail repair and for emergency access to Ipsut Creek. Over time, however, this ability would diminish as the road/ unimproved trail continued to deteriorate because of decreased ability to maintain the washout areas. Eventually, ATV access would end with the loss of the unimproved trail and emergency access would be by foot on the wilderness trail or via helicopter.

g. Carbon River Road and Facility Obliteration / Restoration

While the reroute trail was under construction, there would be passive restoration on the washed out portions of the unused road surface (14-16 feet) not occupied by the trail between the Old Mine Trailhead and Ipsut Creek. Over time, vegetation would begin to establish on these unused portions of washed out road. Most restoration would occur passively as areas of former roadway experienced less use. This practice would continue for some time to come after the reroute trail was constructed to maintain loop trail opportunities for as long as possible between the newly constructed reroute trail and remaining intact sections of the roadway.

Table 17: Carbon River Area Access Management Environmental Assessment Alternative Comparison Chart

	ALTERNATIVE 1: No Action	ELEMENTS COMMON TO ALL ACTION ALTERNATIVES (2-5) (CTAA)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5
Alternative Title	(Continue Current Management). Unimproved Hiking and Bicycling Trail in Historic Road Corridor.		Hiking and Bicycling in Historic Road Corridor	Reconstruct Road for Public Vehicle Access to Chenuis; Hiking / Bicycling to and Beyond Chenuis	Reconstruct Road for Seasonal Shuttles and Hiking and Bicycling in Historic Road Corridor	Retain Unimproved Trail in Historic Road Corridor until Wilderness Hiking Trail Bypass is Available
Alternative Description (Road/Trail Facility)	Maintain current unimproved trail (4-6 feet wide) within historic road corridor between Old Mine Trailhead and Ipsut Creek Trailhead.		Construct and maintain improved hike/bike trail (10 feet wide) within or adjacent to washed out sections of the historic road corridor and outside wilderness to Ipsut Creek Trailhead (5.0 miles). When flood damage occurs, gradually replace damaged sections of road with new trail 10 feet wide.	Reconstruct one-lane public road (12 feet wide) in historic road corridor with turnouts to Chenuis (3.6 miles). Construct improved hike/bike trail (10 feet wide) within the Carbon River Road corridor from Chenuis to Ipsut Creek (same as Alternative 2). When flood damage occurs, gradually replace two-lane sections of road with one-lane sections of road.	Reconstruct one-lane shuttle road (10 feet wide) in historic road corridor for seasonal / weekend shuttle use to Milepost 4.4. Construct improved hike/bike trail (10 feet wide) from Milepost 4.4 to Ipsut Creek Trailhead (same as Alternative 2). When flood damage occurs, gradually replace two-lane sections of road with one-lane sections of road.	Maintain unimproved trail (4-6 feet wide) in historic road corridor to Ipsut Creek Trailhead until reroute trail is complete (Same as Alternative 1). Construct wilderness reroute trail (36-inches wide) from the Carbon Rainforest Loop Trail at the entrance to Ipsut Creek Trailhead. When wilderness trail is complete, close unimproved trail.
Treatment of Historic Carbon River Road	Passive restoration (over time) of 14-16 feet width of historic road and parking areas between Old Mine Trailhead and Ipsut Creek Trailhead (3.8 miles).	Retain 1.2 miles (20 feet wide) of historic road to Old Mine Trailhead. Construct vehicle turnaround at Old Mine Trailhead for passenger drop-off.	Where possible retain canopy, vegetation, and drainage ditch relief culverts over full 20-feet width of road between washout sections. Over time, however, allow road between washout sections to narrow to 10 feet with non-woody plants established along the edges. Provide space for bicycle rack parking and administrative ATV parking at former	Maintain historic road (20 feet) between washout segments, up to Chenuis until additional damage occurs. Beyond Chenuis, retain or reconstruct 10-feet wide formal hiking and bicycling trail to Ipsut Creek Trailhead.	Maintain historic road (20 feet) between washout segments, up to Milepost 4.4 until additional damage occurs. Beyond Milepost 4.4, retain or reconstruct 10-feet wide hiking and bicycling trail to Ipsut Creek Trailhead. Provide space for bicycle rack parking and administrative ATV parking at former Green Lake and Chenuis Trailhead parking areas and obliterate remaining	Same as CTAA. Following construction of reroute trail and closure of informal trail, actively restore 14-16 feet of remaining sections of intact roadway between washouts. Obliterate former parking areas at Green Lake Trailhead and Chenuis.

	ALTERNATIVE 1: No Action	ELEMENTS COMMON TO ALL ACTION ALTERNATIVES (2-5) (CTAA)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5
			Green Lake and Chenuis Trailhead parking areas and obliterate remaining area.		area.	
Facility Type/	Unimproved hike/bike trail annually reconstructed / "scratched in" beside historic road corridor, in areas where flood damage has occurred.	Bicycle racks at Carbon River Entrance, Carbon River Maintenance Area, and trailheads.	Formal improved hike/bike trail within or adjacent to historic road corridor from Old Mine Trailhead to Ipsut Creek Trailhead.	Formal public road to Chenuis. One lane with turnouts in reconstructed sections. Above Chenuis, formal hike/bike trail within or adjacent to historic road corridor to Ipsut Creek Trailhead.	Formal one lane road for seasonal/weekend shuttle use to Milepost 4.4. Above Milepost 4.4, formal hike/bike trail within or adjacent to road corridor from Milepost 4.4 to Ipsut Creek Trailhead.	<u>Short-term</u>: Same as Alternative 1. <u>Long-term</u>: New wilderness bypass trail connecting to spur trails along intact sections of roadway.
Facility Tread	<u>Unimproved Trail</u>: Native soil and rock trail. <u>Road Sections</u>: Existing surfacing.	<u>Road</u> (from Entrance to Old Mine Trailhead): Maintain existing surfacing.	<u>Improved Trail</u>: Variable construction with native materials to form permeable and/or firm base where needed. Trail surfaced with imported compacted crushed gravel. <u>Road</u>: Same as CTAA to Old Mine Trailhead. Same as Alternative 1 between sections of constructed trail.	<u>Road</u> (from Old Mine Trailhead to Chenuis): Base would be imported large angular rock mixed with native rock surfaced with compacted crushed gravel. <u>Improved Trail</u>: Above Chenuis, same as Alternative 2.	<u>Road</u> (from Old Mine Trailhead to Milepost 4.4): Same as Alternative 3. <u>Improved Trail</u>: Above Milepost 4.4, same as Alternative 2.	<u>Unimproved Trail</u>: Same as Alternative 1 <u>Wilderness Trail</u>: Native soil and rock surfacing.
Facility Tread	<u>Unimproved Trail</u>: Native soil and rock trail. <u>Road Sections</u>: Existing surfacing.	<u>Road</u>: Entrance to Old Mine Trailhead: Maintain existing surfacing.	<u>Improved Trail</u>: Variable construction with native materials to form permeable and/or firm base where needed. Trail surfaced with imported compacted crushed gravel. <u>Road</u>: Same as CTAA to Old Mine Trailhead. Same as Alternative 1 between sections of constructed trail.	<u>Road</u>: Base would be imported large angular rock mixed with native rock surfaced with compacted crushed gravel. <u>Improved Trail</u>: Above Chenuis, same as Alternative 2.	<u>Road</u>: Same as Alternative 3 to Milepost 4.4. <u>Improved Trail</u>: Above Milepost 4.4, same as Alternative 2.	<u>Unimproved Trail</u>: Same as Alternative 1 <u>Wilderness Trail</u>: Same as Alternative 1
User Groups	Hikers, mountain bicyclists, administrative	Hikers	Public and administrative vehicles to Old Mine	Public and administrative vehicles to Chenuis; with	Public vehicles to Old Mine Trailhead; shuttle and	<u>Short-term</u>: Same as Alternative 1.

	ALTERNATIVE 1: No Action	ELEMENTS COMMON TO ALL ACTION ALTERNATIVES (2-5) (CTAA)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5
	ATVs.		Trailhead; administrative ATVs, hikers, and bicyclists to Ipsut.	administrative ATV's, hikers, and bicyclists to Ipsut.	administrative vehicles to Milepost 4.4; administrative ATV's, hikers, and bicyclists to Ipsut.	Long-term: Hikers
Accessibility	With permission, drive to Milepost 1.2; no accessibility beyond.	Drive to Milepost 1.2. Trail construction and maintenance would comply with accessibility guidelines to the extent possible but may not be fully accessible.	Drive to Milepost 1.2. Accessible trail initially constructed between Milepost 1.2 and Ipsut Creek Campground. With future washouts, accessibility may diminish.	Drive to Milepost 3.6. Accessible trail initially constructed beyond to Ipsut Creek Campground. With future washouts, accessibility may diminish.	Shuttle access to Milepost 4.4 on weekends and in summer. Accessible trail initially constructed beyond to Ipsut Creek Campground. Other times, same as Alt 2. With future washouts, accessibility may diminish.	Drive to Milepost 1.2.
Buildings and Infrastructure Entrance	Retain facilities until damaged by flooding or gradually remove as called for by GMP. Reconstruct Ipsut Creek Patrol Cabin in former fee booth location as a visitor contact station.	Remove all buildings (except vault toilets) and replace with expanded parking and picnicking. Construct one-room visitor contact station on south side of road. Reconstruct Carbon Entrance Arch.	Same as CTAA.	Same as CTAA.	Same as CTAA.	Same as CTAA plus: Outside Entrance Eventually reconstruct Ipsut Creek Patrol Cabin at boundary expansion property in connection with new campground.
Buildings and Infrastructure Maintenance Area		Remove buildings and replace with expanded parking and picnicking. If radio tower / shed and weather station are retained, install security fence these facilities. Eventually relocate historic CCC garage to boundary expansion property.	Same as Alt 2	Same as Alt 2	Same as Alt 2	Same as Alt 2
Buildings and Infrastructure Ipsut Creek Campground Area		Remove asphalt, bumper stops, signs, amphitheater storage building, damaged chlorinator building, and vault toilets.	Same as CTAA plus: Reconstruct Ipsut Creek Patrol Cabin in former campground or trailhead parking area for seasonal	Same as Alternative 2	Same as Alternative 2.	Same as CTAA

	ALTERNATIVE 1: No Action	ELEMENTS COMMON TO ALL ACTION ALTERNATIVES (2-5) (CTAA)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5
		Add backcountry toilets and bear proof food storage containers.	use and information. Restore unused parking area.			
Culverts	As culverts become obsolete or are damaged, replace with fish-friendly culverts or trail bridges.	Replace round corrugated metal culverts at perennial and intermittent stream crossings with fish-friendly culverts, box culverts or road / trail bridges. Retain ditch relief culverts in undamaged sections of road. Clean and maintain road culverts between Entrance and Old Mine Trailhead.	Replace culverts between Milepost 1.2 and 5.0 with 9 trail bridges.	Replace culverts between Milepost 1.2 and 3.6 with fish friendly culverts. Construct 2 trail bridges to replace culvert and Ipsut Creek Bridge.	Replace culverts between Milepost 1.2 and 4.4 with fish friendly culverts. Construct 2 trail bridges to replace culvert and Ipsut Creek Bridge.	Same as CTAA except remove all culverts from road following construction of wilderness trail and closure of unimproved trail. Construct trail bridges where necessary to cross intermittent and perennial streams.
Parking Locations	Carbon Entrance, parallel parking for 800 feet along Entrance Roadway up to maintenance area, and informal non-sanctioned overflow parking along road shoulder outside park entrance.	<u>Carbon River Entrance</u> and Carbon River Maintenance Area. <u>Outside Entrance</u>: Additional parking via agreement with partners at locations TBD.	Same as CTAA plus: Restore part of Green Lake, Chenuis and Ipsut Creek parking areas not occupied by new functions (such as bicycle and administrative ATV parking).	Same as CTAA plus: Limited parking at Old Mine, Green Lake, and at Chenuis. Restore part of Ipsut Creek parking area not occupied by new functions (such as bicycle and administrative ATV parking).	Same as Alternative 2 plus: Shuttles would pick up hikers and bicyclists at entrance and other parking areas TBD.	Same as CTAA.
Ipsut Creek Bridge	Retain Ipsut Creek Bridge.		Retain Ipsut Creek Bridge as long as it is viable for public trail use and doesn't impede hydrological conditions. Remove bridge same as Alternative 5 if no longer serviceable.	Remove Ipsut Creek Bridge using heavy equipment. Haul out by truck from Chenuis (10 loads)	Same as Alternative 3.	Remove Ipsut Creek Bridge by sawcutting and jackhammering into pieces. Haul out either by ATV with trailer (approx. 75 loads) or via helicopter (15,000 pound crated loads) (approx. 20 trips).
Erosion Protection	Construct up to four logjams between the	Construct grade control structures on Ranger	Same as Alternative 1 and CTAA plus:	Same as Alternative 1 and CTAA plus:	Same as Alternative 3, except construct one road	Same as Alternative 1 plus:

	ALTERNATIVE 1: No Action	ELEMENTS COMMON TO ALL ACTION ALTERNATIVES (2-5) (CTAA)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5
Measures	Entrance and Maintenance area. Two temporary rock barbs constructed and converted to ballast for log jam.	Creek and unnamed tributary near Chenuis (approx. three each) to facilitate removal of large culverts.	Construct 5-9 road / trail humps between Milepost 0 and 1.4 and approximately 15 between Milepost 1.4 and 4.4. Construct six log-crib walls or toe-roughened log-crib walls and one buried groin to retain trail. Drop logs spanning the Falls Creek Channel to serve as check dams (with fish passage features). Consider grade control structures on Falls Creek tributary.	Construct four road humps, seven log-crib walls or toe-roughened log-crib walls, one buried groin and eight flow deflection engineered logjams to retain road and trail.	hump, another flow deflection engineered logjam could also be constructed instead of or in conjunction with one of the log-crib walls.	Construct 5-9 road / trail humps between Milepost 0 and 1.4, with additional trail humps located on the 0.25 mile section of trail around the knob below Chenuis.
Round Trip Hiking Distance to Primary *Trailheads* and Glacier from road end	Carbon Rainforest = 0 Old Mine = 2.4 Green Lake = 6.2 Chenuis = 7.2 Ipsut = 10.0 Carbon Glacier = 16.8	Carbon Rainforest = 0 With passenger drop-off pick-up at Old Mine Trailhead (Milepost 1.2): Old Mine: 0 Without drop-off: Old Mine: 2.4	With passenger drop-off / pick-up at Old Mine Trailhead: Green Lake = 3.8 Chenuis = 4.8 Ipsut = 7.6 Carbon Glacier = 14.4 miles Without drop-off / pick-up: Same as Alternative 1.	From Chenuis Green Lake: 1.0 Chenuis: 0 Ipsut: 2.8 Carbon Glacier = 9.6 miles	With seasonal shuttle drop-off / pick-up: Green Lake: 0 Chenuis: 0 Ipsut: 1.2 Carbon Glacier = 8.0 miles Without drop-off / pick-up: Same as Alternative 1.	Slightly longer)0.2 miles) than in Alternative 2.
Camping	<u>Type of Campground</u> Hike-in, bike-in backcountry camp. <u>Number of Sites</u> 21 individual sites (8 individual and 1 group site closed) 1 group site.	Pack it in/Pack it out. No garbage services provide beyond Entrance. <u>Facilities</u> Tent sites Non-potable water Backcountry toilet(s)	<u>Type of Campground</u> Medium primitive hike-in / bike-in campground with group sites. <u>Number of Sites</u> 15 individual sites 3 group sites 2 group sites added	<u>Type of Campground</u> Medium primitive hike-in / bike-in campground with group sites. <u>Number of Sites</u> 15 individual sites 3 group sites 2 group sites added	<u>Type of Campground</u> Large primitive seasonal shuttle-in, hike-in / bike-in campground with group sites. <u>Number of Sites</u> 20 individual sites 3 group sites	<u>Type of Campground</u> Hike-in, bike-in backcountry camp. <u>Number of Sites</u> 4 individual sites 1 group site <u>Site Restoration</u> 26 individual sites

	ALTERNATIVE 1: No Action	ELEMENTS COMMON TO ALL ACTION ALTERNATIVES (2-5) (CTAA)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5
	Facilities Tent sites Picnic tables Vault Toilets Non-Potable Water		(location to be determined) Site Restoration 15 individual and 1 group sites removed / restored Facilities Same as CTAA plus Picnic tables Bear-proof food storage containers.	(location to be determined) Site Restoration 15 individual and 1 group sites removed / restored Facilities Same as Alternative 2	2 group sites added (location to be determined) Site Restoration 10 individual and 1 group sites removed / restored Facilities Same as Alternative 2	removed / restored Facilities Same as CTAA. Upon completion of reroute trail Close Ipsut Creek Campground and develop a new backcountry site in another location.
Picnicking	Three tables at Carbon Entrance Three tables at Chenuis Picnicking at Ipsut Creek Campground.	Picnic tables at Entrance	Same as CTAA plus: Retain picnicking at Chenuis and Ipsut.	Same as Alternative 2	Same as Alternative 2	Remove picnic tables from Chenuis and Ipsut Creek Campground upon completion of reroute trail.
Interpretation	Wayside at entrance to highlight changes.	Same as Alternative 1 plus: River- view wayside at maintenance area.	Same as CTAA plus: Wayside exhibits at Chenuis and Ipsut.	Same as Alternative 2	Same as Alternative 2	Same as CTAA
Effect on NHLD	Adverse Effect		Same as Alternative 1.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Effect on T&E Species	Marbled Murrelet: May Affect, Likely to Adversely Affect Northern Spotted Owl: May Affect, Likely to Adversely Affect Bull Trout: May Affect, Likely to Adversely Affect Steelhead: May Affect, Likely to Adversely Affect Chinook Salmon: May Affect, Not Likely to Adversely Affect		Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1

H. Alternatives (and Actions) Considered but Dismissed

Under the National Environmental Policy Act (NEPA) alternatives may be eliminated from detailed study based on the following reasons [40 CFR 1504.14 (a)]:

- *Technical or economic infeasibility;*
- *Inability to meet project objectives or resolve need for the project;*
- *Duplication of other less environmentally damaging alternatives;*
- *Conflicts with an up-to-date valid plan, statement of purpose and significance, or other policy; and therefore, would require a major change in that plan or policy to implement; and*
- *Environmental impacts too great.*

The following alternatives or variations were considered during the design phase of the project, but because they met one of the above criteria during the preliminary design phase, they were rejected.

1. Road Access to Ipsut Creek Campground via North Side of Carbon River

This alternative was rejected because it would not be located within Mount Rainier National Park, and because it was also dismissed in the GMP:

> "Further rerouting of the road in this area would be difficult because of the sensitivity of the resources in the area – designated wilderness, endangered species, old-growth forest, and aquatic riparian systems. Rerouting the road to an existing road on the north side of the Carbon River would require the replacement of a bridge (scheduled to get underway in the summer of 2001 according to Mount Baker-Snoqualmie National Forest representatives). However, the rerouting would not give visitors direct access to the Carbon Glacier (NPS 2002: 324)."

This option, which was addressed in the GMP has now been considered but rejected. During initial planning, it was rejected because it would have involved the construction of approximately two miles of new trail and because the GMP stated that it was not feasible. The GMP reasoning (in the public comments section), however, was that the Copley Lake Bridge was unavailable. That bridge was reconstructed in 2003.

During the current planning process, when PC Alt. 3b was added it proposed between five and eight miles of new trail. As a result the north side road / trail option was reconsidered. Further investigation, however, found that it would not allow an improved level of road access into the Carbon River area (the road on the north side would need to terminate in the vicinity of Chenuis Falls).

The proposed road would require agreements with the USFS to construct. When the Clearwater Wilderness was designated, the Old Chenuis Creek Road (7840) was identified for closure. The northwest park boundary near the head of Chenuis Creek has not been accessible by vehicle since the designation of the Clearwater Wilderness. The 7810 Road (Copley Lake Road) has been open to its end since the Copley Lake Bridge across the Carbon River was replaced. Although it is possible that the Mount Baker – Snoqualmie National Forest could reconsider providing additional road access to the Carbon River area, it too would need to reverse previous decision-making about the area.

The proposed north side road or trail would also require multiple access trails and river crossings to access visitor use areas along the current Carbon River Road (Green Lake, Chenuis Falls, Ipsut Creek Campground). It would also prevent continued bike-in camping or bicycle access to Ipsut Creek Campground.

2. Partial Closure of the Carbon River Road (Other Locations)

<u>Former Falls Creek Picnic Area</u>: Closure of the Carbon River Road at this location would require the park to construct a vehicle turnaround and parking area in the vicinity of the fomer Falls Creek Picnic Area, repairing the road through the first washout. This alternative would place vehicles in a known area of

repeated flooding and, although the physical space needed for the turnaround exists, would thus have greater adverse impacts on public health and safety than other alternatives. The former Falls Creek Picnic Area is not suitable for parking due to repeated flooding impacts and the potential for stranding people and vehicles. Repeated flooding in this area also makes the ability to build sustainable infrastructure unlikely. Repairing the Falls Creek washout section without extending the road further up does not make sense because there is over a mile of intact roadway above it. Parking would be problematic unless the explosives cache area could be used, however the explosives cache (former Carbon garbage dump) is located over 100 feet off the road and is therefore within wilderness.

Green Lake Trailhead: Closure of the Carbon River Road at this location would require a vehicle turnaround and parking area only 0.47 miles before the Chenuis Falls Picnic Area location and therefore offers little benefit over the Chenuis Falls closure point. There is little space outside of adjacent wilderness that would allow the construction of the turnaround / parking area. As a result, it would have greater impacts than the Chenuis Falls turnaround alternative (Alternative 3a).

Before Ipsut Creek Campground Bridge: Closure of the Carbon River Road at this location (Milepost 4.6), while it would not require replacement of the Ipsut Creek Campground Bridge would offer little benefit over replacing the bridge and allowing turnaround and parking in the existing areas at the Wonderland Trail trailhead and Ipsut Creek Campground / Picnic Area because it would require new disturbance for these new facilities at a location only a short distance from the existing facilities. This alternative was rejected because it would reopen the Carbon River Road to private vehicles (in contrast to the GMP direction) and would therefore require greater improvements (more effects on park resources) than other alternatives.

3. **Delayed Closure: Keep the Carbon River Road open as long as possible for public vehicle access (rehabilitate washouts and maintain sustainable road to Ipsut Creek Campground). Reconstruct the Carbon River Road as a two lane road, one lane road with turnouts or one lane road for shuttle access.**

This alternative was rejected because continuing to maintain the Carbon River Road for private vehicle access conflicts with the intent of the GMP ROD (NPS 2002). Even though the GMP calls for keeping "the road open to public use as long as possible," the decision point to implement closure of the Carbon River Road came with the "major washout" that the NPS has defined as occurring in fall 2006 (based on downstream measurements at the Fairfax gauge and the extent of damage to the Carbon River Road). The proposal in the GMP to implement shuttle use of the Carbon River Road has also been inferred to be precluded by the major washout that occurred.

4. **Replacement-in-Kind of the Carbon River Road: Maintenance of the Full Historic Road Corridor**

This alternative is similar to the two-lane road above. Although this alternative would honor the intent of the Carbon River Road's contribution to the Mount Rainier NHLD, it would continue to result in an unsustainable road. The road was constructed partially within the floodplain using poorly sorted riverine and glacial sediments, including sand, gravel and small cobbles and has been historically difficult to maintain, requiring numerous efforts toward reconstruction.

5. **Reroute the Carbon River Road**

This alternative was rejected based on the very limited physical space between the Carbon River Road and the wilderness boundary. The road cannot effectively be rerouted unless it is rerouted within wilderness. The wilderness boundary is 100 feet from the centerline of the Carbon River Road. Other reroutes would be too close to the current alignment and would therefore have a high cost and low benefit. Moving the road within this very short distance would not prevent the damage that results from repeated flooding.

6. **Wilderness Boundary Adjustment to Reconstruct Carbon River Road Outside of the Floodplain**

Although many commenters requested a change in the wilderness boundary and suggested that the current boundary was not intended to deny general visitors road access to the Carbon River area, in the absence of Congressional action, the wilderness boundary cannot be changed. (Several commenters were also specifically opposed to wilderness boundary changes.) This alternative was rejected because it would diminish the integrity of the Mount Rainier Wilderness; it would require congressional legislation to accomplish; and because the hydrologic conditions in the Carbon River valley make it difficult to relocate the road. Because this alternative does not meet the *Purpose and Need* criteria for implementing the GMP, it would also require a change in management direction and therefore additional environmental analysis, similar to reconsideration of the closure of the Carbon River Road.

7. **Road Reconstruction Options**

Individual comments included: *a) reconstruct the road by placing a berm between the river channel and the road; b) incrementally raise sections of road over time; c) construct an Arizona crossing in the Falls Creek area to allow water to flow over the road; and d) locate bridges across the washouts.* Many of these ideas were initially considered during the planning process but were rejected due to unacceptable impacts on park resources (constructing a raised dike or berm in the floodplain) or because they would be cost prohibitive (constructing road bridges).

8. **No Relocation of the Ipsut Creek Cabin**

The Ipsut Creek Patrol Cabin was damaged in the 2006 flood. Although it remained standing, even in late summer 2007, there was still water flowing under it, with approximately 1-2 feet of soil lost beneath most of the structure. As a result, the park consulted with the Washington State Historic Preservation Office to determine how to proceed. Following a Memorandum of Agreement, the cabin measured and then deconstructed to allow it to be temporarily moved so that collapse did not occur. The agreement specifies that the park will determine the best place to relocate the Cabin through this environmental impact analysis process. As a result, this alternative was rejected.

9. **Relocate Ipsut Creek Patrol Cabin to Green Lake Trailhead Area**

This alternative was considered during development of the preliminary alternatives but was eventually discarded because of the lack of space available at this location outside of wilderness and outside the floodplain.

10. **Equestrian Use of the Carbon River Road**

The GMP states that the only equestrian use in the park will continue to be on the Pacific Crest Trail and through access points to it at Chinook Pass and the Laughingwater Creek Trail.

11. **Reestablish Ipsut Creek in its Old Channel / Prevent the Carbon River from Flowing into Ipsut Creek**

Recent analysis of Ipsut Creek's change in course has resulted in a determination that Ipsut is now within a relatively stable channel and is not likely to readjust, except in another extreme flood event. Over time, as the Carbon River bed aggrades, there becomes a greater likelihood that the Carbon will continue to contribute to Ipsut flow. As a result it is likely technically infeasible to try to maintain Ipsut Creek in its former channel and to prevent the Carbon River from joining it. *NPS Management Policies* also discourage major river manipulation.

12. **Allow parking along the Carbon River Road up to the Old Mine Trailhead**

This alternative was dismissed because of safety issues that would make it not viable unless it was widened into the adjacent old growth forest, where the widening would impact the area where the largest remnant old growth trees are found along the road. The section of road from just past the entrance to the beginning of the Falls Creek washout is among the most curvilinear sections of the Carbon River Road, with very limited sight distance. It was built with a crown and side ditches on both sides. There are over 100 old growth trees with a diameter of five feet or greater within the first mile of the road. To allow two-way traffic to turn around and park along the edge of the road, the road would have to be widened approximately 10 feet. Although this widening would allow space for up to 200 parked cars, it would heavily impact this intact section of rainforest, where the trees are most closely under a maritime influence. This area is the only location in the park where Sitka spruce intermingles with Douglas-fir, western hemlock and western red cedar. In addition to the space needed for the two way traffic / parking, visitors would need a safe place to walk. Even though the ditch could be filled on one side and water diverted to the other side, which would not allow enough room for this activity to meet established FHWA safety guidelines. Without a safe pathway, visitors would likely trample tree roots and other adjacent vegetation.

13. Preserve a section of historic road and acknowledge its significance on the ground and in an interpretive display in the new boundary expansion visitor center

Actions linked to the proposed boundary expansion area near Carbon River are considered to be outside the scope of the current plan because the NPS has not yet acquired all of the properties in this area. The NPS cannot initiate planning for property it does not yet own. The park has, however, acquired some of the property in the boundary expansion area including all of the land formerly owned by the Thompson family. The former Thompson home site is being rehabilitated to serve as a visitor contact station, staff offices, employee housing and maintenance. Rehabilitation is anticipated to be complete in 2011.

14. Allow the public to use electric bikes, motor bikes, scooters, and all terrain vehicles (ATVs) on the Carbon River Road

The design of the corridor under other alternatives would not be suitable to accommodate these kinds of alternative vehicles without potential conflicts between alternative vehicle use and hikers or bicyclists.

15. Reestablish frontcountry camping

Individual comments included: *a) establish car camping at the new road terminus (either at the entrance or near Chenuis Falls); b) add a campground at the Carbon River Entrance – the proposed boundary expansion camping area at the Thompson property is too far; c) identify what facilities will be available in the boundary expansion camping area. d) Consider a campground at Hucklechuck / Thompson property; e) work with the USFS to establish a campground across the Copley Lake Bridge (near the Carbon River Entrance); and f) there will be few places to go from the proposed boundary expansion area campground.* There were numerous comments about the establishment of a new public drive-in campground, including questions about what facilities would be contained in the proposed boundary expansion campground. Because there is insufficient land to reestablish a drive-in campground outside of the floodplain along the Carbon River Road, these concerns are outside the scope of this environmental assessment. Drive in camping and other facilities and services will be considered in future planning within the Carbon River corridor.

16. Provide vehicles on the other side of the washouts to facilitate access

A vehicle would need gas regularly and getting the gas in would take a major effort getting four or five five-gallon cans back and forth. The vehicle would also periodically need maintenance and this would require flying one in and out on an uncertain schedule. The gain also would not be worth the cost and risk to the vehicle (and river) in future flooding. Scheduling regular runs would be difficult to implement.

17. Erosion Protection Measures Not Incorporated into Alternatives 2-5 suggested by Geotechnical Consultants

There were a variety of additional erosion protection measures suggested by geotechnical consultants to improve erosion resistance along the Carbon River Road. Aside from rerouting the road (see #5 above) most recommendations were either dropped due to equipment limitations associated with the alternative or in favor of a more robust or fish-friendly structure that incorporated use of wood.

I. Mitigation Measures

See individual environmental impact analysis sections in Chapter V: *Environmental Consequences* and in Appendix 1: *Impact Avoidance, Mitigation and Minimization Measures*.

J. Environmentally Preferable Alternative

In accordance with Director's Order-12, *Conservation Planning, Environmental Impact Analysis, and Decision-making* and CEQ (Council on Environmental Quality) requirements, the NPS is required to identify the "environmentally preferred alternative" in all environmental documents, including Environmental Assessments. The environmentally preferred alternative is determined by applying the criteria suggested in the National Environmental Policy Act (NEPA) of 1969, which is guided by the CEQ). The CEQ (46 FR 18026 - 46 FR 18038) provides direction that the "environmentally preferable alternative is the alternative that would promote the national environmental policy as expressed in NEPA's Section 101," including:

1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2. Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
3. Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
4. Preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;
5. Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources (NEPA Section 101(b)).

Generally, these criteria mean the environmentally preferred alternative is the alternative that causes the least damage to the biological and physical environment and that best protects, preserves, and enhances historic, cultural, and natural resources (46 FR 18026 – 46 FR 18038).

Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations

All alternatives would meet this criterion; however those that have greater long-term impacts on the environment would meet it less fully. As a result, Alternatives 1 and 2 would best meet this criterion. Alternatives 3, 4, and 5 would have more adverse effects on more resources. In Alternatives 3 and 4 these would be from partial reconstruction of the road and in Alternative 5 from loss of GMP pristine zone resources from construction of five miles of new trail.

Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings

All alternatives would meet this criterion. Alternatives 3 and 4, however, would best meet this criterion because they would allow for retention of more of the historic Carbon River Road corridor and would therefore have more beneficial effects on cultural resources.

Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences

Alternative 2 would best meet this criterion because there would be a balance between reducing adverse effects combined with a broad range of visitor use opportunities. Although visitor use opportunities would be greater in Alternatives 3 and 4, impacts would also be greater. Alternatives 1 and 5 would provide fewer visitor use opportunities by reducing opportunities to some visitors (no accessibility in Alternative 1 and hiking only opportunities in Alternative 5).

Preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice
Although all alternatives would have an adverse effect on the contribution of the Carbon River Road to the National Historic Landmark District, Alternatives 3 and 4 would best preserve cultural resources. Similarly, although all alternatives would adversely affect marbled murrelets, northern spotted owls and bull trout, Alternatives 1 and 2 would have the fewest of adverse effects and would best preserve natural resources. Alternatives 3 and 4 allow for more visitor use opportunities because in comparison Alternative 2 has less drivable road and Alternative 5 is minimally accessible and ends bicycle use. Alternatives 3 and 4 would best meet this criterion.

Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities
Alternative 3, followed by Alternatives 4, 2, 1 then 5 would allow the most use of the Carbon River area, while Alternative 1, followed by Alternatives 5, 2, 4 and 3 would use the fewest resources. Alternative 2 would best meet this criterion because it would both allow for visitor use and balance impacts on resources.

Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources
Alternative 2 would best meet this criterion because it would improve resource conditions over Alternative 1 and would do so while importing the fewest additional resources, compared to Alternative 5 which would also import the fewest additional resources but would have impacts on an undisturbed area.

Conclusion: Alternative 1 would best meet one criterion. Alternative 2 would best meet four criteria. Alternatives 3 and 4 would best meet two criteria. Alternative 5 would not best meet these criteria. Therefore, Alternative 2 is the environmentally preferable alternative.

Chapter IV: Affected Environment

Information in this section is derived from a comprehensive review or "data gap analysis" of existing information pertaining to the repair of the Carbon River Road in Mount Rainier National Park. It includes information from the General Management Plan (NPS 2002), various natural and cultural resources management plans and other park planning documents as well as specific information developed for this analysis. Information in this section has been gained from research and analysis throughout the history of Mount Rainier National Park.

Introduction

Mount Rainier National Park is comprised of 235,625 acres [plus the 755 acre boundary expansion area of which 214 acres have been acquired] acres in west central Washington, on the western slope of the Cascade Range. Eighty three percent (196,181 acres) of the park lies in Pierce County and 17 percent (39,444 acres) is in Lewis County. The park's northern boundary is approximately 65 miles southeast of the Seattle-Tacoma metropolitan area and 65 miles west of Yakima. Elevations in the park range from about 1,400 feet above sea level at the Tahoma Woods Administrative Site to 14,410 feet at the summit of Mount Rainier.

The focal point of the park is the towering, snow and ice-covered volcano, a prominent landmark in the Pacific Northwest. The base of the volcano spreads over an area of about 100 square miles. Mount Rainier is the second most seismically active and most hazardous volcano in the Cascade Range (National Research Council 1994). The 26 major glaciers that flank the upper mountain cover 35 square miles. Below, steep glaciated valleys, and ice carved peaks dominate the park landscape. The Carbon, Mowich, White, West Fork White, Nisqually, South Puyallup, and North Puyallup rivers and their tributaries carry water from Mount Rainier to the Puget Sound. The Ohanapecosh River flows into the Cowlitz River and on into the Columbia River. Over 470 mapped rivers and streams, 382 mapped lakes and ponds, and more than 2,500 acres of wetlands, numerous waterfalls and mineral springs characterize this park in the Cascades.

Mount Rainier's scenic landscapes – including the dense lower old-growth forests, the magnificent display of subalpine wildflowers, and the mountain itself – have attracted people for generations. The mountain is a destination for not only snow and ice climbers from throughout the world, but other national and international visitors as well. About 2.0 million people visit the park annually, with most visitation (75 percent) occurring between June and September. A large part of the park's visitation is from the Seattle-Tacoma metropolitan area and other urban and suburban areas surrounding the park.

Park vegetation is diverse, encompassing three ecological zones. Above tree line (around 7,000 feet) is the alpine zone which comprises approximately 19 percent of the park and generally consists of snow, ice, rock and fragile alpine plants. From about 5,000 feet to tree line and covering about 23 percent of the park is the subalpine zone, characterized by scattered stands of subalpine fir and subalpine meadows. Below the subalpine lies the forest zone, occupying about 58 percent of the park and dominated by western hemlock, silver fir, Douglas-fir, western red cedar and other species.

In addition to its natural wonders, the national park has a long history of human activities. The area was used by Native Americans for hunting and gathering, as well as for spiritual and ceremonial purposes. In the early 20th century miners, climbers, and tourists, among others, came into the area. The establishment of the park, and subsequent planning and development for visitor use and landscape protection constitutes an important chapter in the development of the American park idea. As a result, the park has rich and diverse cultural resources, including prehistoric and historic archaeological resources, historic structures and cultural landscapes.

At least six federally recognized tribes have traditional association with Mount Rainier:

1) Muckleshoot Indian Tribe
2) Puyallup Tribe of Indians
3) Cowlitz Indian Tribe
4) Nisqually Indian Tribe
5) Yakama Indian Nation, and the
6) Squaxin Island Indian Tribe

Important treaties include the Treaty with the Yakama (1855), the Treaty of Medicine Creek (1854), and the Treaty of Point Elliot (1855). Also of note is the presence of the Cowlitz Tribe at negotiations for the Chehalis River Treaty of 1855.

Ethnographic research demonstrates historical activity in the park, and current evidence indicates ongoing contemporary uses of the park by Indian people. As the park broadens its research and collaborative efforts with tribal groups, it is likely that traditional Native American uses of Mount Rainier will become better understood. Partnerships provide an opportunity for native tribes and the park to cooperate in mutually beneficial efforts for the purpose of preserving the park's resources to their fullest extent and highest level of integrity (National Park Service 2001).

1. Air Quality

Mount Rainier National Park is designated a class I area under the Clean Air Act (1977). Class I areas are afforded the highest degree of protection under the Clean Air Act. Even small impacts to air quality, therefore, are considered potentially detrimental. Activities such as campfires and the operation of vehicles and equipment cause local temporary air quality degradation, although stationary and mobile emissions from the Puget Sound area are the major sources of pollution near the park.

Air quality is measured at two primary areas in the park. Visibility, ozone, wet and dry deposition are monitored at Tahoma Woods. Bulk wet deposition is monitored at Paradise. Past ozone measurements have been obtained at various locations throughout the park including Longmire, Carbon River, Paradise, West Side Road, and at various sites in the designated Wilderness.

Mount Rainier National Park is within 25 miles of the Puget Sound urban zone. The four counties adjacent to the park emit a significant proportion of the state's air pollutants. In addition, most of the populated and industrialized areas in Washington are located along the Puget trough, and these source areas likely affect air quality at Mount Rainier National Park. There is growing concern that air masses originating in Asia, and carried across the Pacific Ocean, may carry persistent organic pollutants into the park.

A National Atmospheric Deposition Program/National Trends Network (NADP/NTN) site was established at Tahoma Woods in late 1999. Representative long-term data are also available from the La Grande NADP/NTN site, located approximately 16 miles west of the park that has been monitoring air quality since 1984. An analysis of the La Grande data indicates wet sulfate concentration has decreased since 1984, but there has been no apparent change in wet sulfate deposition. Wet ammonium deposition, and wet nitrate and ammonium concentration, increased through 1994, and then returned to 1986 levels. Bulk deposition data have been collected at Paradise since 1986. Recent data suggests slight decrease in nitrogen and sulfate deposition.

Dry deposition has been measured at Mount Rainier National Park since 1995 as part of the Clean Air Status and Trends Network (CASTNet). An analysis of 1995 through 1998 CASTNet data shows no trend in dry nitrogen or sulfur deposition at the park.

Mount Rainier has an extensive network of rivers radiating from the mountain and the glacial activity has created nearly 400 lakes and ponds. The lakes are distributed around the face of the mountain and extend from montane to alpine settings. The lakes at higher elevations may remain ice-free only three to four months of the year. A series of surveys of lake chemistry in the park show that most are sensitive to atmospheric derived acidification and episodic acidification is occurring during spring snowmelt (Clow and Campbell 2008).

Ozone has been monitored at Tahoma Woods since 1991 and at Paradise since 1998. To date, the data indicate that although hourly ozone levels have been hourly ozone concentrations have been high enough to be of concern, no exceedences of the human health-based primary National Ambient Air Quality Standard (NAAQS) has occurred. However, On January 6, 2010, EPA proposed to strengthen the NAAQS for ground-level ozone. This action was in response to a lawsuit against EPA alleging that the ozone standards set at 0.075 parts per million (ppm) in 2008 were not sufficiently protective of human health or welfare. EPA now proposes to strengthen the "primary" NAAQS to protect public health, to and to establish a distinct "secondary" standard to protect sensitive vegetation and ecosystems. If the proposed new levels were set, the ozone levels recorded in the park would exceed them.

As part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, visual air quality in the park has been monitored using an aerosol sampler (1988 through the present), nephelometer (1992 through the present), and 35mm camera (1985 through 1995). The EPA's new Regional Haze regulations require improving visibility in Class I air quality areas on both the best visibility and the worst visibility days. Data suggest that existing sources are affecting visibility in the park.

Toxic compounds such as mercury and other metals, pesticides such as DDT, and various organic compounds that are byproducts of industrial processes can also be transported and deposited in wet and dry form onto national park lands. The extent to which these atmospherically transported toxics are currently affecting the park is unknown, but because research indicates these compounds may be deposited in greater quantities at high-elevation snow covered areas, there is concern about potential impacts. Deposition of toxics in high elevation ecosystems can result in impacts throughout the food chain, as many toxics tend to bioaccumulate in plant and animal tissue. Research and monitoring projects assessing the extent and risk of airborne toxics to park resources have been initiated, and will likely be increasing in extent and scope in the next decade.

Greenhouse Gas Emissions (GHG): GHG emissions result from the combustion of fossil fuels for energy (e.g., boilers, electricity generation) and transportation, the decomposition of waste and other organic matter, and the volatilization or release of gases from various other sources (e.g., fertilizers and refrigerants). In 2006 (the last emissions inventory), the park's GHG emissions totaled 12,710 metric tons of carbon dioxide equivalent ($MTCO_2E$). This total includes emissions calculated from Park Operations, Visitors, and Concessioner operations. Waste for Park Operations and the concessioner were based on a 3-year average from FY 2004, 2005, and 2006. The Paradise Inn was closed for renovation in FY 2006 so emission sources from this operation were not included. Fuel and energy consumption were based on previous year's estimations (2005). Visitor vehicle miles traveled were based on a 2004 Traffic Study. Numbers were generated using traffic counters and assumptions on visitor traffic patterns and vehicle types. Contractors implementing park construction projects were not included in the emission inventories.

Emissions from Park Operations, which excludes emissions from visitors and concessioners, totaled 3,100 $MTCO_2E$, resulting from Energy (66 percent), Transportation (24 percent), Waste (10 percent), and Other (<1 percent) activities. Concession operations emissions totaled 1,127 $MTCO_2E$, resulting from Energy (79 percent), Waste (13 percent), and Transportation 8 percent). For park operations included, the largest emission sector for Mount Rainier National Park is Transportation - totaling 9,238 $MTCO_2E$. The majority of these emissions result from visitor vehicle travel within park boundaries. Table 18: shows recent analysis of air pollution and greenhouse gas emissions generated in the park.

Table 18: Mount Rainier National Park Generated Air Pollutant Emissions and Greenhouse Gases

	EMISSION RESULTS BY SECTOR AND GAS/POLLUTANT					
	tons/year					
Gas	**Stationary Sources**	**Mobile Sources**	**Area Sources (Burning)**	**Area Sources (Other)**	**Other CAP Sources**	**Gross Emissions**
SO_2	0.027	0	0.017	0	N/A	0.044
NO_x	5.363	62.626	0.107	0	N/A	68.095
VOC	0.003	73.255	9.435	4.5	N/A	87.193
PM_{10}	0.046	0.023	1.426	0	N/A	1.494
$PM_{2.5}$	0.023	0.554	0	0	N/A	0.577
CO	0.018	571.586	10.556	0	N/A	582.16

2. Geology / Geologic Hazards

Mount Rainier has an extensive geologic and historic record of activity, including lava flows, ash eruptions, avalanches, and mudflows. The threat of mudflows is of particular concern due to the weakened array of rocks hydro-thermally altered by hot acidic waters within the volcano, and the presence of an extensive glacial cap. Although they may also be associated with periodic volcanic activity, earthquakes are also a threat in and of themselves.

The western Cascades were volcanically most active between twenty and forty million years ago. The lavas that built up Mount Rainier began to erupt approximately 650,000 years ago (Lillie and Driedger, 2001). Mount Rainier erupted as recently as between 1820 and 1854 (pumice) and may have erupted as recently as 1894 (unverified ash and steam). The most recent lava eruptions were approximately 1,000-2,000 years ago (Sisson, 1995). Since that time numerous large floods and debris flows have been generated on its slopes (National Research Council 1994). The National Research Council (1994) has stated that "volcanic hazards or volcano related events that are likely to pose threats to persons or property include the following:

> Volcanic eruptions: The eruption of ash flows and tephra (ash or pumice).
> Edifice failure: The gravitational collapse of a portion of the volcano.
> Glacial outburst floods: The sudden release of meltwater from glaciers and snowpack or from glacier dammed lakes on the edifice.
> Lahars or debris flows, and debris avalanches: Gravitational movement of commonly water-saturated volcanic debris down the steep slopes of the volcano and into nearby valleys."

Mount Rainier presents considerable geologic hazards to park visitors, employees, and infrastructure. The most significant geologic hazard is from debris flows. Many of the park's developed sites are located on debris flow deposits in valley bottoms, and 7 of 23 developed sites in the park are in a debris flow hazard zone with an estimated recurrence interval of less than 100 years (Scott *et al.* 1992; Hoblitt *et al.* 1995). Other potential hazards include pyroclastic flows, ash fall, and lava flows (if Mount Rainier erupts), as well as snow avalanches, rock falls, debris flows, and landslides (non-eruptive events).

Debris flows constitute the greatest volcanic hazard in the Cascade Range in terms of the potential effects and probability of occurrence (Hoblitt *et al.* 1995). Debris flows consist of slurries of water and sediment (60 percent or more sediment by volume) that look and behave much like flowing concrete. Debris flows are sometimes called mudflows or, when they originate on volcanoes, *lahars* (Hoblitt *et al.* 1995). Recently the term debris flow has been applied to small events within Mount Rainier National Park boundaries, while lahar has been reserved for larger, more catastrophic events that generate and extend outside the park.

The White River Valley is the site of the most devastating lahar Mount Rainier is known to have unleashed. The Osceola mudflow dates to about 5,600 years before present. It exhumed the northeast flank and summit of Mount Rainier and inundated the valleys of the White River and its West Fork, covering a total area of more than 195 square miles (Dragovitch, Pringle and Walsh 1994). The mudflow, estimated to contain more than 4.9 billion cubic yards of material, deposited a layer up to 30 meters (approximately 100 feet) thick and buried the areas where the towns of Enumclaw, Buckley, Orting, Puyallup, Sumner and Auburn are now located. A portion of the mountain also collapsed and formed the Paradise lahar.

More recent and smaller collapses from the west flank of Mount Rainier produced the Round Pass mudflow (Nisqually and Puyallup Rivers: 2,800 years ago; more than 200 million cubic yards) and Electron mudflow (Puyallup River: 550 years ago; 340 million cubic yards) among others (Crandell 1971; Scott, Vallance and Pringle 1995). The Paradise lahar (4,500-5,000 years ago) inundated the Nisqually River Valley, at least to the National area. The National lahar (1,200-1,700 years ago) retained a significant amount of sediment downstream as it traveled toward the Puget Sound lowland (below La Grande).

On December 14, 1963, the largest rockslides on Mount Rainier in historic time occurred on its east flank. Huge masses of rock fell in a series of avalanches from the steep side of Little Tahoma Peak (Crandell 1969). Altogether, about four billion cubic feet of rock fell. Although most rock fell on the Emmons glacier, some traveled to within 0.6 miles of the White River Campground (Scott and Vallance 1994). These rockslides occurred on a clear day and were heard by U.S. Forest Service employees on ski patrol at Crystal Mountain.

A fairly small debris flow occurred in February 2002 originating from high on the mountain near the Van Trump Glacier. It was caused by unstable soil and rock in the vicinity and heavy rain on snow and produced a debris flow that was detected beyond the Nisqually Entrance in Ashford up to the Kernahan Road Bridge over the Nisqually River, although effects of high water could also be noted downstream to Alder Lake.

The Carbon River basin is comprised of surficial deposits consisting of alluvium, mudflows, and glacial deposits (Fiske *et al.* 1964). Crandell (1969) mapped the surficial geology of the Carbon River basin as alluvium. Alluvium includes both unvegetated sand and pebble to boulder-sized gravel deposited by modern streams and rivers. This material is found in the stream and river channels of the drainage as well as in underlying forested terraces or benches as much as 15 feet higher than the stream channels. Some low terraces contain poorly-sorted boulder deposits that may be mudflows or alluvium transported by floods. Near the terminus of present glaciers such as Carbon, alluvium may include lenticular mudflows a few feet thick that came from moraines or rock debris on the glaciers; boulders larger than 5 feet in diameter in the alluvium were probably carried by these mudflows.

3. Soils

The park contains areas of high elevation solid rock and talus slopes with virtually no soil to low elevation glacial valleys with well-developed organic soils. Hobson (1976) classified park soils into four types as follows: tephra soils (pyroclastic deposits identified by individual ash layers); colluvial soils (coarse, unconsolidated soils of mixed parent materials); alluvial soils (river or glacially deposited soils); and mudflow soils (surface or subsurface parent materials resulting from volcanic mudflows). Beyond the work done by Hobson, however, there is little information on park soils, although Franklin *et al.* (1988) included the following information.

Tephra soils are common in forest communities and are comprised of volcanic parent materials (ash, pumice, etc.). They are typically coarse sands or gravelly sandy loams with less than 10 percent organic material.

Colluvial soils are the dominant soil group in the park (Franklin *et al.* 1988). They are generally unstable, rapidly drained and consist of coarse, unconsolidated mixed parent materials. They are found on slopes at all elevations, but especially on steeper slopes and south facing aspects.

Alluvial soils occur in major river valleys, along streams, wet benches and alluvial slopes and fans. They consist of coarse undifferentiated fine or very fine sands. Alluvial deposits are of varying thickness and texture. These are the dominant soils in the Carbon River area.

Mudflow soils result from lahars (volcanic debris flows). They are characterized by poorly sorted materials and often include rounded rocks and boulders intermixed with fine loamy sands, cobbles and gravel. These soils are generally clay-rich.

4. Water Resources

Physical Hydrology

The Carbon River flows north and west from the terminus of the Carbon Glacier into the Puyallup River northwest of Orting. After the confluence of the Carbon River, the Puyallup River (which originates at the Puyallup Glacier) empties into Puget Sound at Commencement Bay in Tacoma. The Carbon River takes its name from coal deposits that once supported communities along its upper reach such as Wilkeson, Carbonado, and Fairfax among others (Hall 1980 *in* Burtchard 2009). The Carbon River is fed by the Carbon Glacier at its upstream end and laterally by streams, including June, Falls, Cayada, Chenuis, Ranger and Ipsut creeks. The muddy brown color of the river during peak runoff season is due to fine-grained sediments discharged into the river with glacial melt-water (Burtchard 2009). In summer, however, the Carbon River exhibits the characteristic milky white water flow of glacial rivers from suspended glacial flour (pulverized rock debris from intra-glacial movement).

The Carbon River watershed within the park encompasses approximately 26,320 acres (or approximately 52 square miles) and ranges in elevation from 1,800 feet at the Carbon Entrance to almost 14,000 feet. The north portion of the watershed lies outside the park in the Mount Baker-Snoqualmie National Forest. In the park, the watershed is heavily vegetated below 5,500 feet and is characterized by relatively steep valley walls, foothills, and alpine terrain. On the forest, much of the watershed has recently been logged, particularly on the north side above the Falls Creek washout area and near the entrance. The average annual precipitation is estimated to be between 90 to 100 inches per year, making this area similar to a temperate rainforest.

The Carbon River is dynamic and braided. The Carbon Glacier, glacial outburst floods and steep tributary streams supply large volumes of sediment to the system and are responsible for this braided character. The Carbon River is an aggrading river, which accumulates material faster than it can be removed; consequently, the river's height increases in relation to the surrounding land, decreasing the ability for the river to contain flood surges (Beason 2006). The Carbon River has been shown to aggrade more quickly than any other river in the park, at a rate of nearly 0.5 ft per year (31 feet between 1915 and1971). Increased aggradation, along with the road having been built on the grade of the river bed has resulted in large, devastating floods impacting the road so relentlessly over its lifespan (Burtchard 2009). This rise in the bed of the Carbon River continues to contribute to effects from flooding in the Carbon River area. In addition, there has been a recent increase in rain-on-snow events (fall flooding). The road, built within and adjacent to the floodplain, however, has suffered from flood damage since before it was finished (1924) (Figure 3: *History of Carbon River Road Flooding 1925-2008*).

The Carbon River is characterized by a wide valley floor occupied by a network of several main channels, islands, and abandoned overflow channels. The main river channels consist of sand, coarse gravel and small cobbles. The area between the main channel and the road consists of large cobbles (4 to 10 inches). The existing road and adjacent forest contain an unconsolidated mixture of silt, sand, gravel and cobble. There are few boulder-sized and larger rocks in the channel. Flow depths are relatively shallow, even at flood stage, with the highest velocities concentrating in the channels. Large increases in discharge typically result in small increases in water surface elevation because the flow spreads out over the wide floodplains.

Braided glacial streams at Mount Rainier are naturally increasing in height due to sediment moving downstream from their namesake and other glaciers. As with other glaciers, the Carbon Glacier continues to expose unconsolidated sediment, though it has retreated only minimally in the last decade. Because the glacier is on the north side of the mountain and surrounded by steep valley walls, and the lower end of the glacier is well insulated by thick rock debris, melt rates have been less than those on the south and west side of the mountain (Driedger 1986).

Overall, however, glacial recession on all Mount Rainier glaciers between 1913 and 1994 has resulted in the disappearance of approximately 25 percent of its glacial volume (Nylen 2001)

As a result, the rate of aggradation in the last decade on the Nisqually, has been approximately 6 to 12

Photo28: Carbon River and Ipsut Creek Combined Flow

inches per decade (Beason 2006). This rate can occasionally be dramatically increased from debris flows, which "clog" the channel. In these events, deposits of five feet or more of material can accumulate across the channel.

On the White River, 1.5 miles below the Emmons Glacier, Fahnestock (1963) measured bed aggradation of one foot over a two-year period; on Tahoma Creek, from three to six miles below South Tahoma Glacier, Driedger and Walder (1994) measured bed aggradation of 6.6 ft in six years; and on the Nisqually River at Longmire, the NPS estimated bed aggradation of 3-4 feet over a 12 year period between surveys (NPS 1997, Riedel 1999, December 20, 2006 Rebuilding Rainier Newsletter). There are no current aggradation rates for the Carbon channel.

While, aggradation is a natural event in a dynamic environmental setting like Mount Rainier, data are showing an increased rate of aggradation over the last three decades (Beason 2006). This has been combined with an increase in fall rain-on-snow flooding.

According to Entrix (2008:2): "In the 2006 flood, channels raised (sic) an average of about one meter, a rise which previously would have taken 20 years, based on historic aggradation rates. . . River aggradation is altering entire valley bottoms, burying old growth riparian forests and overwhelming infrastructure constructed with assumptions about flow, sediment and wood regimes that are no longer valid."

Maintaining infrastructure that can withstand current and future rates of aggradation will be difficult. In several areas, the Carbon River bed is higher than the Carbon River Road because of this aggradation (FHWA 1997, Beason 2006, Entrix 2008, Geomax 2008). Based on the history of flooding on the Carbon River Road (since 1895), there have been large floods with minor damage and small floods with major damage to facilities (primarily the road). There have also been (as 1996 and 2006 have shown) large floods with a large amount of damage.

<u>Description of Carbon River Area Damage in 2006 and 2008 Floods</u>: In November 2006, only four years after completion of the GMP, Mount Rainier received over 18 inches of rain in 36 hours. Resulting rainwater runoff – locally exacerbated by small glacial outburst floods and debris flows – resulted in significant flooding and road damage throughout the park. The Carbon River Road was not spared. Over one linear mile was damaged or destroyed in six locations between the park entrance and Ipsut Creek Campground. In places, damage was severe. In addition to a deep scour in the Falls Creek area (similar to what occurred in 1996), Ipsut Creek Campground was isolated by a nearly eight foot deep erosion channel immediately west of the log-jammed Ipsut Creek bridge. Here, and in other places, the roadbed was removed. Elsewhere, damage was less dramatic.

The 2006 flood caused damage to the Carbon River Road and eroded areas adjacent to park infrastructure at the Carbon River Entrance and Ipsut Creek Campground. A description in the Entrix report (2008:3), characterizes what happened: "the primary mechanism that washed out the road was the clogging of several culverts upstream that lead (sic) to a buildup of flowing water on the road sufficient to ultimately scour out large portions of road." The report goes on to state that multiple factors are contributing to flooding and damage on the roadway, including "the lack of capacity in the existing culverts crossing the road. . .flood flows in excess of the culvert capacity damage the roadway as flows overtop and flow down the road."

The entrance was protected from major flooding by a natural logjam that continues to remain fairly intact behind the vault toilets. Nonetheless this natural logjam has diminished and without supplementation could fail and cause major erosion of the bank alongside the Carbon entrance facilities (Geomax 2008, Entrix 2008). Above the entrance, damage to the road began just below the Old Mine trailhead with head-cutting caused by inadequate and blocked culverts.

The Carbon River Maintenance Area was not damaged in 2006 flooding but was heavily damaged in 2008 flooding, when the former bunkhouse was washed downstream during loss of 120-150 feet of riverbank. Since then, another non-historic building located in the area has been removed and this plan calls for the removal of another historic building to boundary expansion lands to open up the Maintenance area for parking.

The greatest damage to the Carbon River occurred in the Falls Creek area, above the Old Mine Trailhead (MP 1.2). Past washouts have occurred fairly regularly here, including most recently in 1998 and 1999. Although the overall active width of the river (from forest edge to forest edge) in the vicinity of the Falls Creek washout did not change much in the 1996 flood (FHWA 1997:2), in the 2006 flood it lost most of the forest buffer that lay between the Carbon River Road and the Carbon River. The former island of forest between the river and the road is now a very narrow strip of riparian forest. Historic aerial photographs (1951 to 1984) analyzed by FHWA (1997) show that thinning vegetation adjacent to the Carbon River near Falls Creek likely began in 1984 from erosion and migration of the channel during flooding.

It is in the Falls Creek alluvial fan that the road corridor became a channel for the river and eroded away the surface of the road and 5-10 or more feet for a distance of approximately 2,600 feet. The river is inherently unstable within the active channel. The active river channel widens considerably in the vicinity of Falls Creek, compared to narrow channel caused from bedrock formations on the right bank upstream and on the left bank at Chenuis. As a result, flow velocity is reduced as this formerly fast moving water spreads out. Some of the sediment load through the narrow reach is deposited, building up bars and amplifying the braided character of the river particularly at flood stage.

Directly above the Falls Creek washout section, the Carbon River Road continues a steady rise in elevation and is located on a forested terrace that is currently approximately one-quarter mile from the river. This forested area has also thinned over time and it is possible to foresee a time when it too may become part of the active river channel. This long 2,600 foot (0.49 miles) undamaged section continues to above the Green Lake Trailhead (Milepost 3.1).

As the road corridor rises out of the forested terrace, closer to the Carbon River, it traverses along a bedrock knob (near Milepost 3.0) where ongoing sloughing is narrowing the road corridor. At this large bedrock knob, the river has already begun to flow into the forest around it. Although this channel now does not contain enough flow to continue its incursion, the main stem of the Carbon River is continuing to erode the bank near it.

As the road travels around this knob, it is located above a former side channel of the river on a steep bank above another narrow forest buffer from the main channel. In this section, flood flow through the side channel during flooding has begun to cause sloughing of the road edge, which becomes more apparent as the road nears the Green Lake Trailhead. Sloughing erosion at the parking area for the trailhead caused bumper stops there to now be at the edge of a cliff overhanging the channel.

Just below Chenuis (Milepost 3.5), an approximately 200-foot section of the road (where sloughing of the bank had been occurring) was eroded out through both lanes of the road and into the adjacent forest. At Chenuis, ongoing bank erosion continues in areas below where 1980s riprap was placed. The rip rapped area continues to be fairly stable. Above Chenuis, near a hanging culvert (on a tributary to Ranger Creek) minor damage associated with head-cutting has begun to occur as a result of an undersized culvert.

Also above Chenuis, the Carbon River Road has been damaged in several places, including by water washing across it at one location where the river and the road are at the same elevation (Milepost 4.1) and by erosion of two lanes of roadway in an area just less than 400 feet long (Milepost 4.4).

Just above Milepost 4.4, the 2006 flood caused major damage to the Carbon River Road when the river, joined by Ipsut Creek, flowed down the road below the campground, forming a deep gully, approximately 1,600 feet long, similar to the gully formed during the 1998, 1999 and 2006 floods at Falls Creek.

At Ipsut Creek Campground Light Detection And Ranging (LiDAR) images using remote sensing technology show a narrow channel that widens in the vicinity of the campground then narrows considerably as it flows southwest toward Chenuis. Whereas the Carbon River formerly flowed only alongside the north side of Ipsut Creek Campground, some water (about 5-30 percent) from the river now joins Ipsut Creek flows on both sides of Ipsut Creek Campground, essentially turning the campground into an island at peak flows. During the 2006 flood, Ipsut Creek jumped its bank near the Ipsut Creek Bridge due to a debris jam that formed first downstream, then upstream of the bridge. Ipsut Creek now flows near, but not under its namesake road bridge.

Ipsut Creek, a tributary to the Carbon River, draws from a moderate watershed of approximately 4.1 square miles (2,624 acres). Two perennial creeks and one intermittent creek flow into Ipsut Creek above Ipsut Falls (located just southwest of Ipsut Creek Campground). The Ipsut Creek drainage is characterized by a steeply incised canyon, generally with a mostly bedrock bottom above Ipsut Falls with boulders and cobbles and occasional small areas of sand or gravel, and a cobble/gravel substrate below the falls. In the upper watershed, trails comprise the only development.

Water Quality

Water quality in the Carbon River and Ipsut Creek is not routinely monitored but from existing data collected by NPS staff meets standards for Clean Water Act designated Class AA (extraordinary) water quality standards. Limited development in the Ipsut Creek watershed (essentially just the Wonderland Trail and associated wilderness camps) results in a minimal amount of point pollution sources. However, the effects of non-point sources such as atmospheric contaminants are unknown. Outside of storm events and periods of high glacial melting during the summer season, when turbidity is high, the Carbon River, like other streams throughout the park, runs very clear, providing habitat for aquatic organisms that require clean, cold waters for survival.

Water quality criteria are numeric values or narrative descriptions of the physical, chemical, and biological characteristics of waters necessary to support their designated beneficial uses. These criteria include parameters such as temperature, dissolved oxygen, pH, turbidity, alkalinity, nutrients, bacteria and toxic chemicals. Washington (WDOE 2006).

The CWA requires all states to establish protected use, also called designated beneficial use, classifications for all water bodies within their boundaries. Washington states' designated uses for fresh water include uses for aquatic life, recreation, water supplies and other miscellaneous criteria.

Beginning in 2006 a federally mandated water quality program began in Washington State. Three tiers of water quality protection were identified:

- "Tier 1: protect existing and designated in-stream uses (Tier I),
- Tier II: to limit the conditions under which water of a quality higher than the state standards can be degraded, and
- Tier III (outstanding resource waters): to provide a means to set the very best waters of the state side from future sources of degradation entirely."

Waters in the Carbon watershed exceed state standards for water quality and are subject to the following "Tier II: Antidegradation" regulations: "Whenever a water quality constituent is of a higher quality than a criterion designated for that water in the state surface water quality standards, new or expanded actions within the categories identified in subsection (2) of this guidance that are expected to cause a measurable change in the quality of the water [described in subsection (4)] may not be allowed unless the department determines that the lowering of water quality is necessary and in the overriding public interest." These qualities include designation of the waters of the Carbon River for:

- Aquatic Life Uses (Char rearing and spawning and other aquatic species similarly dependent on such cold water),
- Recreational Uses (extraordinary quality primary contact waters, primary contact recreation),
- Water Supply, and
- Miscellaneous Uses (Wildlife Habitat, Aesthetics).

Table 19: Washington State Fresh Water Quality Criteria Applicable to Carbon River

Designated Use	Temperature (highest 7-day average daily max.) [1]	Dissolved oxygen (lowest 1-day min.)	pH
Aquatic Life Stage			
Char spawning	9°C		
Char spawning and rearing	12°C	9.5 mg/L	6.5 - 8.5 (human-caused variation within this range < 0.2)
Salmon and trout spawning	13°C		
Core summer salmonid habitat	16°C	9.5 mg/L	6.5 - 8.5 (human-caused variation within this range < 0.2)
Salmonid spawning, rearing, and migration	17.5°C	8.0 mg/L	6.5 - 8.5 (human-caused variation within this range < 0.5)
Salmonid rearing and migration only	17.5°C	6.5 mg/L	6.5 - 8.5 (human-caused variation within this range < 0.5)

[1] Washington DOE has identified water bodies, or portions thereof, which require special protection for spawning and incubation in DOE publication 06-10-038 (Payne 2006). This document indicates where and when additional temperature criteria are to be applied to protect the spawning and incubation of native char, salmon, and trout.

The following are the designated recreational and miscellaneous beneficial uses of the Puyallup – White River Basin (Carbon River and tributaries above latitude 46.9998 longitude -121.9794 that are in or above the Snoqualmie National Forest or Mount Rainier National Park) by the Watershed Resource Inventory:

Char Spawning / Rearing
Core Summer Habitat[#]
Spawning / Rearing[#]
Extraordinary Primary Contact
Domestic Water[1]
Industrial Water
Agricultural / Irrigation Water
Stock Water
Wildlife Habitat
Harvesting / Fishing
Commercial / Navigation
Boating / Fishing
Aesthetics

[#] NPS proposed Designated Use
[1] In Washington, temperature shall not exceed a 1-day maximum (1-DMax) of 20.0°C due to human activities. When natural conditions exceed a 1-DMax of 20.0°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C; nor shall such temperature increases, at any time, exceed 0.3°C due to any single source or 1.1°C due to all such activities combined. Dissolved oxygen shall exceed 90 percent of saturation. Special condition - special fish passage exemption as described in WAC 173-201A-200 (1)(f).

Floodplains

The NPS manages floodplains in accordance with Executive Order 11988, Floodplain Management, and the NPS Floodplain Management Procedural Manual (NPS 2003)). It is NPS policy to preserve floodplain values and minimize potentially hazardous conditions associated with flooding. To implement NPS floodplain policy, proposed actions are classified into one of three action classes. Depending upon the action class, one of three “regulatory floodplains” applies (100-year, 500-year, or Extreme). If a proposed action is found to be in an applicable regulatory floodplain and relocating the action to a non-floodplain site is considered not to be a viable alternative, then flood conditions and associated hazards must be quantified as a basis for management decision making and a formal Statement of Findings (SOF) must be prepared. The SOF must describe the rationale for selection of a floodplain site, disclose the amount of risk associated with the chosen site, and explain flood mitigation plans.

Generally, the regulatory floodplain is the 100-year flood for most park functions. For critical actions such as schools, hospitals, and large fuel storage facilities, the regulatory floodplain is defined as the 500-year floodplain. Some facilities such as picnic areas and day-visitor parking are exempt from the NPS guidelines because they are often located near water for the enjoyment of visitors and do not involve overnight occupation.

The removal of structures from the 100-year floodplain is considered a beneficial impact to human life or property and to natural floodplain values and functions. Development of new facilities in the 100-year floodplain is considered an adverse impact to human life or property.

The *Floodplains Statement of Findings* in the *GMP Record of Decision* acknowledged that the road and the campground would remain within the 100-year floodplain and the extreme (debris flow hazard) floodplain and anticipated ongoing impacts to them. Because of their location in the floodplain and because of ongoing anticipated damage to access the facilities, the GMP called for the entrance facilities to be relocated to the non-floodplain boundary expansion area. The report prepared for the GMP, stated that future bank erosion could threaten the Carbon River Entrance facilities. It also noted (regarding Ipsut Creek Campground) that “over the next few decades it is anticipated that continued deposition in the modern channel and upstream channel alignment will cause the Carbon River to shift to the south, isolating and claiming all or parts of the campground, and causing considerable damage to roads, trails and other facilities” (Riedel 1997).

Portions of the Carbon River Road and Ipsut Creek Campground lie within their regulatory floodplain. In addition, Ipsut Creek Campground and the Carbon River Entrance are within the regulatory floodplain.

In a report prepared for the GMP, *Geologic Hazard and Floodplain Management*, the administrative structures at the Carbon River Entrance were found to be outside of their regulatory floodplain (100-year), however, flooding (less than two feet at very low velocities) that affected entrance structures based on recollection of staff was noted in the report. This flooding was attributed not to the Carbon River, but rather to June Creek, a tributary stream that enters the Carbon River west of these facilities at the entrance. The report also noted that bank erosion would likely threaten portions of the area in the future and that the absence of volcanic tephra and the presence of floodplain soils indicated that larger floods might occasionally have inundated the site (Riedel 1997).

Analysis from the GMP that ultimately allowed retention of these facilities is quoted below:

> *Ipsut Creek Campground*. A preliminary floodplain assessment in 1994 determined that the campground is in a high flood hazard area adjacent to the floodplain of the Carbon River (NPS 1997b). The many channels that form the large braided channel network in this area shift constantly. Numerous modern and old flood channels crisscross the floodplain. Flood flow through the channels is shallow, but rapid. Depths of for the 50-year and 100-year floods in the main channel of the Carbon River are only 3.5 feet, but velocities are estimated at 8 feet per second.
>
> A detailed floodplain study conducted after the 1994 assessment indicated that parts of the campground, former walk-in sites, and the entrance road occupy very low parts of the floodplain.

Most of the campground rests on a low terrace, 5 to 6 feet above the modern or current channel. The *[former]* walk-in sites were isolated by swift water in a side channel during even small flood events. As a result, these sites were permanently closed in 1997. High flood hazard occurs in this area with discharges of 1,000 cubic feet per second or greater.

Hydraulic model output indicated that most of the campground is outside the existing 100-year floodplain. However, the unstable nature of braided channels and the location of parts of the campground at lower elevations than the active river channel suggest that the 100-year floodplain boundaries from the model may not be accurate for very long. Therefore, the 100-year floodplain boundaries have been located to include the low-elevation channels on the southwest end of the valley and to include the campground.

Over the next few decades it is anticipated that continued deposition in the modern channel and upstream channel alignment would cause the Carbon River to shift to the south, isolating and claiming all or parts of the campground, and causing considerable damage to roads, trails, and other facilities (NPS 2002: 135).

Carbon River Entrance. An entrance station, a ranger station, and a housing and administrative area are located in the vicinity of the Carbon River Entrance. The entrance station is categorized as an excepted action under the Floodplain Management Guideline because its function depends on a road that is intermittently in the floodplain. The ranger station and the housing and administrative area are not excepted actions. *[Note: Use of the housing was discontinued shortly after this analysis.]*

Initial floodplain studies performed in 1994 suggested that the entrance and housing facilities were within the 100-year floodplain (as noted in table 9) *[See 2001 GMP]*. Detailed floodplain assessments performed in 1996 using hydraulic models indicated that all the facilities are outside the 100-year regulatory floodplain. Historic flooding observed at the entrance station probably was caused by a shift in the channel of June Creek (a tributary to the Carbon River) to the west of the entrance area. (This apparently occurred since the publication of the USGS 7.5 minute map in 1971.) Flooding that does occur at the entrance involves less than 2 feet of standing water and very low velocities.

However, there is other evidence that the facilities are within the floodplain. The presence of floodplain soils, a levee, and an absence of volcanic tephra (clastic material ejected from a volcano) suggest that large floods might have occasionally inundated this site in the recent past. Thus, although the hydraulic model suggests otherwise, because of the erosion of soils and the potential for floods to inundate the site, the entrance facilities are within the regulatory floodplain (J. Riedel, NPS geologist, pers. com., July 10, 2001).

Channel changes in the next few decades also could threaten these facilities through bank erosion. Such channel changes, a common feature of park rivers have resulted in the migration of the Carbon River from its north bank to its south bank over the past few years. For this reason, the road, which is below the river in some places, has been flooded more often with smaller flood discharges.

As noted in the Floodplains Statement of Findings for the Mount Rainier GMP (NPS 2002), the Carbon River Road is an extreme floodplain, a Case III debris flow hazard zone. Case III areas are subject to debris flow hazards on an average recurrence interval of one event every 100 years. Despite this, facilities were recommended for retention of their existing uses in the GMP. This determination was based on the lack of "safe" areas in the non-wilderness portion of the park; the high environmental cost of moving facilities; and public comments indicating a willingness to accept an informed level of risk. Because of the likelihood of the future loss of these facilities, however, and anticipated effects to the Carbon River Road, the GMP also called for a park boundary expansion in the Carbon River area and eventual relocation of the facilities to the boundary expansion area. This plan calls for minimal facilities to be located at the Carbon River Entrance to accommodate visitor use. As noted in the Alternatives, the facilities would provide for visitor orientation because this site is not connected to boundary expansion lands and therefore visitors can arrive at it without stopping at the new proposed Carbon River Ranger Station.

Flooding impacts affecting the Carbon River Road have often been the result of fall rain-on-snow events where periods of intense rainfall are combined with rapidly melting snow (Entrix 2008). This snowfall is from high elevations. During rain-on-snow events the freezing elevation rises so that rain, instead of snow falls at high elevation. As a result, the river has higher flows that may transport large concentrations of rock, sediment and woody debris. These flooding impacts can be combined with the potential for small and large debris flows. Debris flows can block streams and cause them to channel new alignments, as happened both on the Carbon River and on Kautz Creek during the 2006 flood. High sediment and debris loaded streams can change course rapidly, establishing new chutes, and create debris blockages that cause them to reroute themselves down hydraulically smooth corridors, such as roads (Entrix 2008).

Carbon River Ranger Station: The Carbon River Ranger Station is located approximately 3-4 feet above the bed of the Carbon River and 2-3 feet below the road (Entrix 2008:C7). It was not inundated during the 2006 flooding.

The floodplains statement of findings for the GMP was based on a survey of park facilities and their regulatory floodplain. For the current project cross-sections in the Carbon River area from the GMP study were re-measured through the river channel by Entrix (2008) to detect changes that had occurred since 1994 (Riedel 1997). A hydraulic analysis was also completed to estimate flow depths and shear stress conditions along the river at known problem locations.

Nineteen cross-sections were surveyed between valley walls across the channel, in the unvegetated area of the floodplain. The three above Ipsut (near Spukwush Creek) were not surveyed the same way due to difficulties in obtaining data. Seven other cross-sections were surveyed near Ipsut Creek Campground.

From modeling the following estimated peak flows for the Upper Carbon, Ipsut Creek Campground area and Lower Carbon River were derived (Table 20) (Entrix 2008:12).

Table 20: Estimated Carbon River Peak Flows by Section

	Location		
	Upper Carbon	**Ipsut Creek Campground**	**Lower Carbon**
Watershed	*20.5 square miles*	*25.7 square miles*	*60 square miles*
Return Period	**Flow (cubic feet per second**		
2 years	1,884	2,230	3,864
5 years	2,850	3,500	5,760
10 years	3,820	4,513	7,705
25 years	4,899	5,774	9,811
50 years	5,742	6,750	11,418
100 years	6,593	7,752	13,078
200 years	8,674	10,177	17,028

Peak flow data from the gauge on the Carbon River (near Fairfax) show an increasing frequency and occurrence of floods, from below 4,000 cfs in 1927 to above 6,000 cfs in 2006. As noted in the ENTRIX analysis, peak flows have increased similarly throughout western Washington. In the report, flood frequency plots for the Sauk River showed that the 100-year flood in 1986 was less than the 50 year flood discharge in 2007 (Entrix 2008:12).

Table 21: Carbon River Flood Frequency Analysis

	estimated peak flow in cfs			
Recurrence Interval	**With November 2006**	**Without November 2006**	**2100 with**	**2100 without**
2 years	4433	4377	5117	6605
5 years	7041	6824	8357	10491
10 years	8933	8546	11169	13310
25 years	11490	10820	14036	17120
50 years	13520	12570	16378	20145
100 years	15640	14370	18460	23304
500 years	21040	18810	23860	31350

From Entrix (2008) Table 9: Flood Frequency Analysis for the Carbon River at the Fairfax USGS gauge

A Draft Floodplains Statement of Findings for the currently preferred alternative has been included as Appendix 7. Proposed actions in the alternatives, including retention of road or construction of a trail and erosion protection structures are proposed within the regulatory floodplain.

With the exception of the Falls Creek area, the majority of the NPS road and visitor facilities lay outside of the regulatory 100 and 500 year floodplains. A portion of the roadway between the park entrance and maintenance area as well as a large portion of the roadway from the Chenuis Falls trailhead to Ipsut Creek campground, however, has the main stem river flowing within 10-50 feet of the roadway.

Wetlands

Some proposed actions in Alternatives 1-5, including erosion protection structures, are proposed within wetlands, some of which are also within the regulatory floodplain. This description relies on the more liberal Cowardin system of wetland classification used by the NPS. Director's Order 77-1L Wetland Protection (NPS 2008) requires that the NPS use the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979) as the standard for defining, classifying and inventorying wetlands. This system generally requires that a positive indicator of wetlands be present for only one of the indicators (vegetation, soils or hydrology) rather than for all three parameters as used by the U.S. Army Corps of Engineers and the Environmental Protection Agency under the Clean Water Act.

Wetlands in the project area, along the Carbon River Road and Ipsut Creek include perennial and intermittent riverine, palustrine forested, and palustrine shrub scrub wetlands (USFWS 1978). These are described based on road mileposts below. Although the road is generally surrounded by wetlands, it is not itself a wetland, except where the river has affected it in the Falls Creek and Ipsut Creek areas.

Key

	Occurrence in Wetlands
OBL = Obligate wetland species	>99 percent
FACW = Facultative wetland species	67-99 percent
FAC = Facultative species	34-66 percent
FACU = Facultative upland species	1-33 percent
UPL = Upland	< 1 percent

Note: FacW, Fac and FacU have + and – values to represent species near the wetter end of the spectrum (+) and species near the drier end of the spectrum (--).

<u>Mile 0.0 to Mile 0.5: Palustine, forested, needle-leaved evergreen seasonally flooded Cowardin wetland</u>: Understory vegetation adjacent to this section of the project area is dominated by obligate wetland, facultative wetland and facultative species including skunk cabbage (*Lysichiton americanum* – OBL), devil's club (*Oplopanax horridum* – FAC), deer fern (*Blechnum spicant* – FAC+), lady fern (*Athyrium filix-femina* – FAC), salmon berry (*Rubus spectabilis* – FAC+), thimble berry (*Rubus parviflorus* – FAC-) and oak fern (*Gymnocarpium dryopteris* – FAC), with patches of shore sedge (*Carex lenticularis* – FACW+), arctic sweet coltsfoot (*Petasites frigidus* – FACW-) short-scale sedge (*Carex deweyana* –FAC+), Scouler's corydalis (*Corydalis scouleri* – FAC+), and slender wood-reedgrass (*Cinna latifolia* – FACW). Sphagnum moss (*Sphagnum* sp.) was also associated with wetter spots in this area (Photo 29).

Photo 29: Forested Wetland Milepost 0.0 – 0.5 Section

Tree species include Sitka spruce (*Picea sitchensis* – FAC), western red cedar (*Thuja plicata* – FAC) mixed with western hemlock (*Tsuga heterophylla* – FACU), and with red alder (*Alnus rubra* – FAC) regeneration on the side of the former road. Facultative upland and upland species also occur in this area, but are restricted to elevated logs and hummocks within the matrix of wetland associated species.

<u>Mile 0.5 to Mile 1.5: Palustine, forested, needle-leaved evergreen seasonally flooded Cowardin wetland</u>: Vegetation adjacent to this section of the road is similar to the previous section, except that skunk cabbage (OBL) is much less abundant, possibly indicating a shorter hydroperiod in this area. The dominance of facultative wetland and facultative species in the understory, however gives this area its wetland character. These species include devil's club (FAC), deer fern (FAC+), lady fern (FAC), salmon berry (FAC+), thimble berry (FAC-), with patches of arctic sweet coltsfoot (FACW-) short-scale sedge (FAC+), Scouler's corydalis (FAC+), and slender wood-reedgrass (FACW). Tree species composition also changes in this section with Sitka spruce (FAC) becoming less abundant, while Douglas fir (*Pseudotsuga menziesii* – FACU) becomes co-dominant. Both western red cedar (FAC) and western hemlock (FACU) remain abundant, and red alder (FAC) regeneration is still present on the side of the former road. Similar to the previous section of road, facultative upland and upland species also occur in this area, but are restricted to elevated logs and hummocks within the matrix of wetland associated species (Photo 30).

Within this section of road there are two stream crossings that include culverts under the road bed. These areas are riverine, intermittent streambed, cobble-gravel substrate Cowardin wetlands. Edges of these stream beds support dense populations of facultative wetland and facultative species mentioned above, especially devil's club. These crossings are at approximately 1.3 miles and 1.4 miles and are about 60 feet wide each (Photo 31).

Photo 30: Milepost 0.5 – 1.5 Section **Photo 31: Stream Crossing Milepost 0.5 – 1.5**

<u>Mile 1.5 to Mile 2.0 (Falls Creek washout area): Riverine, intermittent streambed, cobble-gravel and sand substrate Cowardin wetland</u>: This section of the project crosses the Falls Creek washout area where Falls Creek enters the Carbon River. The proposed trail area (Alternative 2) traverses a complex of intermittent water courses with cobble-gravel and sand bottoms (Photo 32). The temporary trail is generally comprised of sandy alluvium mixed with rounded river rocks. The former road bed is now occupied by a downcut side channel of the Carbon River which runs parallel to the proposed trail route and no more than 25 feet from it.

Species composition is similar to the previous section of road corridor, with devil's club forming dense populations adjacent to the intermittent stream channels (Photo 33). The trees have formed buttresses at the base indicating a saturated soil condition for at least part of the year.

Photo 32: Seasonal Stream in Falls Creek Area **Photo 33: Dense Devil's Club in Falls Creek Area**

<u>Mile 2.0 to Mile 3.1: Non-wetland</u>: The road corridor heads gradually uphill from the Falls Creek area and the road bed in this area is intact. The composition of the understory vegetation adjacent to this section of road is more typical of an upland environment. Species include western sword fern (*Polystichum munitum* - FACU), Cascade barberry (*Berberis nervosa* - UPL), twin flower (*Linnaea borealis* – FACU-), red huckleberry (*Vaccinium parvifolium* - UPL) and salal (*Gualtheria shallon* – FACU+). Devil's club (FAC), deer fern (FAC+) are still present, but are not very abundant. Trees include Douglas fir (FACU) and western hemlock (FACU) with occasional western red cedar (FAC), but western hemlock seedling and saplings are abundant in the understory (Photo 34).

At approximately 2.7 miles a side channel begins to run immediately adjacent to the road corridor, and at approximately 2.9 miles the road corridor borders the open flood plain of the Carbon River with a side channel running at the base of the fill slope.

Mile 3.1: Ranger Creek Culvert: Riverine, lower perennial, cobble-gravel unconsolidated bottom and palustrine, forested, broad leaved deciduous and needle leaved evergreen Cowardin wetlands: The road corridor crosses Ranger Creek just before it enters the Carbon River. Species associated with this wetland area include Scouler's corydalis (FAC+), devil's club (FAC) and arctic sweet coltsfoot (FACW-). Tree species include western red cedar (FAC), western hemlock (FACU) and red alder (FAC). The road corridor crosses the creek and associated wetlands for about 100 feet associated with erosion and cutbank damage to the road bed.

Photo 34: Upland Forest Milepost 2.0 – 3.1

Mile 3.3: Existing twin culvert: Riverine, intermittent, cobble-gravel and sand streambed and palustrine, forested, needle leaved evergreen Cowardin wetlands: An intermittent stream crosses the road corridor through twin culverts that are plugged with debris. The water has been diverting down both sides of the road such that the road corridor is now included as part of the intermittent stream channel.

Understory species in the wetland associated with the streambed include skunk cabbage (*Lysichiton americanum* – OBL), devil's club (*Oplopanax horridum* – FAC), lady fern (*Athyrium filix-femina* – FAC), and salmon berry (*Rubus spectabilis* – FAC+). The road corridor crosses the old intermittent stream channels for about 30 feet, but the evidence of water running down both sides of the road extends over 100 feet to the west.

Mile 3.5: Road Washout: Riverine, intermittent, cobble-gravel and sand streambed and palustrine, forested, needle leaved evergreen Cowardin wetlands: Two branches of an intermittent stream come together just before the road corridor and washed out the road as it joined the Carbon River. The proposed trail crosses the intermittent streambed and associated wetlands for about 120 feet.

Dominant understory species include devil's club (FAC), lady fern (FAC), salmon berry (FAC+), and slender wood-reedgrass (FACW).

Mile 3.6 to Mile 3.8: Chenuis Falls Parking Area: Riverine, lower perennial, cobble-gravel unconsolidated bottom and palustrine, forested, broad leaved deciduous and needle leaved evergreen seasonally flooded Cowardin wetlands: Two streams come together at beginning of this section and enter the Carbon River through a "hanging" culvert. East of the culvert and parking area the road corridor has a perennial branch of the Carbon River on the north side (Photo 35) and an intermittent stream bed with standing water on the south side. The trail route is river alluvium and rounded river rock as a result of water channeling down and along both sides the road bed.

The forested wetlands associated with the riverine wetlands on both sides of the road corridor is dominated by mature red alder (FAC) with western red cedar (FAC). The understory is dominated by devil's club (FAC), lady fern (FAC), salmon berry (FAC+), slender wood-reedgrass (FACW), cow parsnip (*Heracleum lanatum* – FAC+), stinging nettle (*Urtica dioica* – FAC+) and reed canary grass (*Phalaris arundinacea* – FACW).

Photo 35: Alder in Active River Side Channel **Photo 36: River Side Channel Crosses Trail**

<u>Mile 3.9: Riverine, intermittent, cobble-gravel bottom streambed Cowardin wetland</u>: An intermittent side channel of the Carbon River crosses the road corridor and continues south into the surrounding forest. The proposed route crosses the intermittent channel for about 30 feet (Photo 36).

<u>Mile 3.9 to Mile 4.5: Palustrine, forested, needle-leaved evergreen seasonally flooded Cowardin wetland</u>: This section of the road corridor is similar to the second section described above. Understory vegetation is dominated by facultative wetland and facultative species including devil's club (FAC), deer fern (FAC+), lady fern (FAC), salmon berry (FAC+), thimble berry (FAC-), with patches of arctic sweet coltsfoot (FACW-) short-scale sedge (*Carex deweyana* –FAC+), Scouler's corydalis (FAC+), and slender wood-reedgrass (FACW) (Photo 37). Tree species include Douglas fir (FACU), western red cedar (FAC) and western hemlock (FACU), with red alder (FAC) regeneration abundant on both sides of the road bed. Facultative upland and upland species also occur in this area, but are restricted to elevated logs and hummocks within the matrix of wetland associated species.

Photo 37: Forested Wetland Milepost 3.9 – 4.5 **Photo 38: Dense Ferns Milepost 4.5 – 4.8**

<u>Mile 4.5 to Mile 4.8: Palustrine, forested, needle-leaved evergreen seasonally flooded Cowardin wetland</u>: This section of the road corridor is where the former road bed is now occupied by a perennial branch of Ipsut Creek, therefore the proposed trail is through previously undisturbed vegetation. Numerous blow-down trees have exposed the river alluvium and rounded river rock that is below 4" to 6" of organic matter. Understory vegetation is dominated by devil's club (FAC), deer fern (FAC+), salmon berry (FAC+), thimble berry (FAC-), and arctic sweet coltsfoot (FACW-), with dense patches of mountain

woodfern (*Dryopteris expansa* [syn. *D. dilatata*] – FACW) and lady fern (FAC) in the lower, wetter spots (Photo 38). Tree species include Douglas fir (*Pseudotsuga menziesii* – FACU), western red cedar (FAC) and western hemlock (FACU).

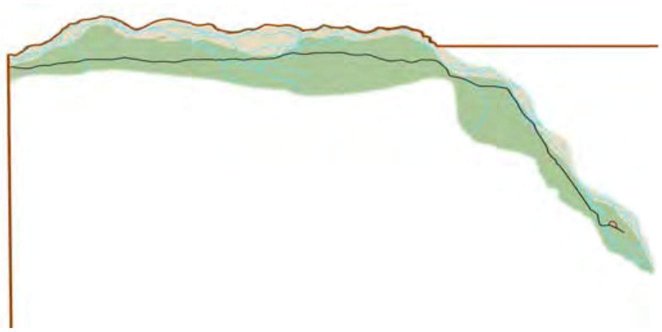
Mile 4.7: Riverine, intermittent, bedrock bottom streambed: Proposed trail route crosses an intermittent stream bed. Crossing is about 60 feet wide. A 30"x 30" culvert is proposed for this site to accommodate seasonal flows.

Mile 4.8: Riverine, lower perennial, bedrock and rubble bottom Cowardin wetland: Existing log bridge over Ipsut/Carbon River is about 40 feet long. Existing concrete bridge over Ipsut/Carbon is about 70 feet long.

5. Vegetation

Park vegetation is diverse, encompassing three ecological zones: the alpine zone, the subalpine zone and the forest zone. Vegetation in the Forested Zone, which comprises the Carbon River area is described below (Figure 25).

Figure 26: Map and Photo of Western Hemlock / Devil's Club Forest in the Carbon River Area



❖ Forested Zone

The forested zone blankets the lower elevations of the Mountain's flanks, occupying about 58 percent of the park, and is dominated by the following evergreen trees: western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), western red cedar (*Thuja plicata*), Pacific silver fir (*Abies amabilis*), mountain hemlock (*Tsuga mertensiana*), Noble fir (*Abies procera*), grand fir (*Abies grandis*), subalpine fir (*Abies lasiocarpa*) Alaska yellow cedar (*Chamaecyparis nootkatensis*), Engelmann spruce (*Picea engelmannii*), western white pine (*Pinus albicaulis*), and lodgepole pine (*Pinus contorta*). Deciduous trees include: bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), black cottonwood (*Populus balsamifera*), etc.

Photo 39: Carbon River Forest

Common forest understory plants include: salal (*Gaultheria shallon*), seven species of huckleberry (*Vaccinium* sp.), white-flowered rhododendron (*Rhododendron albiflorum*), kinnikinnick (*Arctostaphylos uva-ursi*), twinflower (*Linnaea borealis*), Indian-plum (*Oemleria cerasiformis*), salmonberry (*Rubus spectabilis*), thimbleberry (*Rubus parviflorus*), five-leaved bramble (*Rubus pedatus*), dwarf bramble (*Rubus lasiococcus*), devil's club (*Oplopanax horridus*), red-flowering currant (*Ribes sanguineum*), sitka willow (*Salix sitchensis*), cascara (*Rhamnus purshiana*), Sitka alder (*Alnus crispa*), beaked hazelnut (*Corylus cornuta*), vine maple (*Acer circinatum*), oregon grape

(*Mahonia nervosa*), false solomon's seal (*Smilacina racemosa*), false lily of the valley (*Malanthemum dilatatum*), queen's cup (*Clintonia uniflora*), bear grass (*Xerophyllum tenax*), western coralroot (*Corallorhiza maculata*), foamflower (*Tiarella trifoliata*), yellow wood violet (*Viola glabella*), white-veined wintergreen (*Pyrola picta*), pipsissewa (*Chimaphila umbellata*), vanilla leaf (*Achlys triphylla*), inside-out flower (*Vancouveria hexandra*), redwood sorrel (*Oxalis oregana*), wild ginger (*Asarum caudatum*), bunchberry dogwood (*Cornus canadensis*), skunk cabbage (*Lysichiton americanum*), sword fern (*Polystichum munitum*), deer fern (*Blechnum spicant*), and lady fern (*Athyrium filix-femina*).

Stands of 500 to 600-year old western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*) and western red cedar (*Thuja plicata*) are the dominant vegetation in the Carbon River area. Sitka spruce (*Picea sitchensis*), Pacific yew (*Taxus brevifolia*), silver fir (*Abies amabilis*) and vine maple (*Acer circinatum*) are intermixed in the stands.

The Carbon River corridor also supports deciduous stands of red alder (*Alnus rubra*), black cottonwood (*Populus trichocarpa*), and bigleaf maple (*Acer macrophyllum*). Understory shrub species include devil's club (*Oplopanax horridus*), Oregon grape (*Berberis nervosa*), red huckleberry (*Vaccinium parvifolium*), sword fern (*Polystichum munitum*) and deer fern (*Blechnum spicant*). Herbaceous species such as twin flower (*Linnaea borealis*), oxalis (*Oxalis oregana*), and vanilla leaf (*Achlys triphylla*) as well as various species of mosses and lichens are also present.

Nonnative Invasive Plants

Non-native invasive plants are found within the whole Carbon River corridor in relatively low density, frequency and abundance (Mount Rainier National Park 2007). One area of note, however, exceeds this general condition. This is the Chenuis Falls trailhead/picnic area, where a large population of the herb-Robert (*Geranium robertianum*) is found, along with the only known park locations of Japanese knotweed (*Polyginum cuspidatum*) and comfrey (*Symphytum officinale*).

Table 22 shows the non-native plants controlled in the Carbon River area in 2006.

Table 22: 2006 Nonnative Invasive Plant Control in the Carbon River Area

Common Name	Scientific Name	Location						TOTAL
		Mile 0-1	Mile 1-2	Mile 2-3	Mile 3-4	Mile 4-5	Ipsut Creek	
Oxeye daisy	*Chrysanthemum leucanthemum*				17			17
Canada thistle	*Circium arvense*				41			41
Bull thistle	*Circium vulgare*	2	20	11	24		1	57
Foxglove	*Digitalis purpurea*	1	17	1461	715		4	2194
Herb-robert	*Geranium robertianum*			2	5541			5543
Japanese knotwee	*Polygonum cuspidatum*				6			6
Common Comfrey	*Symphytum officinale*					10		10

In addition, the following plants were treated, but no control numbers were given:

- Tansy ragwort (*Senecio jacobaea*) (Milepost 1-2, 3-4, 4-5)
- St. John's wort (*Hypericum perforatum*) (Milepost 3-4, Ipsut)
- Creeping buttercup (*Ranunculus repens*) (Milepost 3-4)
- Himalayan blackberry (*Rubus armeniacus*) (Milepost 3-4)
- Evergreen blackberry (*Rubus laciniatus*) (Milepost 3-4)
- Scotch broom (*Cytisus scoparius*) (Milepost 3-4)
- Common nipplewort *Lapsana communis* (Milepost 0-1), and
- Reed canary grass (*Phalaris arundinacea*) (Milepost 3-4)

In 2009, the following plants were treated: tansy ragwort, Canada thistle, bull thistle, St. John's wort, ox-eye daisy, spiny sowthistle (*Sonchus asper*), common comfrey, foxglove, herb Robert, creeping buttercup, and Japanese knotweed.

6. Wildlife

Mammals: Sixty species of mammals are known from Mount Rainier National Park. Another three occurred historically, but have not been documented recently, including gray wolves, fishers, and Canada lynx. Small mammals include the deer mouse, dusky shrew, Townsend's chipmunk, Douglas squirrel, flying squirrel, hoary marmot, pika and snowshoe hare. Small and medium-sized carnivores include the long-tailed weasel, pine marten, raccoon, striped and spotted skunks, river otter, bobcat, red fox and coyote. Large mammals include the black bear, black-tailed deer, elk, mountain goat and mountain lion. In addition, a number of bats occur in the park, including a nursing colony of the long-eared myotis and the state and federally sensitive Townsend's big-eared bat.

Birds: There are over 229 species of birds listed for the park, with approximately 80 of these known to nest in the park (see NPS 1995: Checklist of the Birds of Mount Rainier National Park). Raptors include the northern goshawk, Cooper's hawk, red-tailed hawk, sharp-shinned hawk, peregrine falcon, merlin, bald eagle, golden eagle, northern saw whet owl, barred owl, great horned owl, western screech owl, etc. Other bird species include the gray jay, varied thrush, red-breasted sapsucker, common flicker, pileated woodpecker, Steller's jay, Oregon junco, hermit thrush, gray-crowned rosy finch, white-tailed ptarmigan, etc.

Amphibians: Fourteen species of amphibians occur within the park with one additional species unverified but that potentially occurs within the park.

Aquatic Breeding Amphibians: Aquatic breeding amphibians documented in the Carbon River area include the tailed frog (*Ascaphus truei*), the coastal giant salamander (*Dicamptodon tenebrosus*), Cascades frog (*Rana cascadae*), Pacific chorus frog (*Pseudacris regilla*), Northwest Salamander (*Ambystoma gracile*), and Long-toed salamander (*Ambystoma macrodactylm*). Tailed frogs and coastal giant salamanders breed in streams along with occasional Cascades frog and Pacific chorus frog. The two aquatic breeding salamanders breed in ponds in the project area. The Cascade torrent salamander (*Rhyacotriton cascadae)* potentially occurs within the project area.

Terrestrial Breeding Amphibians: A variety of terrestrial amphibians also occur in the Carbon River area. These include: Ensatina (*Ensatina eshscholtzi*) (found in or under woody debris); Larch Mountain Salamander (*Plethodon larselli*) (found in forested and talused environments that provide cool, moist conditions, under wood or rock substrates); Van Dyke's Salamander (*Plethodon vandykei*) (found in a variety of habitats, such as streams upland forests, talus slopes and seeps); and the Western Redback Salamander (*Plethodon vehiculum*) (found near seeps or streams, and under logs and other woody debris).

Reptiles: Five species of reptiles occur within the park and potentially within the project area include the northwestern garter snake (*Thamnophis ordinoides*), western terrestrial garter snake (*Thamnophis sirtalis*), northern alligator lizard, rubber boa, and other species.

Fish: A variety of fish species either are known to occur or potentially occur in the Carbon River including rainbow trout and steelhead (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), bull trout (S*alvelinus confluentus*), mountain whitefish (*Prosopium williamsoni),* coho salmon (*Oncorhynchus kisutch*), and chinook salmon(*Oncorhynchus tshawytscha*). Dolly Varden (*Salvelinus malma*), although thought to be found in areas closer to the Puget Sound, may also occur in the project area. These fish are not known from Ipsut Creek above Ipsut Creek Falls; the Falls are considered impassable to fish. Bull trout occur within the Carbon River and almost all tributaries within the project area. Rainbow trout or steelhead, brook trout, and coho salmon also occur in the Carbon River and tributaries below falls.

Invertebrates: In addition, there is a wide variety of known and unknown invertebrates, including insects, spiders, worms, and freshwater mollusks.

Ten freshwater species of bivalves occur west of the Rocky Mountains; only five species of them are known to occur in the state of Washington. Of the five, three are known to occur within MORA: the Oregon floater, the western or Cascade floater, and the western pearlshell (Frest and Johannes 2005). The remaining two, the western ridge mussel and the California floater potentially occur within the park. All five mussels are Washington State Watch species and the California floater is currently a federal species of special concern.

The Fender's Soliperlan (*Soliperla fenderi*) stonefly is listed as a species of special concern in the state of Washington. The distribution is limited to Mount Rainier, where it was first discovered, and Mt. Adams. The larval form of this species is found in small headwater streams and require clean, clear, oxygen rich water to survive. This species potentially occurs within the project area. Other mollusks that occur in the Carbon area are noted in Table 23.

Table 23: Mollusks in the Carbon River Area

Mollusk	Status	Habitat
Ancotrema sportella sportella	land snail fairly widespread	found around logs, coarse woody debris, and leaf litter in moist areas
Ariolimax columbiana	Pacific banana slug scattered in park	found around logs, leaf litter in moist areas
Haplotrema vancouverense	land snail fairly widespread	found around logs, leaf litter in moist areas
Pisidium casertanum	widely scattered, at all elevations	in wetlands, springs, seeps in Carbon area
Pristiloma lansingi	fairly common	found around logs, leaf litter in moist areas
Prophysaon dubium	slug-scattered in park	found around logs, leaf litter in moist areas
Prophysaon vanattae	Slug-common in park	found around logs, leaf litter in moist areas
Punctum randolphi	land snail widespread	found around logs, leaf litter in moist areas
Striatura pugetensis	land snail widespread at lower and mid elevations	found around logs, leaf litter in moist areas
Vertigo andrusiana	quite rare land snail	found around logs, leaf litter in moist areas
Vertigo columbiana	land snail fairly widespread except at high elev	found around logs, leaf litter in moist areas

After Frest and Johannes 2005.

Relationship to Life Zones: There are four distinct life zones in which animals occur, although some animals may inhabit several of the life zones depending on the time of year. Three of these may be affected by the proposals in this Environmental Assessment. These are discussed below.

Below 3,500 Feet: The lowest areas of the park (below 3,500 ft) are characterized by having mature forests of Douglas-fir, western red cedar, grand fir and western hemlock. This zone provides suitable habitat for the northern spotted owl (*Strix occidentalis caurina*), and marbled murrelet (*Brachyramphus marmoratus*) (see specific information below under *Threatened and Endangered Species*). Other birds found in this life zone are barred owls (*Strix varia*), Cooper's hawk (*Accipiter cooperii*), varied thrush (*Ixoreus naevius*), brown creeper (*Certhia americana*), red-breasted sapsucker (*Sphyrapicus varius*), common flicker (*Colaptes auratus*), Steller's jay (*Cyanocitta stelleri*), red-breasted nuthatch (*Sitta canadensis*), Townsend's warbler (*Dendroica townsendi*), chestnut-backed chickadee (*Parus rufescens*), and winter wren (*Troglodytes troglodytes*). Many other birds, including seasonal visitors or year around residents, occur in this zone.

The mammals found in this zone include Trowbridge shrew (*Sorex trowbridgii*), vagrant shrew (*Sorex vagrans*), dusky shrew (*Sorex obscurus*), the mountain beaver (*Aplodontia rufa*), Townsend chipmunk (*Eutamias townsendii*), Douglas squirrel (*Tamiasciurus douglasii*), flying squirrel (*Glaucomys sabrinus*), deer mouse (*Peromyscus maniculatus*), long-tailed vole (*Microtus longicaudus*), and Townsend vole (*Microtus townsendii*). The beaver (*Castor canadensis*) is found in low numbers along many of the streams and rivers in this zone. The raccoon (*Procyon lotor*) and spotted skunk (*Spilogale putorius*) are two carnivores which are only found in this zone. Other carnivores found in this zone include the pine marten (*Martes americana*), bobcat (*Lynx rufus*), red fox (*Vulpes vulpes*), black bear (*Ursus americanus*), coyote (*Canis latrans*), and mountain lion (*Puma concolor*). Black-tailed deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*) can be found in this zone with the highest numbers found during the winter and early spring. Elk populations are the highest in the northeastern and southeastern area of the park. During the winter, mountain goats (*Oreamnos americanus*) can also be found in this zone. Native fish and amphibians are found in the lakes, ponds, streams and rivers in this zone. Native fish found in the streams include rainbow trout or steelhead (*Oncorhyncus mykiss*), coastal cutthroat trout (*Oncorhyncus clarki clarki*), mountain whitefish (*Prosopium williamsoni),* bull trout (*Salvelinus confluentus)*, and coho salmon.. Chinook may also occur in the Carbon River and tributaries. Native amphibians found in this zone include Cascades frog, tailed frog, the rough-skinned newt (*Taricha granulosa*), Pacific giant salamander (*Dicamptodon tenebrosus*), red back, Ensatina, larch mountain salamander and Van Dyke's salamander. . These amphibians and fish also occur in the higher elevation zones up to 6,500 feet. The northernwestern garter snake (*Thamnophis ordinoides)*, common terrestrial garter snake (*Thamnophis sirtalis)*, rubber boa (*Charina bottae*), western terrestrial garter snake (*Thamnophis elegans*), and northern alligator lizard (*Elgaria coerulea*) are also found in this life zone as well as the other life zones. Many other invertebrate species, including the mollusk species noted above, occur in this zone.

3,500 to 5,000 Feet: The next zone of the park (3,500 to 5,000 feet) is characterized by its mixed forests of western white pine, western hemlock, and Pacific Silver fir. Blue grouse (*Dendragapus obscurus*) are found in this zone along with sharp-shinned hawk (*Accipiter striatus*), golden-crowned kinglet (*Regulus satrapa*), northern three-toed woodpecker (*Picoides tridactylus*), hermit thrush (*Catharus guttatus*), and yellow warbler (*Dendroica petechia*). Other birds occur in this zone depending on weather, food sources, migration, and breading season. Mammals in this zone include masked shrews (*Sorex cinereus*), Townsend chipmunk, yellow pine chipmunk (*Eutamias amoenus*), golden mantled ground squirrels (*Callospermophilus saturatus*), Douglas squirrels, flying squirrels, deer mice, and the jumping mouse (*Zapus trinotatus*). The large predators found in the lower zone are also found in this zone. The long-tailed weasel (*Mustela frenata*) and pine martin are very common in this zone. Mountain goats may be found in this area in the winter and spring. Deer and elk are common here, especially in the summer and fall. Many other birds, including seasonal visitors or year-round residents, and invertebrate species, occur in this zone.

5,000 to 6,500 Feet: The elevational zone in the park which attracts numerous visitors in the summer is between 5,000 and 6,500 feet; this is where Paradise and Sunrise are located. This zone is characterized by mixed forest and subalpine meadows. The trees are primarily subalpine fir, mountain hemlock, Alaska yellow cedar, and whitebark pine and they tend to grow in clumps. The birds of this zone include the Clark's nutcracker (*Nucifraga columbiana*), common raven (*Corvus corax*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), western flycatcher (*Empidonax difficilis*), rufous hummingbird (*Selasphorus rufus*), mountain bluebird (*Sialia currucoides*), and Lincoln's sparrow (*Melospiza lincolnii*). Many of these birds can be found in other zones depending on the season. This is the zone where large numbers of elk congregate in the summer months, especially on the eastern half of the park. In this zone there are pika (*Ochotona princeps*), snowshoe hare (*Lepus americanus*), Hoary marmot (*Marmota caligata*), golden-mantled ground squirrel and yellow pine chipmunk. In the meadows are numerous pocket gophers (*Thomomys talpoides*). The most common carnivore is the pine marten. Black bear, coyote, red fox, and mountain lion use this zone in the summer and fall. There are large herds of mountain goats in this zone. . Many other birds, including seasonal visitors or year-round residents, and invertebrate species, occur in this zone.

7. Federally Listed Wildlife Species

Table 24: Federally Listed Wildlife Species

Species	Status	Habitat Occurrence	Effect of Proposed Project
Birds			
Marbled Murrelet *Brachyramphus marmoratus marmoratus* 	FT	See detailed information in Biological Assessment.	May Affect, Likely to Adversely Affect
Northern Spotted Owl *Strix occidentalis caurina* 	FT	See detailed information in Biological Assessment.	May Affect, Likely to Adversely Affect
Fish			
Bull Trout *Salvelinus confluentus*	FT	See detailed information in Biological Assessment.	May Affect, Likely to Adversely Affect
Bull Trout Critical Habitat *Salvelinus confluentus* 	Designated	See detailed information in Biological Assessment.	May Affect, Likely to Adversely Affect
Puget Sound Chinook Salmon *Oncorhynchus tshawytscha*	FT	See detailed information in Biological Assessment.	May Affect, Likely to Adversely Affect

Puget Sound Chinook Salmon Critical Habitat	Designated	See detailed information in Biological Assessment	May Affect, Not Likely to Adversely
Puget Sound Steelhead *Oncorhynchus mykiss*	FT (Puget Sound)	See detailed information in Biological Assessment. An anadromous form of rainbow trout, steelhead may be present in the Carbon and White Rivers.	May Affect, Likely to Adversely Affect
Mammals			
Grizzly Bear *Ursus arctos*	FT	No known occurrences in the park. See detailed information in Biological Assessment.	No effect
Canada Lynx *Lynx canadensis*	FT	Extirpated from the park. Suitable habitat exists. See detailed information in Biological Assessment.	No effect
Gray Wolf *Canis lupus*	FE	Extirpated from the park. Suitable habitat exists. See detailed information in Biological Assessment.	No effect

Northern Spotted Owl
Northern spotted owls (spotted owl) are long-lived, non-migratory birds that establish territories that they defend against other owls and avian predators. Spotted owls range across their territories over the course of the year hunting for prey. In western Washington, spotted owls prey almost entirely on northern flying squirrels and other small mammals (Forsman *et al.* 2001). Spotted owl territories are large and encompass thousands of acres of forest habitat. Suitable spotted owl habitat is generally mature or old-growth forest that has a moderate to high canopy closure; a multi-layered, multi-species canopy dominated by large overstory trees; numerous large snags and down logs; and sufficient open space below the canopy for owls to fly through (Thomas *et al.* 1990). Forests with these characteristics provide nesting and roosting sites for spotted owls and support the highest densities of northern flying squirrels (Carey 1995).

At Mount Rainier, the spotted owl nesting season extends from March 15 through September 30. The nesting season is divided into early and late seasons. The early nesting season is defined as March 15 to July 31. Early nesting season behavior includes nest site selection, egg laying, incubation, and brooding of nestlings to the point of fledging (Forsman *et al.* 1984:32-38). The late nesting season extends from August 1 through September 30. During this period, the juvenile spotted owls have left the nest and are able to fly short distances, but they remain close to the nest site and depend upon the adults for feeding. By late summer, the adults are rarely found roosting with their young and usually only visit the juveniles to feed them at night (Forsman *et al.* 1984:38). Juvenile owls typically disperse away from their natal sites in late September or early October, and become non-territorial "floaters" for 2 to 5 years before they acquire their own territories (Forsman *et al.* 2002:2).

Status of Spotted Owls in Mount Rainier National Park: Mount Rainier National Park contains approximately 80,000 acres of suitable spotted owl habitat (Myers 2009). Spotted owl habitat extends up to an elevation of about 4,800 feet in the Park. Surveys for spotted owls have been conducted annually in the Park since 1997 as part of an ongoing spotted owl demography study (Herter *et al.* 2008, Myers 2009). In 2008, there were 31 historic spotted owl sites surveyed in the Park. Spotted owls were detected at 15 sites (11 pairs, and 4 singles), and nesting pairs were documented at 5 sites in the Park (Myers 2009). In 2009, spotted owls were detected at 13 sites in the Park, including 7 pair sites, but there were no nesting attempts documented (Herter 2009). It is common for spotted owls to nest in alternating years, with most nesting attempts occurring in even years, and relatively few nesting attempts documented in odd years (Anthony *et al.* 2006). The apparent lack of nesting in 2009 is not unusual considering the low numbers of pairs present in the Park, and the documented nesting that occurred in 2008. Not all suitable habitat in the Park is surveyed for spotted owls. Approximately 10 percent of the suitable habitat in the Park is not surveyed during annual monitoring, and additional owl pairs may be present in these areas.

Mount Rainier National Park constitutes approximately 40 percent of the entire Rainier Spotted Owl Demographic Study Area (DSA). The spotted owl population in the north half of the Rainier DSA has declined significantly and now over half of the spotted owls remaining in the DSA (including most of the breeding pairs) are located within the Park (Herter *et al.* 2009). Monitoring in the Rainier DSA indicates the spotted owl population has declined annually since 1995, resulting in a loss of approximately 40 to 60 percent of the occupied owl territories in the study area (Anthony *et al.* 2006). Competition with barred owls is implicated as the primary cause for this decline (Herter *et al.* 2008). Barred owls have now been detected at 84 percent of spotted owl sites monitored in the Park (Myers 2009). Barred owls were first detected in the Park in 1986, and by 2006 there were 37 probable barred owl territories identified in the Park (Myers 2009). Despite the apparent high densities of barred owls in the area, low numbers of spotted owls continue to persist and successfully reproduce in the Park.

Status of Spotted Owls in the Carbon River Valley: The upper Carbon River valley contains approximately 12,300 acres of suitable spotted owl habitat, including over 7,200 acres of habitat within the Park (60 percent). Spotted owl habitat in the Carbon River valley extends up to an elevation of approximately 4,500 feet, and is somewhat topographically isolated from habitat in adjacent river valleys. Within the Park boundary, spotted owl habitat is relatively pristine, with minor habitat loss (< 25 acres) associated with existing Park developments (i.e., roads, trails, and campgrounds). Outside the Park, much of the forested area on private and National Forest lands has been previously harvested, resulting in the fragmentation and loss of much of the suitable spotted owl habitat outside the Park boundary.

Spotted owl monitoring efforts have documented 4 spotted activity centers in the Carbon River valley, 3 territories in the Park, and 1 historic spotted owl territory located just north of the Park in the Mt. Baker-Snoqualmie National Forest. However, this site has not been monitored since 1998 (Herter *et al.* 2008). Spotted owl occupancy at historic activity centers in the area has been inconsistent in recent years. No spotted owls were detected in the Carbon River valley in 2008. In 2009, a new pair of spotted owls was detected at Ipsut Creek, and a single male spotted owl was detected near Green Lake (Herter *et al.* 2009). The male at Green Lake was only sighted once, and surveyors speculate it may have been the same male that was present at Ipsut Creek in 2009, but this is uncertain (Herter *et al.* 2009). In July 2010, a new pair of spotted owls was located near Falls Creek. The actual nest tree for this pair was not located, but two fledgling juveniles were sighted with this pair, indicating a nest site location in the vicinity of the Falls Creek washout.

Marbled Murrelet

Murrelets are small, diving seabirds that spend most of their life in nearshore marine waters foraging on small fish and inverterbrates, but use old-growth forests for nesting. Murrelets nest in forested areas up to 52 miles inland from their saltwater foraging areas (Hamer 1995:167). Nests occur primarily in large, old-growth trees, with large branches or deformities that provide a suitable nest platform. Murrelets do not build a nest, but rather create a nest depression in moss or litter on large branches (Nelson 1997). In Washington, the murrelet breeding season occurs between April 1 and September 15 (Hamer *et al.* 2003). For management purposes, the USFWS defines the murrelet early nesting season as April 1 through August 5. Early nesting season behaviors include egg laying, incubation, and brooding of nestlings. The late nesting season is defined as August 6 through September 15. During the late season, murrelet chicks are left unattended at the nest site until they fledge, except during feedings by the adults, with all chicks fledging by mid-September (Hamer *et al.* 2003). Both parents feed the chick, which receives one to eight meals per day (Nelson 1997). Most meals are delivered at dawn, while about a third of the food deliveries occur at dusk and intermittently throughout the day (Nelson and Hamer 1995a).

Nest site predation is suspected to be the principal factor limiting murrelet reproductive success. Losses of eggs and chicks to avian predators have been determined to be the most important cause of nest failure (Nelson and Hamer 1995b; McShane *et al.* 2004). The risk of predation by avian predators appears to be highest in close proximity to forest edges and human activity, where many corvid species (e.g., jays, crows, ravens) are in highest abundance (McShane *et al.* 2004).

Status of Murrelets in Mount Rainier National Park: The Park Service has conducted surveys for murrelets in the Park annually since 1994. To date, murrelet presence has been documented within four watersheds: the Carbon, Mowich, Puyallup, and Nisqually River (NPS 2009). Based on the presence of suitable murrelet nesting habitat and multiple detections indicating presence or occupancy behaviors, it is assumed that murrelets are nesting in these areas. However, because of the difficulty of detecting murrelet nests, no active nests have been located within the Park (NPS 2009).

With the establishment of the Northwest Forest Plan in 1994, the range of the murrelet for management and conservation purposes was established at 55 miles inland from marine waters in Washington (Raphael *et al.* 2006:101). Essentially the entire Park, with the exception of a small area in the southeast corner of the Park, is located within the potential range of the murrelet. The murrelet potential nesting habitat maps produced by Raphael *et al.* (2006, p.119) indicate there is approximately 26,500 acres of potential murrelet nesting habitat in the Park extending up to an elevation of about 3,800 ft, which constitutes about 11 percent of the Park area.

The Park provides large blocks of murrelet nesting habitat and supports reproductive pairs of murrelets. Because most of the Park is designated Wilderness, high-quality murrelet nesting habitat within the Park is largely undisturbed by development or human presence. Murrelet nesting habitat within the Park is considered essential for the long-term conservation and recovery of murrelets (USFWS 1997).

Status of Murrelets in the Action Area – Carbon River: The upper Carbon River valley contains approximately 5,600 acres of suitable murrelet habitat, including over 3,900 acres of habitat within the Park (70 percent). Murrelet habitat in the Carbon River valley extends up to an elevation of approximately 3,800 feet. Within the Park boundary, murrelet habitat is relatively pristine, with minor habitat loss (< 25 acres) associated with existing Park developments (i.e., roads, trails, and campgrounds). Outside the Park, much of the forested area on private and National Forest lands has been previously harvested, resulting in the fragmentation and loss of much of the suitable murrelet habitat outside the Park boundary. Based on the work by Marzluff and Neathelin (2006), we expect murrelets nesting in close proximity (within a 1 km radius) to Ipsut Creek Campground may have a higher rate of nest predation due to the potential for increased corvid abundance adjacent to campgrounds.

The Park has conducted both audio-visual surveys (1994-2009) and ornithological radar surveys (2000 - 2009) in the Carbon River valley (NPS 2009, ABR 2009). These surveys have documented hundreds of audio-visual observations of both murrelet presence and occupancy behaviors in the Carbon River corridor from Park entrance up to Ipsut Creek Campground.

Radar-surveys of murrelets can provide an index for the number of murrelets using a particular drainage, and the technique has been widely used in several different study areas (e.g., Rapheal *et al.*, 2002). In the Carbon River, the number of murrelets detected entering the watershed was used as the index for murrelet abundance (ABR 2009). From the 2000 to 2009, the number of murrelets detected entering the upper Carbon River drainage with radar ranged from 2 to 30 birds, with a 10-year average of about 11 to 14 murrelets (ABR 2009). In 2009, the mean landward count of 9.5 murrelets generally fell in the low end of other mean radar counts at the Carbon River site (ABR 2009). The authors note that first ten years of data show a slight negative trend in radar counts of murrelets at the Carbon River site, but that given the high inter-annual variation in counts, it is premature to make definitive statements regarding murrelet trends in the Carbon River drainage until more years of data are collected (ABR 2009).

Bull Trout

Bull trout are salmonid fishes native to the Pacific Northwest and western Canada. Bull trout exhibit both resident and migratory life-history strategies. Resident bull trout completed their life cycles in the streams in which they spawn and rear. Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form), or saltwater (anadromous form) to rear as subadults and to live as adults. Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime).

Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (USFWS 1999).

Bull trout typically spawn from August through November during periods of decreasing water temperatures. Cold water temperatures play an important role in determining bull trout habitat quality. Bull trout are primarily found in colder streams (below 15 °C or 59 °F), and spawning habitats are generally characterized by temperatures that drop below 9 °C (48 °F) in the fall. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel. Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater. Depending on water temperature, incubation is normally 100 to 145 days. After hatching, fry remain in the substrate, and time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (USFWS 1999).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools. Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (USFWS 1999).

Critical habitat for bull trout in the coterminous United States was designated in 2005. On January 14, 2010, the USFWS issued a proposed rule that would significantly revise bull trout critical habitat (USFWS 2010). The 2010 proposed critical habitat designation includes all areas identified in the 2005 designation, as well as additional areas that have been identified as essential for the conservation of bull trout. In the Puget Sound region, over 1700 miles of streams and shorelines are proposed as bull trout critical habitat, including many streams within Mount Rainier National Park. The existing 2005 critical habitat designation remains in place until the proposed rule is finalized.

In the draft recovery plan for Coastal – Puget Sound Distinct Population Segment of bull trout, the USFWS identified the Puyallup River and its tributaries as a core area for bull trout recovery (USFWS 2004, p. 20). A core area is large watershed or river basin that contains habitat necessary to support all life stages of bull trout (e.g., spawning, rearing, migration, overwintering, and foraging habitat) and contains one or more local populations of bull trout. A local population is defined as a group of bull trout that spawn within a particular stream or portion of a stream system. The Puyallup core area has five identified local populations: the upper Puyallup and Mowich Rivers; Carbon River; upper White River; West Fork White River; and Greenwater River (USFWS 2004). With the exception of the Greenwater River local population, rivers and streams within the Park provide important spawning and rearing habitat for all of the local populations in the Puyallup core area. Within the Puyallup River core area, the USFWS has identified 306.5 miles of rivers and stream habitat as bull trout critical habitat, including 59.1 miles in Mount Rainier National Park (19 percent) (USFWS 2010:2331).

Both anadromous and fluvial/resident bull trout local populations have been identified in the Puyallup River core area. Limited information is available regarding the distribution and abundance of bull trout in this core area. Local populations in the Puyallup core area are estimated to have fewer than 100 spawning adults, based on the low number of observed redds in spawning streams and low numbers of migrating adults counted at the Buckley fish trap on the lower White River (USFWS 2004:221).

Many of the headwater reaches of the Puyallup River basin are either within the Park or in designated Wilderness areas which provide high quality habitat. The presence of brook trout in many parts of the Puyallup basin, including National Park waters is considered an ongoing threat to bull trout (USFWS 2004:194). A majority of the basin outside of the National Park boundary has been significantly altered by a variety of factors including dams that impede natural bull trout migration, extensive timber harvest and associated road construction; conversion of landscape to residential, commercial, and agricultural use; substantial channelization of lower mainstem reaches; and total commercial development of the estuarine habitat. These factors have undoubtedly reduced the overall productivity and abundance of bull trout populations in the Puyallup River basin, and strongly influence the number and distribution of bull trout now present in the Park (USFWS 2004,:121).

Bull Trout in the Carbon River: Bull trout critical habitat has been identified from the Carbon River confluence with the Puyallup River, upstream for approximately 32.7 miles. The Park boundary is located at approximately river mile 23. All known reports of spawning bull trout in this watershed are confined to the upper Carbon River, indicating a spatial separation from other bull trout local populations in the Puyallup core area. Therefore, bull trout in Carbon River are currently considered to represent a local population (USFWS 2004, p. 123). The overall abundance of the Carbon River local population is currently unknown, but is estimated to be less than 100 spawning adults. Migratory connectivity to other local populations and forage areas within the Puyallup basin is believed to be good, although the canyon reach in the Carbon River may present some short-term upstream migration delays (USFWS 2004, p. 123.

Fisheries surveys have detected juvenile, subadult, and adult bull trout in the upper Carbon River and in several tributary streams including June Creek, Falls Creek, Chenuis Creek, and Ipsut Creek (USFWS 2004:123, NPS 2009). Park staff documented spawning bull trout and bull trout redds in June Creek, Chenuis Creek, a small tributary stream to lower Chenuis Creek, Ranger Creek, and lower Ipsut Creek. Of the 33 bull trout redds documented in Carbon River tributaries since 2002, 17 redds were counted in Ranger Creek, indicating this is likely the most significant spawning stream for the Carbon River local population (NPS 2009). In 2009, Park staff counted 5 bull trout redds in Ranger Creek. Spawning activity has generally been documented from late September into October in the Carbon River tributaries, but active spawning may begin as early as mid-September based on bull trout surveys in the Upper White River basin (Marks *et al.* 2009:167).

The NPS collected fin clip samples from 100 individual native char in 2006 to assess genetic variation within and among bull trout collected from three tributaries to the Puyallup River in the Park (Carbon, White and West Fork). Samples were analyzed by the USFWS, Abernathy Fish Lab (DeHaan *et al.* 2008). Of the 100 individuals analyzed, four fish were identified as brook trout and all other individuals were identified as bull trout. Levels of genetic variation observed over all three populations were comparable to those observed in other populations in Puget Sound and coastal Washington and somewhat lower than observed in other inland populations of bull trout. Within the three populations, the lowest levels of genetic variation in the Carbon River. Differences in genetic variation were observed among all three populations, suggesting that each of the three tributaries contains a distinct local spawning population. The level of variation between the White River and the West Fork White River was much lower than the level of variation between these two tributaries and the Carbon River. These data suggest that geneflow occurs between the White River and West Fork White River but individuals likely do not migrate between the Carbon River and the other two populations.

Existing Impacts to Bull Trout Habitat from the Carbon River Road: The Carbon River Road has a long history of flood damage resulting in direct input of road fill sediments and potentially contaminants (e.g. oil and grease from vehicles) into tributary streams. The Carbon River Road is identified in the draft bull trout recovery plan as high priority area for addressing chronic habitat degradation associated with unstable road locations (USFWS 2004, p. 239). Culverts in tributary streams crossed by the Carbon River Road block natural sediment transport and have resulted in significant aggradation of sediment behind culverts, resulting in seasonal loss of surface flow in some stream segments, particularly in the Falls Creek area. Scour and erosion at culvert outlets has left several culverts perched, forming partial or full barriers to fish passage, most notably at Ranger Creek and the unnamed tributary stream at the Chenuis Falls Trailhead.

At Falls Creek, there are 3 stream crossings, 1 on Falls Creek and 2 tributaries. All crossings are filled with sediment, and there is extensive flood damage from road scour along 0.5 miles of the stream channel. Gravel aggradation in the vicinity of the road causes tributary streams to go dry seasonally, resulting in loss of perennial fish habitat. The lower 0.4 miles now carries the combined flow from Falls Creek and an active Carbon River side channel. Bull trout were seen rearing in the new scour channel in 2007. Emergency flood repairs in 2007 (check dams) installed in the scour channel currently block fish passage into upper Falls Creek.

Ranger Creek is identified as the most significant spawning stream for bull trout in the upper Carbon River. The lower 0.21 miles below culvert is now combined with an active Carbon River side channel which closely parallels the road, and is beginning to cause road failure, and cause road fill to deposit into bull trout spawning habitat. The culvert is partial barrier to fish passage, and blocks access to 0.5 miles of bull trout spawning and rearing habitat. Road fill at the culvert is failing, resulting in road fill deposition into the stream, and chronic degradation of spawning habitat. The upstream side of culvert is forming a logjam and gravel aggradation. The culvert is highly threatened and could fail with the next major flood.

At Ipsut Creek, there were major changes to the channel configuration that resulted from the 2006 flooding. A side channel from the Carbon River now intercepts Ipsut Creek above the historic road crossing. The concrete bridge is blocked by a massive logjam, and caused the channel to reroute and scoured out 0.21 miles of road surface. The Lower 0.5 miles of Ipsut Creek channel now carries the combined flow of Ipsut Creek and an active side channel of the Carbon River. Only a relatively small amount of stable spawning habitat is now present in the stream above the confluence with the Carbon side channel. The bull trout population in the Ipsut Creek may be reduced from historical levels as a result of the significant disturbance to spawning and habitat in this stream from the 2006 flood.

Steelhead
Both steelhead and rainbow trout are present throughout the Puyallup River basin. The steelhead is the anadromous form of rainbow trout; offspring from either steelhead or rainbow trout can become anadromous, or remain in freshwater (resident form) their entire lives. However, the Federal threatened species status does not pertain to resident rainbow trout.

Steelhead are generally categorized as winter-run or summer-run, depending on the time of the year they return to freshwater river systems to reproduce. Steelhead can spawn more than once during their life-cycle. The majority of steelhead returning to the Puyallup River system are winter-run fish that generally enter the river beginning in winter (January), and continue through spring (June). Peak migration occurs from mid-April through early May. Puyallup Tribal Fisheries spawning ground data shows peak spawning takes place in the upper Puyallup and White River basins in late April to early May. Steelhead spawning occurs in the mainstem Puyallup, White, and Carbon rivers; although, the majority of spawning takes place in tributary streams (Marks *et al.* 1999).

After fertilized eggs are deposited in the gravel substrate, the embryonic development and emergence of fry takes between 4-8 weeks depending on water temperature. Depending on spawning timing, steelhead eggs and alevins can be present in stream gravels into early July. Juvenile steelhead will rear in freshwater for 1- 4 years before migrating to marine waters in the spring.

The Puyallup River winter-run steelhead population is declining. The mean estimate of escapement to the Puyallup River was 1,714 natural spawners a year between 1980 and 2004, and 907 natural spawners a year between 2000 and 2004 (Hard *et al.* 2007).

<u>Steelhead in the Carbon River</u>: The majority of steelhead spawning in the Carbon River basin occurs in South Prairie Creek and in the lower 11 miles of the Carbon River. The 2002 stock assessment completed by WDFW indicates the Carbon River steelhead stock is depressed due to a long-term negative trend and a short-term severe decline in wild spawner escapement estimates (WDFW 2002). Spawning ground survey data from 1995 to 2006, shows an average of 15.8 redds annually (range 0-54) in the Carbon River (from the Park boundary downstream to the Puyallup River) and an average redd count of 133 (range 32-196) in South Prairie Creek. The authors note that steelhead surveys over the past three years have been incomplete due to poor survey conditions (Marks *et al.*).

Suitable spawning habitat for steelhead is present in the upper Carbon River and in tributaries such as Ranger Creek (Marks *et al.* 2009). Past surveys at Ipsut Creek have not documented spawning Puget Sound (PS) steelhead in this area (Marks *et al.* 2009). There have been no systematic surveys for PS steelhead in the Carbon River above the Park boundary, so the number of steelhead that spawn in this part of river is unknown, but is expected to be low based on the overall low abundance of PS steelhead in the Carbon River. Fish surveys completed by Park Service staff have documented juvenile steelhead/rainbow in Chenuis Creek and Ranger Creek, and juvenile coho salmon in June Creek. Based on habitat accessibility and long freshwater residence time for juvenile steelhead, we consider the current potential distribution of steelhead in the upper Carbon River to be the same as the distribution of bull trout.

Chinook Salmon

The Puyallup River basin has two historically independent populations of Chinook: Puyallup River fall-run and White River spring-run. The Puyallup River fall-run includes Chinook that spawn and rear in the Carbon River and its tributaries. Most fall-run Chinook enter the Puyallup River system in mid- to late July and spawn from mid-September to early November. Incubation occurs from mid-September to late February when the fry emerge from the gravel and begin their downstream migration. Most fall-run Chinook express an "ocean type" life history. After emergence from redds, ocean type Chinook fry migrate downstream to lower river and estuary habitats, where they rear through early August before outmigrating to the ocean as an age 0 smolt (Healy 1991). A small number of fall-run Chinook express a "stream type" life history where the juveniles rear in their natal rivers for over a year before outmigrating to the ocean as an age 1 smolt (Healy 1991). Approximately 99 percent of Puyallup River fall-run Chinook are ocean type fish, with the remaining one percent being stream type fish (Beechie *et al.* 2006). Chinook rear in the ocean for 1 to 5 years before returning to their natal river to spawn (Healy 1991).

The mean number of natural Chinook spawners in the Puyallup River between 1998 and 2002 was 1,679, with a range of 1,193 to 1,988, which is about 4 percent of the estimated historical population of 42,000 fish (Good *et al.* 2005). Fall-run Chinook natural spawning occurs primarily in South Prairie Creek up to RM 15, the Puyallup River mainstem up to the Electron Dam, and in the lower Carbon River (Marks *et al.* 2009).

<u>Chinook in the Carbon River</u>: The majority of Chinook spawning in the Carbon River basin occurs in South Prairie Creek and the lower 11 miles of the Carbon River (Marks *et al.* 2009). The upper limit of potential Chinook salmon distribution within the Carbon River has not been clearly defined. The Carbon River watershed analysis shows potential Chinook distribution up to the Ipsut Creek confluence at about RM 28 (USFS 1998, p. 2-61). Suitable spawning habitat for Chinook is present in the upper Carbon River along channel margins and pool tailouts. Surveys at Ipsut Creek have not documented spawning Chinook in this area (Marks *et al.* 2009). Fish spawning surveys completed by Park staff over the past five years have not documented Chinook spawning in the Carbon River. There have been no reported observations of Chinook in this part of the Carbon River since the 1980's (G. Piazza, WDFW pers. comm. 04/08/2010). Recent spawning surveys completed by the Puyallup Tribe in 2008 documented only 1 PS Chinook redd in the lower Carbon River (between RM 8.5 - 9.5) and 369 redds in South Prairie Creek (Marks *et al.* 2009). This information suggests that Chinook salmon spawning is probably very uncommon in the upper Carbon River, but the area is potentially accessible to PS Chinook salmon, and may occasionally be used by these fish in years of high abundance. For this analysis, the USFWS assumed that PS Chinook potentially occur in the Carbon River up to RM 28, but the probability that these fish are present in the analysis area is considered to be very low.

Critical habitat for Chinook salmon has been designated in the Carbon River up to about RM 22.7, approximately 0.3 mile downstream from the Park boundary, and within the defined action area.

Gray Wolf

As of September 2009, Washington had two breeding packs of wolves; one was confirmed in Okanogan/Chelan counties in 2008 and one in Pend Oreille County in 2009. There are also indications of an additional pack in the Blue Mountains and a few solitary wolves in other scattered locations (WDFW 2009). The expansion of the currently small breeding population in Washington is expected as a result of increased dispersal of wolves from recovering populations in Idaho and Montana, and dispersers from

British Columbia. Wolves can live in essentially any habitat that supports an abundance of natural prey and has minimal conflict with human interests and uses.

In the vicinity of the Park, there have been several unconfirmed wolf sightings reported over the past 20 years (Almack and Fitkin 1998; WDFW 2009). The most recent documented sighting occurred in 2002, with a single wolf sighted running across Highway 410 at Chinook Pass (WDFW 2007; 2009). Given the wide-ranging nature of wolves, it is possible that transient individuals occasionally occur in the Park. Given the present low wolf population in Washington, the probability that resident wolves are present in the Park is extremely low.

Until the wolf population in Washington increases significantly, it is unlikely that resident wolves will be present in the Park. Potential effects to wolves including disruption of denning behavior or new road construction in wolf habitat would not occur. Therefore, the proposed action would have no effect to the gray wolf.

Grizzly Bear

Grizzly bears are rare in Washington, and are believed to be resident only in the North Cascades and in the Selkirk Mountains of northeastern Washington (Almack and Fitkin 1998). The revised grizzly bear recovery plan (USFWS 1993) identified the North Cascades Ecosystem in Washington as one of six areas south of Canada that are considered essential for grizzly bear recovery. The North Cascades Ecosystem includes primarily federal lands located north of Interstate 90, and was estimated to have a minimum population of 5 grizzly bears (USFWS 1993). The Park is not included in the North Cascades grizzly bear recovery zone.

Given the wide-ranging nature of grizzly bears, it is possible that transient bears may occasionally occur within the Park. However, given the present low bear population in the North Cascades recovery zone, the probability that resident grizzly bears are present in the park is extremely low. Management considerations for grizzly bear include reducing the likelihood of human encounters with bears. This is achieved primarily through road management and by reducing open road densities in grizzly bear habitat (USFWS 1993). , Until the grizzly bear population in the North Cascades recovery zone increases significantly, it is unlikely that resident grizzly bears will be present in the Park. Potential effects to grizzly bear including disruption of denning behaviors, loss of denning or spring foraging habitats, or new road construction in grizzly bear habitat would not occur. Therefore, the proposed action would have no effect to grizzly bear.

Canada Lynx

The lynx is rare in Washington, probably numbering fewer than 100 individuals in the state (Stinson 2001). Resident lynx populations presently occur only in the mountains of north-central and northeastern Washington, although transient individuals occasionally occur outside these areas (USFWS 2009). Lynx occur in boreal forests that have cold, snowy winters and provide an abundant prey-base of snowshoe hares. Mount Rainier National Park contains some suitable habitat for lynx and their favorite prey, the snowshoe hare, in subalpine areas below the tree line, but lynx habitat in the Park is considered to be marginal (Stinson 2001). Historical records indicate small numbers of lynx were present in the southern Washington Cascades, but this population appears to have been extirpated from the region (Stinson 2001). Surveys conducted in the Washington Cascades from 1998 through 2000 failed to detect lynx in the southern Washington Cascades (Stinson 2001).

Given the wide-ranging nature of lynx, it is possible that transient lynx may occasionally occur in the Park. Lynx habitat within the Park may be adequate to sustain short-term survival of during lynx dispersal, but these areas are not likely to support resident lynx. Potential effects to lynx including disruption of denning behaviors, loss of denning or foraging habitats, new road construction in lynx habitat, or increased winter recreation in lynx habitat would not occur. Therefore, the proposed action would have no effect to Canada lynx.

8. Special Status and State Status Plants

The Washington Natural Heritage Program maintains an official list of state endangered, threatened, and sensitive plant species. Approximately 37 species on that list are either known to occur in the park or are likely to occur there based on the presence of suitable habitat. Of the 37 listed (Table 27), none are known to occur in the Carbon River area (Degerman 2007).

Table 25: Washington Natural Heritage Program Plants that could occur in the Carbon River Area

Common Name	Scientific Name	Washington Natural Heritage Program Status
Forbs		
Tall Agoseris	*Agoseris elata*	SS
Northern False Coolwort	*Bolandra oregana*	SS
Longbeard Mariposa Lily	*Calochortus longebarbatus* var. *longebarbatus*	SS; FSC
Obscure Indian Paintbrush	*Castilleja cryptantha*	SS; FSC
Golden Chinquapin	*Chrysolepis chrysophylla*	SS
Northern Golden-Carpet	*Chrysosplenium tetrandrum*	SS
Spleenwort-Leaved Goldthread	*Coptis asplenifolia*	SS
Goldthread	*Coptis trifolia*	ST
Clackamas Corydalis	*Corydalis aquae-gelidae*	SS
Pink Fawn-Lily	*Erythronium revolutum*	SS
Western Wahoo	*Euonymous occidentalis var. occidentalis*	ST
Creeping Snowberry	*Gaultheria hispidula*	SS
Diffuse Stickseed	*Hackella diffusa* var. *diffusa*	ST
Oregon Goldenaster	*Heterotheca oregana var. oregana*	ST
Twayblade	*Liparis loeselii*	SE
Northern Microseris	*Microseris borealis*	SS
Branching Montia	*Montia diffusa*	SS
Slender Crazyweed	*Oxytropis compestris* var. *gracilis*	SS
Mount Rainier Lousewort	*Pedicularis rainierensis*	SS
Small Northern Bog-Orchid	*Plantanthera obtusata*	SS
Great Polemonium	*Polemonium carneum*	ST
Skunky Jacob's-Ladder	*Polemonium viscosum*	SS
Black Snake-Root	*Sanicula marilandica*	SS
Pygmy Saxifrage	*Saxifraga rivularis*	SS
Wenatchee Mountains Checkermallow	*Sidalcea oregana ssp. oregana* var. *calva*	SE; FE
Kidney-Leaved Violet	*Viola renifolia*	SS
Grasses Sedges and Rushes		
Dense Sedge	*Carex densa*	ST
Large-Awn Sedge	*Carex macrochaeta*	ST
Wheeler's Bluegrass	*Poa nervosa*	SS
Curved Woodrush	*Luzula arcuata* ssp. *unalaschkensis*	SS
Ferns		
Crested Wood-Fern	*Dryopteris cristata*	SS

Mosses		
	Brotherella roelli	SH
	Buxbaumia viridis	SU
	Discelium nudum	S1
	Schistostega pennata	S2
	Tayloria serrata	S1
	Tetraphis geniculata	S2

KEY
Federal Status
FE = Federally Listed, Endangered; FT = Federally Listed, Threatened; FSC = Federal Species of Concern

State Status
SE = State Endangered; ST = State Threatened; SS = State Sensitive.

Heritage State Rank
S1 = Critically imperiled (5 or fewer occurrences); S2 = Imperiled (6 to 20 occurrences), very vulnerable to extirpation; SH = Historical occurrences only but still expected to occur; SU = State Unranked (more information needed).

9. Federal Wildlife Species of Concern and State Special Status Wildlife Species

Wildlife

Table 26: Federal Wildlife Species of Concern and State Status Wildlife Species

WILDLIFE SPECIES	FEDERAL STATUS	STATE STATUS	HABITAT NEEDS OCCURRENCE
Bald Eagle *Haliaeetus leucocephalus*	FSC (FD)	SS	For the purposes of this analysis, bald eagle breeding season is between January 1 and August 15; bald eagle wintering season is between October 31 and March 15.
Due to the lack of suitable large river/large lake habitat, bald eagles may use Mount Rainier National Park seasonally but there is no evidence of breeding activity in or adjacent to the park. A wintering population is found along the Cowlitz River several miles south of the park's southeastern boundary. A single nest exists near the town of Elbe approximately 20 miles west of the southwest park boundary. On June 28, 2007, the USFWS delisted the bald eagle. Bald eagles remain a protected species under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. There would be no effect on bald eagles.			
Golden Eagle *Aquila chrysaetos*	--	SC	Golden eagles have been seen throughout the park in suitable habitat, usually in the subalpine and alpine zones. They are believed to nest in the park. (NPS 1995a). There would be no effect on golden eagles.
Merlin *Falco columbarius*	--	SC	Merlins are rare park visitors to subalpine areas in summer and occasionally are noted in fall. No known nesting occurs. (NPS 1995a). There would be no effect on merlins.
^Northern Goshawk *Accipter gentilis*	FSC	SC	Goshawks nest in trees in mature or old growth coniferous forests. Visitors and biologists regularly observe goshawks in the park. There may be some negligible to minor (disturbance) effects to goshawks.
^Peregrine Falcon *Falco peregrinus*	FSC	SS	Peregrines have been taken off the Endangered Species List, but remain a federal species of concern. Peregrines nest primarily on cliffs along rivers or near lakes. In the spring and fall, migrants may pass through the park. The only known eyrie is located in the southwest corner of the park, but few surveys have been performed. There would be no effect on

			peregrine falcons.
Ferruginous Hawk *Buteo regalis*	--	ST	Ferruginous hawks nest in cliffs or trees and frequent arid plains and open rangeland. Migrants may pass through the park. There would be no effect on ferruginous hawks.
Pileated Woodpecker *Dryocopus pileatus*	--	SC	Pileated woodpeckers are relatively common in low elevation forest. There may be low level disturbance effects on pileated woodpeckers.
^Oregon Vesper Sparrow *Pooectetes gramineus affinis*	FSC	--	It is not known whether this newly described subspecies occurs in the park. Oregon vesper sparrow life history suggests that only drier, open areas on the east side of the park would be suitable habitat. There would be no effect on vesper sparrows.
^Olive-sided Flycatcher *Contopus cooperi*	FSC	--	This flycatcher breeds in the park and prefers forest edges adjacent to open areas, such as burns, montane meadows, and subalpine areas. There may be negligible to minor (disturbance) effects on olive-sided flycatchers.
Vaux's Swift *Chaetura vauxi*	--	SC	Vaux's swifts may be found in forested areas and are considered common in spring, summer and fall. They are believed to nest in the park. (NPS 1995a) There may be negligible to minor (disturbance) effects on Vaux's swifts.
^California wolverine *Gulo gulo luteus*	FSC	SC	Wolverines inhabit high elevation coniferous forests and subalpine areas and have home ranges of up to 100 square miles. Wolverines were last documented in the park in 1933. There would be no effect on wolverines.
^Pacific Fisher *Martes pennanti pacifica*	FC	SE	Pacific fishers inhabit dense forests, with extensive continuous canopies and complex forest floor structures and are often associated with wetland or riparian areas.
Fishers have declined throughout their range and may be on the verge of extinction in Washington State. Fishers were last documented in the park in 1947, with more recent unconfirmed observations in the 1990s. A state reintroduction program is in planning development but immediate release sites are not likely to include the park. A 1991 study in the southeastern park did not detect them (Jones and Raphael 1992), nor did recent hair snare and remote camera bait station surveys (1999-2001). There would be no effect on Pacific fishers.			
^Long-eared Myotis *Myotis evotis*	FSC	--	Long-eared myotis' inhabit forests and chaparral. A nursing colony occurs near Longmire. There would be no effect on long-eared myotis.
^Long-legged Myotis *Myotis volans*	FSC	--	Long-legged myotis' forage over ponds, streams, open meadows and forest edges. Night roosts occur in caves or mines. This species occurs in the park. There would be no effect on long-legged myotis.
^Pacific Townsend's Big-Eared Bat *Plecotus townsendii townsendii*	FSC	SC	Big-eared bats hibernate in caves and use caves and abandoned buildings for breeding and roosting. Nursery colonies are extremely sensitive to human activity. Two hibernacula occur near Longmire. There would be no effect on big-eared bats.
Chinook Salmon *Oncorhynchus tshawytscha* (Puget Sound ESU)	FT & Magnuson-Stevens Act Essential Fish Habitat	SC	See detailed information above
Dolly Varden *Salvelinus malma*	FPROP	SC	Dolly Varden are listed under the similarity of appearance provision of the Endangered Species Act. They occupy the same

			habitats and are nearly indistinguishable from bull trout. Recent genetic analysis found native char in the Carbon drainage are bull trout but insufficient samples were collected to conclude that Dolly Varden does not occur within the park.
^Coastal Cutthroat Trout *Oncorhynchus clarki clarki*	FSC	--	The upper Carbon River is within the natural range of coastal cutthroat trout, and the species has been documented in the upper Carbon River tributaries This project will impact coastal cutthroat trout. The effects to cutthroat would be similar to those described for bull trout and steelhead.
Pink Salmon *Oncorhynchus gorbuscha*	FSC & Magnuson-Stevens Act Essential Fish Habitat		Pink Salmon, although detected in the White River and tributaries within the Park, have not been documented in the Carbon River to date.
^Cascades Frog *Rana cascadae*	FSC	--	Cascades frogs occur within the project area, often in the vicinity of ponds, l and slow streams; There may be minor adverse effects to Cascades frogs and their habitat.
Slater (1933) reported the first observation of mating activity of tailed frog which he observed in 1930 along Ipsut Creek in the northwest corner of the park. The type specimen for the Cascades frog was collected in the northwest corner of the park at the Elysian Fields by Slater (1939). Distribution within the park is not well known. They have been documented throughout the park. There would be no effect on Cascades frogs.			
^Tailed Frog *Ascaphus truei* 	FSC	--	Tailed frogs occur within the project area. There may be moderate adverse effects to tailed frogs and their habitat.
^Western Toad *Bufo boreas* 	FSC	SC	According to historic data, western toads were formerly more abundant in the park. Breeding sites have recently been found in only a few lakes and wetlands. No western toads have been documented in the project area.
^Columbia Torrent Salamander *Rhyacotriton kezeri*	FSC	SC	This species has not been documented in the park, including within the project area. . .
^Larch Mountain Salamander *Plethodon larselli*	FSC	SS	Larch mountain salamanders are found in forested and talus environments in cool, moist conditions under wood or rock. They have been found in several locations in the park including one site within the Carbon watershed. There are unlikely to be adverse effects on Larch Mountain salamanders.
^Van Dyke's Salamander *Plethodon vandykei*	FSC	SC	This species is found in a variety of habitats, including streambanks, upland forests, talus areas and seeps at a range of elevations. They have been documented in several park areas, including near the project area. There may be minor adverse effects on Van Dyke's salamanders.
California Floater Mussel *Anodonta californiensis*	FSC	SC	Freshwater mollusks inhabit permanent waters of all sizes. Mollusks have been identified as an inventory and monitoring element in the Pacific Northwest Forest Management Plan Record of Decision. This species has not been documented in the project area. This one is expected to occur, but surveys have not confirmed it. The

			proposed action would not affect floater mussels or their habitat.
^Fender's Soliperlan Stonefly *Soliperlan fenderi*	FSC	--	This species may be present in the project area . Fender's soliperlan stonefly nymphs are found in seeps in the headwaters of small streams, and in road ditches in the park. Presence in the Carbon River basin is unknown. The project may impact the soliperlan stonefly due to channel and wood habitat disruption. .
Mardon skipper *Polites mardon*	FC	SE	Not documented from the park. There would be no effect on this species.

^ species identified in most recent USFWS consultation as potentially utilizing habitat within the park

***Definitions**

Federal

Endangered (FE): Species in danger of extinction throughout all or a significant portion of its range
Threatened (FT): Species likely to become endangered within the foreseeable future throughout all or a significant part of its range
Candidate: Species is a candidate (proposed) for threatened or endangered status
De-listed (FD): Species that has been taken off the Endangered Species List

State

Endangered: Species in danger of extinction throughout all or a significant portion of its range in the state.
Threatened: Species likely to become endangered in the foreseeable future throughout all or a significant portion of its range in the state.
Rare (plants only): A native plant, not currently threatened with extinction, present in small numbers throughout its range, which may become endangered if its present environment worsens.

10. Ethnography

Note: The following discussion comes from an unpublished draft report of Carbon River archeology (Burtchard 2009).

The upper Carbon River valley was important to pre-contact Native American people for its suite of floral and faunal resources, and as a travel route to higher elevation habitats on Mount Rainier. Both overstory and understory constituents of Carbon River's temperate rainforest were used by Indian people in pre-contact times. Cedar bark, for example, was used for clothing, baskets, and mats (see Stewart 1984). Red cedar logs were used for canoes. Cedar also was split for housing planks, and used for tools of various sorts. The vast understory also provided food and a variety of medicinal plants such as devil's club, for rheumatic conditions (see Pojar and MacKinnon 1994:82). Furthermore, the Carbon River valley and adjacent landforms provided an access link between settled communities in the lowlands and productive subalpine resources on mid to upper elevation slopes of Mount Rainier (see M. Smith 1940:274-323, A. Smith 2006:99-152, and Burtchard 1998 for more detail). These traditional uses continue, albeit in a more restricted manner, to the present. Currently, several tribal groups –especially the Puyallup Tribe of Indians and the Muckleshoot Indian Tribe– maintain a strong interest in resources and events germane to the Carbon River within, and beyond, the park boundary (Burtchard 2009).

Substantial evidence exists for early Native American use of the river valleys around Mount Rainier. Within the park boundaries those river valleys quickly steepen and increase in elevation thorough the montane forests and subalpine meadows, which make them logical transportation routes to resource abundant subalpine parkland destinations. Many archaeological finds support the theory that Native Americans were using the valley, not only as a way to access other more resource abundant regions in the park, but also to take advantage of resources found in the valley itself. Boxberger (1996 in Burtchard 2009) identifies four categories of Native American resource use in Mount Rainier National Park – hunting, fishing, gathering, and religious. While fishing was not as productive in the upper reaches of the Carbon valley, the area within the park provided environments for hunting, gathering, and religious practices. Numerous prehistoric sites have been documented in the subalpine parklands above the Carbon River Valley (Burtchard 2009).

Traditional use of the Carbon River valley diminished, but did not end, with the signing of Medicine Creek and Point Elliott treaties in 1854-1855. In these treaties, the ancestors of the modern Puyallup Tribe of Indians and the Muckleshoot Indian Tribe ceded lands in the Carbon River Valley to the federal government. Concurrently, use of the Carbon River corridor was shifting primarily to coal mining and was soon followed by the establishment of the National Park Service presence in the area (Burtchard 2009).

The Muckleshoot Indian Tribe and Puyallup Tribe of Indians have spoken strongly of their connection with the Carbon River corridor. The Muckleshoot and Puyallup both consider the corridor of primary treaty importance as well as an area within the boundaries of their traditional homelands (Carbon River Charette 2003:iii in Burtchard 2009) and are concerned about both access to tribal hunting areas on U.S. Forest Service lands outside the boundary of the park and to areas within the park. Such concerns prompted a revision of the proposed boundary expansion area identified in the park's General Management Plan (NPS 2002) following its draft release in 2001.

11. Prehistoric and Historic Archaeological Resources

Park Archeological Resources Overview: Despite limited survey, 176 archaeological properties have been documented in Mount Rainier National Park through June 2006. Seventy-seven (77) of these properties are of solely prehistoric origin, 13 have both prehistoric and historic period components; and 86 sites date only to the historic period. Four ethnographic sites documented in the park date to more recent times, indicating continuing Native American use of the mountain.

Prehistoric archaeological sites are found predominantly in high elevation forest, subalpine and alpine environmental contexts. The pattern reflects the enhanced abundance of economically useful plants and animals present in these upper elevation patchy forest and meadow communities.

During the last ice age, when the peak was still draped in ice and permanent snow, Native Americans lived on the plains and valleys below. Between 9,000 and 8,500 years ago, the mid-elevations became free of permanent snowpack and plant and animal communities were established. By 4,000 years ago, Native American hunting and gathering was occurring in several locations in the park, including Cayuse Pass and Sunrise. The Chinook Pass (Yakima) Trail, in use for the last 2,000 to 4,000 years passes through the Tipsoo Lakes area. A 1915 map indicates the trail through the American River drainage, over Chinook Pass, north of Tipsoo Lakes, west to Cayuse Pass and north, northwest along the Klickitat Creek drainage towards Sunrise Ridge. Two years later, Native Americans were barred for the first time by the park from hunting at Sunrise.

The oldest, firmly aged, prehistoric deposits date to approximately 4,500 years before the present. Research into the earliest use of Mount Rainier landscapes continues; it is possible that the prehistoric human record ultimately will be shown to extend to over 8,500 years ago.

Historic-period sites are widely distributed throughout the park in a variety of elevations and environmental settings. Most of the historic properties are associated with late 19th and early 20th century mining activities, and with development of early park infrastructure. Mount Rainier historic research is progressing rapidly. The count of historic period sites is expected to double in the next few years.

The most intensive archaeological survey efforts have been associated with rehabilitation and construction-related projects in the developed areas of the park (including trails and backcountry camps) during the last ten years. Other reconnaissance efforts have focused on subalpine and alpine landscapes, several forest settings; and places where known archaeological resources have been reported. Understanding of the park's prehistoric use patterns is based on the results of these surveys; on the archaeological record in the vicinity of the park; and on environmentally-based models of human subsistence and settlement patterns in mountainous environments (Burtchard 1998). Knowledge of the historical archaeological record also relies on these sources, plus written records, informant accounts and historic documents.

Prehistoric archaeological evidence is dominated by low to moderate-density lithic (tool stone fragment) scatters, most of which are found exposed on the soil surface. Dominant materials are cryptocrystalline silicate rock, most of which originated outside the park. Because of the volcano's depositional history, a relatively small fraction of the total remainder of artifacts anticipated is found on the surface. As a result, most of the material is found under the surface, providing some protection from most recreational use.

<u>Archeological Survey of the Carbon River Valley</u>: As noted in Burtchard (2009), two previous surveys of the Carbon River area were completed in 1996. Both were systematic corridor surveys of the Carbon River Road between the park entrance and Falls Creek. The first survey was initiated due to flooding that washed out 1,350 feet of road in February of 1996, requiring an archaeological assessment for the *Carbon River Road Reconstruction Environmental Assessment* (NPS 1998). In this survey, a 100 meter-wide corridor was surveyed extending from the eastern end of the washed-out area at Falls Creek to the to the park boundary. The survey crew walked parallel transects spaced about 20 meters apart. Three archeological sites and one isolated find were identified.

Four archaeological sites consisting of three segments of road protection levees and a homesteading site were recorded and documented. Those sites respectively were FS1997-03, FS1997-20, FS1997-21 and FS1997-19. The survey project is documented in report ARR1997-01. The four site numbers have gone through numerous confusing changes over the years. The three levee sites originally were recorded separately as FS1997-01 through FS1997-03. Sometime between 1997 and 2008 the site numbers were combined into one site, FS1997-03, with three subsites A, B and C. In 2008, because of the long distance between each levee segment and the very different impacts that occurred to each section, the decision was made to once again separate FS1997-03 into three sites. Those sites became FS1997-03, FS1997-20 and FS1997-21. The site FS1997-19 was originally recorded as isolate IF1997-19. Because of changing site and isolate definitions the isolate was converted to site status in 2002.

The second survey focused specifically on locating the Washington Mining and Milling Co. (WMMC) mine site FS1997-04 to determine if it warranted further investigation. The site was located, but not fully recorded. At the time no assessment was made of site condition or potential as to NRHP eligibility. The site survey is documented in the report ARR1997-18 (Burtchard 2009).

Initial archeological survey of the developed areas in the vicinity of the Carbon River Entrance for the *Carbon River Rainforest Boardwalk Environmental Assessment* (NPS 2001) did not locate any unknown historic or prehistoric archeological resources.

Additional archeological surveys along the Carbon River Road were completed by the NPS in 1996, when the following sites were documented:

- (FS 97-01): Site consists of a log and stone levee structure (about 500 feet-long), a rough-hewn wood culvert or bridge, an extensive area of cut tree stumps with spring-board notching, metal debris and a ceramic insulator. The culvert/bridge was evidently buried in the road fill prior to being exposed by flooding. The levee was likely constructed in the 1930s by public works crews, but its western end was altered with the addition of a 130 foot-long section of gabions in the 1970s (see Historical Levees 1, 2, 3 below).
- (FS 97-02): Site consists of a log and stone levee structure (about 150 ft.-long), spring-board notched stumps, and a small log and milled lumber sled or skid (see Historical Levees 1, 2, 3 below).

- (FS 97-03): Site consists of two levees (one about 260 feet long) near the Carbon River park entrance and ranger station. Spring-board notched stumps were also noted in the vicinity (see Historical Levees 1, 2, 3 below).
- (IF 02-97): An isolated find consisting of a small tin can trash dump dating to approx. 1915-1930 (NPS 1998) (not relocated due to washout in 2008 survey, Burtchard 2009).

None of the identified archeological resources were recommended eligible for the National Register of Historic Places (all lacked integrity and the ability to contribute significant historical information).

Prehistoric archaeological evidence in the upslope drainage basins of the Puyallup and Carbon rivers demonstrates a robust human presence in the area at least 5000 years ago, and probably as much as 8500 years ago (Burtchard 1998 in Burtchard 2009).

For this environmental assessment, an archaeological survey of the Carbon River corridor was conducted in July and August 2008. Three objectives guided the survey:

1) <u>Complete condition assessments of existing archaeological properties in the corridor</u>: Sites and features that had been previously documented were reexamined for damage associated with the 2006 flood. Site forms for these properties were updated with new measurements, photographs, maps and map plotted using Global Position System (GPS) technology.
2) <u>Locate reported but unverified archaeological resources</u>: Eight sites or features had been reported previously by various sources, but had remained unconfirmed and undocumented. Using available information gleaned from these reports, as well as from historic records, the survey attempted to locate and document these sites in the field.
3) <u>Inventory potential new sites</u>: A new pedestrian survey covering the entire length of the Carbon River road corridor from the entrance to, and including, Ipsut Creek Campground, was completed (Burtchard 2009).

Results from this survey included: documentation of previously identified historic archeological sites associated with objective 1) above. Unverified potential archeological resources found or verified in this survey included a logged area likely the origin of the 1930s log-cribbing, a peeled cedar, and an understanding that the former Ranger Creek cabin was located on the north, not the south bank of the Carbon River. Five other potential sites were not located (Burtchard 2009).

For the new survey, reconnaissance by three people on foot, walking parallel transects 10 meters apart starting 10 meters from the edge of the road, occurred for a total of 30 meters on each side of the road. The entire five mile length of the corridor was visually inspected, for a total of approximately 119 acres surveyed (Burtchard 2009). Some results are given below.

<u>Historical Levees 1, 2, 3</u>: The levees were constructed between 1933 and 1941 as part of the Civilian Conservation Corps' (CCC) program to perform maintenance, repairs, and improvements along the Carbon River Road. The levees consist of notched logs held together with wire bundles.
According to the draft CLI (NPS 2006a42), "Four cribs were constructed by the CCC during the 1933 to 1935 period. Crib number one was located at the park entrance and was 366 feet long. Crib number two was located near the Copley Lake trailhead (this trailhead has not been active for over 50 years but was located near the Falls Creek washout. This structure was shorter than the others, measuring only 112 feet. In 2006, Carl Fabiani reported that the Copley Lake trailhead was located approximately 100 yards east of the Falls Creek culvert. Furthermore, Fabiani reported that there are remnants of cribbing at this location today. Crib number three, which was constructed in the 1933-1934 season, was located near the former Evans Cabin and was 285 feet long. Crib number four, the largest crib, was located just above the Ipsut Creek Campground, and measured 400 feet in length (Microfiche D22, 5). Remnants of these cribs still exist at the Carbon River entrance and near Evans Cabin site. Today these groups of logs, bound together by wire and filled with rock, are visual reminders of the CCC role in the development of the Carbon River

Road. Furthermore, the cribs are indicative of flood problems apparent from the earliest years of the road's development."

Additional information in the CLI notes, "Two gabions exist near the intersection of Falls Creek and the Carbon River. These flood revetment devices consist of river cobbles encased in galvanized wire mesh, which serve to deter floodwaters from the road. The gabions, one measuring nearly 50 feet in length and the other measuring 37 feet are contemporary; however, their construction follows an earlier precedent established by the CCC during the 1930s. There are also three segments of compatible riprap located along the road. The riprap is located near Falls Creek, just east of the Green Lake Trailhead and near Chenuis Falls. The riprap associated with Falls Creek is approximately 20 feet long and consists of large angular rocks that may be mixed with historic riprap. Additionally, the riprap associated with the Green Lake Trailhead is significantly longer stretching from 2.69 miles to 2.95 and contains large rock material. Finally, the riprap near the Chenuis Falls Trailhead stretching from 3.48 miles to 3.82 miles, serves as a retaining wall buffering the edge between the Carbon River and the Carbon River Road" (NPS 2006a:78).

Old Mine: The Washington Mining and Milling Company mine adit (FS1997-04), is a historical mining site owned by the Washington Mining and Milling Co. ca. 1899.

Carbon River Entrance Water System: The Carbon River Water System (FS2005-17) is a historical water system that served as the original water system for the Carbon River entrance station.

June Creek Cabin: The June Creek Cabin (FS 2005-17) is a historical mining site, ca. 1900 AD, and is one of six mining claims owned by the Hephizibah Mining Company in the Carbon River Valley. Numerous artifacts were found in association with this site.

Ipsut Creek Campground: Survey of the area documented 31 campsites and 54 historic and non-historic features, as well as the Ipsut Patrol Cabin and an abandoned section of the Carbon River Road. Four historic river cobble water faucets, one historic water fountain, 31 non-historic Mission 66 style grills, and a possible historic trail to the Carbon River were documented (Burtchard 2009). In addition, there is an amphitheater consisting of approximately 15 log benches facing NW to the "stage," a former information building now used for maintenance (C116), and the footprint of the Ipsut Creek Patrol cabin (now in storage) along with several associated features (Burtchard 2009). Lastly, a portion of the former Carbon River Road, extending south of the campground for 130 feet to the open Carbon River channel was documented (Burtchard 2009).

Road surveys also noted extant remains (insulators and wire on trees) from the historic Carbon River telephone system. These are found throughout the park along roads and trails, leading to patrol cabins and developed areas.

Although no new cultural resources were discovered during the 2008 survey, existing sites were more thoroughly documented with pictures, scale maps, and GPS coordinates. Additionally, the extent of flood impacts to existing sites was revealed by the fact that several sites had been lost or destroyed completely (Burtchard 2009). Table 27 shows recommendations resulting from the survey.

Table 27: Archeological Survey Recommendations

Site Number	Site Name	NRHP Recommendation
FS1997-03	Carbon River Historic Levee #1	Ineligible due to modifications in 1980s
FS1997-19	Falls Creek Can Dump	Not relocated, Undetermined
FS1997-20	Carbon River Historic Levee #2	Destroyed, Ineligible
FS1997-21	Carbon River Historic Levee #3	Ineligible due to modifications in 1980s

FS1997-04	Washington Mining and Milling Co. Mine Adit	Eligible
FS2005-15	Carbon River Water System	Ineligible
FS2005-17	June Creek Cabin	Eligible
FS2008-12	Ipsut Creek Campground	Undetermined

Sites recommended eligible and undetermined for listing on the NRHP should be avoided during the course of construction activities. If avoidance is not an option, excavation procedures approved by the Washington State Department of Archaeology and Historic Preservation should be used to mitigate any damage through data recovery (Burtchard 2009).

Because of the difficulty of locating archaeological remains in the heavily vegetated Carbon River floodplain, results should not be considered to be an exhaustive list of archaeological remains preserved in the corridor, but rather should be viewed as baseline data for continuing research and management actions in the Carbon River Valley (Burtchard 2009).

12. Historic Structures / Cultural Landscapes

Area of Potential Effects Summary:
The project area includes the Carbon River Road itself [part of the Mount Rainier National Historic Landmark District (NHLD)] and areas adjacent to the road within the Carbon River Road boundary (30 feet on either side of the centerline of the road, as well as the two CCC-built log cribbing structures located at the entrance and at Falls Creek. At the end of the Carbon River Road may be found the Ipsut Creek Cabin. In addition, the Northern Loop Trail is accessed from the end of the Carbon River Road and there are trails leading to the Wonderland Trail and other sites, such as Green Lake, from the Carbon River Area. The Carbon River Road is in the "Must Be Preserved and Maintained" management category, according to the draft Cultural Landscape Inventory (CLI). According to the CLI, it meets this management category because it is an inventory unit that is nationally significant as defined by National Historic Landmark criteria (NPS 2006a:7).

NPS Director, Stephen Mather envisioned scenic park roads designed with "landscape engineering" (his own term, stating that they should fit in with the contours of their scenic environment and be blended through rustic design features (stone masonry guardwalls, retaining walls, bridges and culvert headwalls) of native materials and naturalistic form to harmonize them and make them appear at home in the park environment. Mount Rainier Superintendent Tomlinson took this vision to heart and worked with NPS Chief Architect Thomas Vint's office to develop a master plan for the park incorporating these ideas. Because Tomlinson was superintendent for 17 years, he was able to develop and then begin implementation of the plan, the first in the National Park System (NPS 2006a: 36-38). "Tomlinson's final iteration of the master plan was almost completely implemented, and the park had almost 100 miles of scenic park roads, and several hundred facilities, all built in the rustic style of architecture, or the naturalistic style of landscape architecture, as it came to be called" (NPS 2006a: 42).

Mount Rainier National Historic Landmark District (NHLD)
The Mount Rainier NHLD was designated in 1997. This large and exceptional District, now on the National Register of Historic Places (under landscape architecture) and which includes Camp Muir, contains 97 historic buildings and 60 historic structures (including most of the park's road system and the Wonderland and Northern Loop trails) as well as 31 other listed features. Together, these resources are considered to be the best example of park master planning in the National Park System. Collectively, they represent an important stage in national park development history. At Mount Rainier in the 1920s and 1930s, the NPS Landscape Planning Division invented and defined modern national park planning. Consequently, the Master Plan for Mount Rainier, completed in 1929, was the first national park master

plan developed by the NPS and it was and is considered a model of NPS planning. The degree of conformance to the plan still present in the park is outstanding. As a whole, no other collection of park roads, bridges, developed areas and trails is more completely preserved as an intact example of national park planning and design of the period 1904-1957. The goal, then as now, was to integrate all park systems and facilities in a unified plan that would ensure the best possible visitor experience while severely limiting how much development would be permitted in the park (Carr 1998). The master plan was executed in the rustic style of architecture and the naturalistic style of landscape architecture, using native materials and natural forms to blend constructed works with their environment.

The designation of a NHLD recognizes that the park does not simply contain individual historic resources, but is itself an historical park. The historic roads, trails, buildings and designed landscapes of the park together comprise a cultural landscape of national significance in American history. Twenty-nine individual cultural landscapes have been identified throughout the park. These occur in a variety of vegetation types on the north, south, east and west flanks of Mount Rainier. The significance of the NHLD is divided into the following categories, which recognize contributing resources:

- Spatial organization – the composition and sequence of outdoor spaces within the district;
- Circulation – the means and patterns of movement through the district;
- Topography – the ways in which the landscape planning responds to the topographic features of the site and the modifications of that topography;
- Vegetation – the response of existing vegetation as well as the management of vegetation through pruning, removal or addition of trees and shrubs;
- Structures – all contributing structures, including roads, trails and other small scale features such as rock walls and culverts; and
- Buildings – structures intended to shelter a human activity.

There are approximately 158 historic resources in the park individually and collectively listed on the National Register of Historic Places, including those designated as part of the NHLD. Many more sites, structures and objects are potentially eligible for the National Register. Prior to designation of the Mount Rainier National Historic Landmark District, and now encompassed by the NHLD but separately listed on the National Register, six historic districts were designated in the park for their rustic architectural significance. These include:

- Nisqually Entrance Historic District
- Longmire Historic District
- Paradise Historic District
- Camp Muir Historic District
- White River Entrance Historic District
- Sunrise Developed Area Historic District

Each of the historic districts exhibits significant examples of NPS rustic architecture in the style of the period of its development. In addition, there are 5 National Historic Landmark buildings or building complexes that have been designated in the park. These represent the some of the best designs of the period and, in many cases, were used as models in other National Parks for similar structures. They include:

- Longmire Community Building,
- Longmire Administration Building,
- Longmire Service Station,
- Paradise Inn, and the Annex
- Sunrise Blockhouses/Stockade Complex.

Carbon River Road

According to the draft CLI (NPS 2006a: 9), "the Carbon River Road is a cultural landscape within the Mount Rainier National Historical Landmark District (NHLD). Designated in 1997, the NHLD is nationally significant for its association with the American Park Movement and early National Park Service (NPS) master planning efforts (criterion A). Additionally, the NHLD is significant for its association with a naturalistic landscape design and engineering style (criterion C), which was perpetuated by the NPS between the First and Second World Wars. The period of significance for the NHLD spans the years 1906-1957, reflecting an intensive period of rustic development in the park. As part of the NHLD, the Carbon River Road is significant for its association with the national park system's most complete example of master planning [criterion A]. It is also significant for its landscape engineering as a scenic park road [criterion C]."

> Aligned as a narrow gravel thoroughfare, the Carbon River Road follows a curvilinear path, winding through old-growth forest along the Carbon River. Implementing few engineered structures into its design, the road was constructed using wagon road technology, rather than modern engineering. The road, also defined by a crowned prism and small turnouts, was constructed on a floodplain. Park planners and engineers designed the road to blend in with the landscape with the utmost sensitivity to its natural surroundings. Careful attention was paid to construct the road near the Carbon Riverbed, instead of on a bench. Regardless of the sensitivity that was applied when considering the construction and design of the road, several contemporary road-engineering tenets were overlooked. Perhaps the most costly mistake that was made included the alignment of the road in a floodplain. Engineers may also have made another mistake, which included not taking into account the ability of the river to change its course. Since the road was completed in 1924, numerous floods have destroyed several portions of the Carbon River Road. It is likely that this damage could have been avoided if different construction and engineering techniques had been implemented during the 1920s.
>
> While historically the road was of relatively archaic design, several rustic engineered structures were situated along the corridor, which included bridges, culverts and other flood revetment devices. Due to the road's close proximity to the Carbon River, engineers were forced to develop a system of bridges and culverts along the road corridor. Generally, rustic bridges were constructed at every creek crossing and cedar culverts were installed to drain the road in numerous locations. Furthermore, log cribbing and riprap were positioned along the road in the 1930s by CCC crews to armor the riverbanks near the road. Regardless of the efforts made by the park, the low elevation route with respect to the floodplain and the lack of sophistication in engineering left the road vulnerable to flooding from the start. Presently, many of these features are non-extant, having been replaced by corrugated steel culverts.
>
> Today, the Carbon River Road retains integrity and as serves as a fine example of an early NPS designed road. Furthermore, the road reflects the spatial organization, physical components, and historic associations that it attained during the period of significance, 1915-1941. Significantly, the road's linear alignment continues to echo planning decisions made in the mid 1910s and early 1920s by early park officials and planners, such as Superintendents DeWitt Raeburn & William H. Peters and NPS Chief Engineer, George Goodwin. The spatial organization of the Carbon River Road, also remains intact, and includes several historic nodes of development, which are located near the entrance, utility and maintenance area and the campground. Finally, the road as a transportation and recreation corridor remains intact. Visitors continue to utilize the Carbon River Road as a pleasure drive, taking advantage of the accessibility of the Carbon River Valley, a temperate rainforest environment defined by specimen trees and the Carbon Glacier.
>
> While it is clear that segments of the Carbon River Road illustrate evidence of deterioration due to natural forces associated with flooding, the overwhelming majority of the resources remain and the integrity of the landscape is intact. As one of the few remaining unpaved historic scenic parkways within the National Park System, the Carbon River Road retains the original historic character of early park roads. Furthermore, it remains an excellent example of what early park

> roads were like before the application of modern materials such as asphalt and bitumen changed the character of these rustic roads. Finally, unlike many other park roads, the majority of the Carbon River Road retains the original configuration of its cross section, never having been upgraded to modern specifications. For these reasons, the Carbon River Road is significant as an example of early NPS road survey and construction (NPS 2006a:11-12).

The Carbon River Road, a 4.9 mile long unpaved spur, is identified as a structure contributing to the significance of a National Historic Landmark District at Mount Rainier National Park and is included within the district's discontinuous boundaries (NPS 1997). The draft CLI also identifies it as an eligible cultural landscape (NPS 2006a:9). For the most part, its alignment and ancillary structures of the Carbon River Road are original and intact. Because this is the only road in the park built entirely by the National Park Service; because the centerline of the road follows (mostly) the alignment of the road during the period of significance; and because almost all of the major structures associated with the road are original, the road can be said to have excellent integrity overall to the period of significance (1920s-1930s). The CLI notes, "therefore, proposed actions which could alter its status as a transportation corridor require consultation with the State Historic Preservation Office."

The boundary for the Carbon River Road is the same as that for other roads within the NHLD. It extends 30 feet on either side of the centerline of the road for a distance of 4.9 miles, terminating at the trailhead parking area associated with Ipsut Creek Campground. This boundary includes all of the historic structures associated with the road's construction, including ditches, swales, culverts and retaining walls. At two points, the boundary expands to include two CCC era log cribbing structures, one on the north side of the road near the entrance station (behind the comfort station) and one on the north side of the road near Falls Creek and the site of Evan's Camp approximately 1.8 miles from the entrance.

Construction of the Carbon River Road: In 1907, prior to park construction activities, a three mile-long road was constructed along the Carbon River within the park boundaries to serve the operations of the Washington Mining and Milling Company (Thompson 1981). The mining road led to a squatter's cabin, referred to as the "Evan's" Cabin and later as a "Ranger" Cabin, located approximately two to three miles from the park boundary. This road eventually fell into disuse and became overgrown with vegetation.

The route for the Carbon River Road was surveyed in 1915. Several years later in 1921, the NPS began construction of the Carbon River Road, and in 1924 it was completed to within one mile of the Carbon Glacier terminus. Of the eight miles, five and a half were two-way (to Ipsut Creek) and the rest was one-way. Delays and difficulties in completing the access road outside the park hampered the in-park roadwork.

The road remains a cul-de-sac (ending at the Ipsut Creek Campground) partly because the West Side Road was never entirely extended along the west side of the park as originally envisioned. As a result, the West Side and Carbon River Roads were not connected. The Carbon River Road was severely damaged by flooding in 1924 prior to its completion, which prompted the construction of protective dikes and revetment walls in some locations. Subsequent floods have periodically damaged the road throughout its existence. The dense forest that borders the road corridor contributes to its distinctive historic setting and character.

Carbon River Road Significant Cultural Landscape Characteristics
The draft CLI, completed just prior to the 2006 flood, states that the naturalistic character of the road is evident in its remaining landscape characteristics: spatial organization, circulation, topography, views and vistas, vegetation, natural systems and features, and archaeological sites. These patterns and their surviving features continued to exist as originally planned in 2006, conveying the integrity of the road as a scenic highway (NPS 2006a:2).

<u>Natural Systems and Features</u>: While other factors, such as the development of the area for tourism and the construction of a hotel, may have played a minor role in the alignment of the road at its eastern end,

access to the Carbon Glacier was the primary objective behind the design of the road. Historically, visitors to the Carbon River District were primarily interested in viewing the Carbon Glacier (NPS 2006a:64).

Spatial Organization: The road's primary spatial feature is its linear alignment that serves to connect the Carbon River Entrance Station near the park boundary, to the Ipsut Creek Campground at the road's terminus. . . A secondary spatial feature associated with the road includes several historic nodes of development, which are located near the entrance, utility and maintenance area and the campground (NPS 2006a:65-66).

Land Use: In 2006, the Carbon River Road and its associated features were utilized in the same manner as they were historically. The road maintained its historic design intent by continuing to provide park visitors with the same informational, recreational and transportation opportunities. Specifically, visitors could still travel by automobile down the road. Along the route, they could stop to view the immense old growth trees and dense undergrowth associated with the temperate rainforest environment. Furthermore, visitors could visit the Carbon Glacier; utilize numerous trailheads via parking areas and camp near the Carbon River while taking in the beauty of the surrounding river valley (NPS 2006:68).

Circulation: Since its construction in 1924, the Carbon River Road has served as a transportation corridor for visitors seeking the opportunity to view the Carbon Glacier. While the road was still a pleasure drive in 2006, its primary purpose was to provide a circulation route in the northwest corner of Mount Rainier National Park. In addition to through-circulation, the road also provided visitors with the opportunity to stop at numerous places along the road, which includes several trailheads, a picnic area and a campground. Many of these features are associated with the historical development of the road and as a result contribute to the significance of the road's circulation patterns (NPS 2006a:68).

Topography: Adhering to the path of least resistance, the road winds along the relatively flat valley floor of the Carbon River for approximately five miles. Following the river floodplain for most of its course, the road grade never exceeds 6 percent. Due to the road's crowned prism, there was very little disturbance associated with the construction of the road. Minor disturbances along the corridor included through-fills in low-lying areas and two earth and rock cuts near the river. Otherwise, the historic road alignment required little cutting and filling. While this rudimentary design avoided scenic impacts and cost considerably less than a bench-cut higher elevation route, it did expose the road to flood hazard (NPS 2006a:72).

Vegetation: In this portion of Mount Rainier National Park, large old growth trees associated with the park's only temperate rainforest envelope the area in an abundant canopy. Here, massive specimen trees, retained during the construction of the road, line the corridor. In 2006, over 100 specimen trees, some measuring ten feet in diameter, were documented near the route. A substantial proportion of these trees were destroyed as a result of the November 2006 flood. These trees were originally saved during road construction through the curvilinear alignment of the road curving to avoid them. They would have been protected during construction and during the felling of trees in the path of the road. Most likely, plywood would have been used to protect the trees from scarring as trees were felled or stumps were dynamited. Today, several of the conserved trees are located within one foot of the road edge. These features serve to contribute to the overall significance and integrity of the road (NPS 2006a:74).

Buildings and Structures: *CCC Garage*: Another building constructed by CCC crews included an equipment shed and garage in the utility/maintenance area, which is located about one eighth of a mile along the road east of the Entrance Station. Designed by the NPS, the garage was a gable-roofed structure, with four vehicular storage bays sealed by overhead doors. The approximately 40 feet by 18 feet structure had a cedar shingle roof, lap sided walls and a dirt floor. Today, beyond the 2006 flood, this building remains in the utility area and is a contributing feature.

Ranger Residence (non-extant, washed into channel in 2008): The first building, measuring 25 feet by 15.5 feet, served as a ranger residence. The residence was a gabled structure with a cedar shake roof and exposed rafter tails. In 2006, the building still sats on poured concrete blocks and was sided with clapboard and painted brown. A lean-to-shed for firewood storage was situated on the eastern side of the building. It should be noted that while this building retained integrity and was therefore is a significant feature in 2006, it was destroyed by subsequent flood damage in 2008 and is no longer extant

Ipsut Creek Patrol Cabin (extant, deconstructed and removed to storage in 2007 when threatened): Built in 1934 by the CCC, this 24 foot by 17 foot rustic building is a wood framed gabled structure with peeled logs and saddle notching. The roof consists of cedar shakes and exposed rafter tails. Before deconstruction in 2007, the building sat on a foundation comprised of river cobbles and concrete. The building is extant in careful storage. .

<u>Views and Vistas</u>: In 2006, the road continued to serve as a pleasure drive. Visitors had the opportunity to view huge Douglas fir, Sitka Spruce and Western Red Cedars as they drove along the winding, curvilinear road. Furthermore, visitors could stop at the Chenuis Trailhead and picnic area to take in the splendid views of the Carbon River valley. While it is clear that the road is characterized by its destination: the Carbon Glacier and Wonderland Trail, it is certain that the views of the old stands of forest, the river and the valley were also appreciated. As a result, views and vistas, while not a primary landscape characteristic of the Carbon River Road, still contributes to the integrity and significance of the road (NPS 2006a:81).

<u>Small Scale Features</u>: While there are a variety of compatible small scale features, including wood-clad iron gates, fencing, interpretive kiosks, and other structures, none were identified as contributing in the CLI.

<u>Archeological Sites</u>: At the time of the draft CLI, five archeological sites had been documented. The five-recorded archaeological sites, located along the Carbon River Road, include the Carbon River Water System, June Creek Cabin, Washington Mining and Milling Company Mine Shaft, the Falls Creek Can Dump and the Carbon River Historic Levy #1. The draft CLI also notes five additional potential archeological sites associated with construction of the road, including 1) historic log cribbing on the north side of the road near the entrance, 2) a concrete pad that served as a generator foundation behind the ranger station, 3) a tool shed foundation in the maintenance area, 4) a clearing where the Evans Creek Cabin was located, and 5) a clearing near the Green Lake Trailhead, thought then to be the location of the first patrol cabin (the 2008 archeological survey, found this to actually be on the north side of the Carbon River).

Carbon River Road Cultural Landscape Integrity

The CLI also found that the Carbon River Road retains all seven aspects associated with cultural landscape integrity, including location, design, setting, materials, workmanship, feeling and association (NPS 2006a:63).

<u>"Location</u>: The road's location, situated in the northwest corner of Mount Rainier National Park, has not changed since the period of significance.

<u>Design</u>: The layout and linear alignment of the road remains unchanged since the period of significance. Additionally, the associated features of the road, including buildings and structures, topography, circulation features and spatial organization (nodes of primary development) still convey historic design patterns and intentions of the NPS landscape architects from the period of significance.

<u>Setting</u>: The physical environment associated with the Carbon River Road has undergone few changes since the period of significance. While traveling along the road, visitors still have the opportunity to enjoy a temperate rainforest environment defined by lush vegetation and specimen trees. Furthermore, visitors can also enjoy picturesque views of the Carbon River and associated valley.

Large old-growth trees growing on the western side of the floodplain were considered an important aspect of the visitor experience of the Carbon River scenic drive. Accordingly, efforts were made during the road construction effort to retain as many trees as possible; providing an opportunity for visitors to enjoy spectacular old-growth forest, and making vegetation an essential part of the historic character of the Carbon River Road (Burtchard 2009).

Materials: Materials such as native stone, wood, and plants were implemented during the period of significance by CCC laborers in the Carbon River District. Extant built features such as the Ipsut Creek Patrol Cabin and several buildings in the maintenance and utility area still reflect the use of these native materials.

Workmanship: The high level of workmanship produced by the CCC crews is evident in all aspects of the road corridor, which includes the construction of log cribbing along the riverbank, the use of native vegetation along the roadbed and the construction of numerous buildings in developed areas along the road.

Feeling: The feeling of the Carbon River Road is conveyed through the retention of much of the historic fabric of the road. The road, designed by NPS landscape architects, followed the basic principles of naturalistic landscape design. Under this philosophy, built works and natural features were integrated to create a unified overall design in which the road and its associated features were intended to appear, to the greatest extent possible, as natural extensions of the living landscape, not as unnatural intrusions. The naturalistic and rustic feeling of the road is still evident in the remaining landscape characteristics: spatial organization, circulation, buildings and structures, topography, vegetation and response to natural systems.

Association: The road's association with the park's early Master Plan, which was designed and implemented in the 1930s, is still evident" (NPS 2006a:63).

Ipsut Creek Patrol Cabin (C-250)

Whether set in a subalpine meadow or in a heavily forested area along the Wonderland Trail, certain characteristics are shared by the surviving cabins and shelters from the pre-World War II period. All use native stone and wood in a straightforward manner that harmonizes with their natural settings. The majority are log frame with cedar shakes or shingled gable roofs and open porches. Taken together the backcountry patrol cabins and shelters represent a thematic group that has strong historical associations with the federal government's administration, management and development of the national park. Collectively they are excellent examples of Rustic Architecture (Toothman 1997).

The Ipsut Creek Patrol Cabin (NRIS #91000181) was nominated to the National Register of Historic Places as part of a multiple property nomination in 1991. It was listed on the National Register on March 13, 1991. It has national significance associated with criteria A: Associated with events significant to broad patterns of our history, and C: Embodies distinctive construction, work of master, or high artistic values (NPS 2006a:8).

The Ipsut Creek Patrol Cabin was built in 1933 by the NPS and is similar in design to patrol cabins at Huckleberry Creek, Lake James and Three Lakes. The cabin measures 14 feet 2 inches by 23 feet 10 inches. A rear lean-to wood shed (6 feet by 16 feet three inches) is enclosed.

At the front of the cabin, the NHLD boundary is the near edge of the road that parallels it; the boundary of the other three sides are lines completing a rectangle 100 feet from the three sides of the building. The boundary was drawn to include the historic building and some land encompassing the structure in order to convey the historic setting.

Ipsut Creek Campground

As part of the NHLD, Ipsut Creek Campground is a discontiguous structure along the Carbon River Road. The campground however has not been evaluated as a cultural landscape and its historical significance has not been determined. It is therefore not listed in the National Register as part of the

Mount Rainier NHLD. It is, however, eligible (as noted in the Cultural Landscape Inventory) and formal concurrence with a determination of eligibility associated with its significance would likely be needed prior to changes proposed in Alternatives 2-5. According to Thompson (1981), a new 125-car public campground had been constructed in the Carbon River area by 1926. Later, in 1933, a CCC camp was established there. That same year, the Ipsut Creek Cabin was completed.

Former Entrance Arch

A log-arch entrance completed in 1934 no longer exists but is proposed to be reconstructed under Alternatives 2-5. The log arch defined the entrance to the park. Although the first arch constructed (Photo 40: *Historic Photograph of Carbon River Arch under Construction c. 1933*), did not have the diagonal log cross pieces bracing the top log, a later photograph in the CLI (from 1953), shows an arch with this type of construction. Both photographs show the early ranger station (destroyed by fire) in the center of the arch.

Figure 27: Historic Drawing of Carbon River Entrance Arch from draft CLI (NPS 2006a: 47)

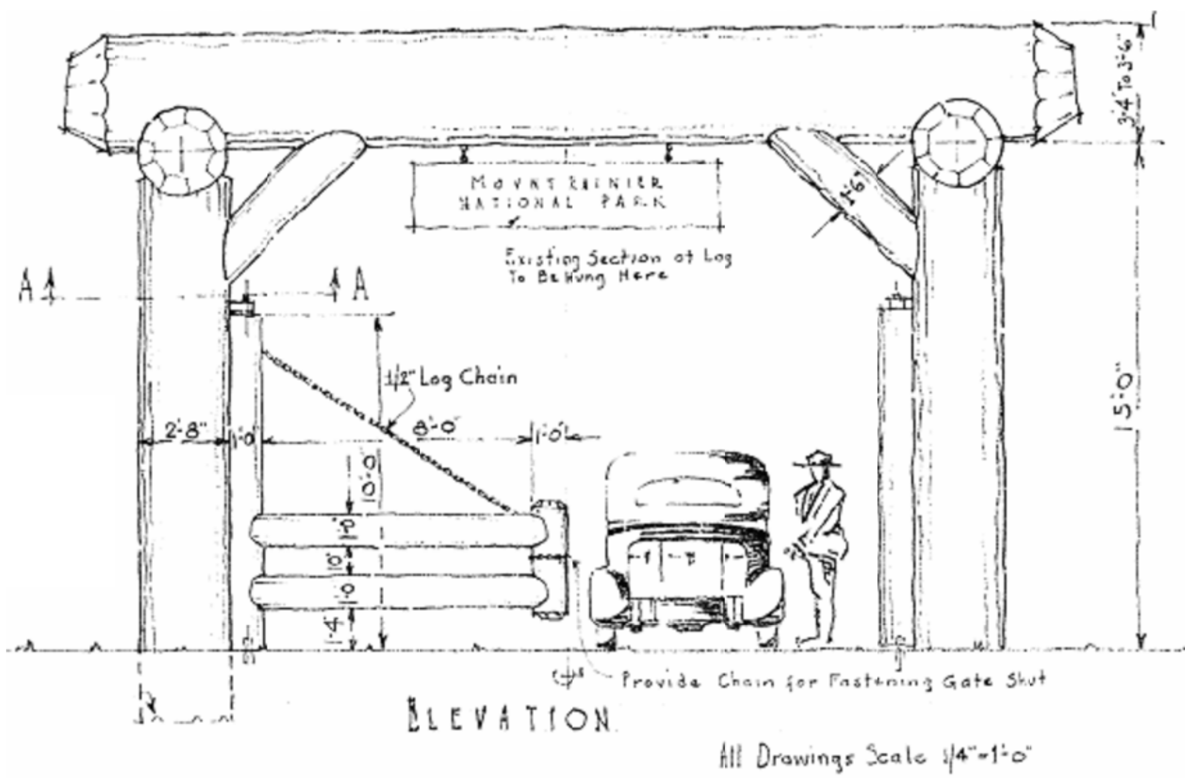


Photo 40: Historic Photograph of Carbon River Entrance Arch under Construction c. 1933 (NPS 2006a: 48)

<u>CCC Garage</u>
The building, located in the maintenance area, has lap siding, cedar shingles, stud walls and rafters, a poured foundation, and gravel floor. Blue prints have also been found. It was listed on the National Register of Historic Places as part of a multiple property nomination in 1991.

Photo 41: Historic CCC Garage

13. Visitor Experience

a. Visitor Use Opportunities

Park visitors participate in a wide array of recreational activities, including camping, hiking, scenic driving, mountain climbing, skiing, snowshoeing, and walks to nearby viewpoints. Traditional recreational activities in the Carbon River drainage included car camping at Ipsut Creek Campground, hiking the backcountry trails accessible from the Carbon River Road, and daily picnicking. The road provided easy access to trails leading to the Carbon Glacier.

b. Visitor Use Access Trends

Origin: Visitors come to Mount Rainier National Park from all over the United States and from other countries. According to a 1990 survey (Johnson *et al.* 1991), the majority of park visitors were from Washington State (59 percent). Others were from California (5 percent), Oregon (3 percent), and other states (30 percent), with about 3 percent from foreign countries. The 2000 Visitor Use Survey (Simmons *et al.* 2001) similarly found that 60 percent were from Washington State, 5 percent from California, 3 percent from Oregon, with a higher percentage (6 percent) from foreign countries.

Access/Facilities: There are five primary entrances to the park, including the Nisqually (southwest) – where approximately 54 percent of park visitors enter, Carbon River (13 percent of visitors)/Mowich Lake (13 percent of visitors) (northwest), Highway 410 (northeast)/Highway 410 (east) (26 percent of visitors) and Stevens Canyon (Highway 123/southeast) (16 percent of visitors) (Simmons *et al.* 2001). Developed areas are located throughout the park at Nisqually Entrance, Longmire, Paradise, Carbon River, Mowich Lake, Ohanapecosh, Sunrise and White River. Minor developed areas are located at Reflection Lakes, Box Canyon, Tipsoo Lake, and Grove of the Patriarchs, among others.

Visitation: Located an hour and a half from metropolitan Puget Sound, Mount Rainier is not only within easy access of over 2 million people, it is also one of the most popular visitor attractions in the Pacific Northwest. About 80 percent of visitor use occurs between May and October (Johnson *et al.* 1990). In 2000, there were 1,970,406 visits and 1,701,153 visits in 2009. The number of visitors to the park has varied little over the last 14 years. Visitation in the early 1990s was 2.1 to 2.3 million people. Visitation reached a record year in 1997 at 2,437,332 people.

Visitation is highly dependent on regional weather conditions. Visitors are drawn to the park from the surrounding region when the weather is clear and the mountain is visible, particularly on weekends. Visitation figures may also be affected by other external factors, such as road construction or flood damage on major access routes, or may vary due to changes in methods of counting visitors.

Between the years of 1983 and 1993, visitation in the Carbon River area ranged from a low of 30,338 visitors in 1990 to a high of 314,164 visitors in 1991 (Supt. Annual Reports, 1983-94). Visits in 1995 and 1996 were 214,112 and 134, 707 respectively. The decline in 1996 was most likely from the closure of the Carbon River Road at the park entrance station. Visitation in 2006 was 98,888, 2007 was 109, 283, 2008 was 58,531 and 2009 was 44,245. In 2008 a correction was made to the Carbon River area visitation statistics to avoid counting people that turnaround and left. Even acknowledging that, it is clear that there has been a downward trend in visitation since 1996.

General Management Planning: Only a short time after the completion of the 1985 FLHP project, a flood destroyed a small segment of the road east of Chenuis Creek. Repairs to 0.284 miles of the road were performed in 1987 (Flood Damage Repair 1987, Denver Etic Drawing # 41936). Again in 1990, significant flood damage occurred during a November storm in which fourteen inches of rain fell in just five days. This flood destroyed a turnout at Chenuis Falls and was rebuilt by the park as an expanded turnout retained by riprap, to accommodate a picnic area (Catton 1996, 569). Flood events continued throughout the 1990s, with the most devastating damage occurring in the spring of 1996 with a 100-year flood. During this event, floodwaters destroyed a dike near Falls Creek and washed out the picnic area. Furthermore, a

1,350-feet-long segment of the road was damaged, with a six to ten foot wide channel cut along the roadway. The damage was estimated to cost at least $500,000 to repair (Purpose and Need for Carbon River Road Repairs-1998). Due to the amount of damage sustained, the park was forced to close the road to vehicular traffic until funds could be appropriated for its repair, a period of approximately two years (The Seattle Times, April 7, 1996). The extensive damage caused by the 1996 flood and the history of flood events on the Carbon River Road motivated the NPS to request the Federal Highway Administration (FHWA) to complete a hydraulics study. The study, completed in 1997, indicated that the historic and contemporary flood damage to the road was random in time and location, with no apparent trends. The study concluded that the annual cost to the park of keeping the road open would be $30,000. While the hydraulics report was completed in February 1997, the decision to reconstruct the Carbon River Road was not made until after the new draft park General Management Plan (GMP) had been released for public review in March 1998. The GMP identified three potential management strategies for the road:

1. Reconstructing the road for private vehicle access to allow for pre-flood recreational uses and management;
2. Reconstructing the road to a lesser standard and allowing only a visitor transportation shuttle system, maintenance, foot and bicycle access; and
3. Decommissioning the road and restoring the area back to wilderness with hiking trails" (Purpose and Need for Carbon River Road Repairs-1998).

GMP comments clearly stated that the public preferred to have the Carbon River Road repaired to its pre-flood condition and be open to private vehicular traffic. As a result, Alternative B—Carbon River Road Reconstruction was selected. This called for the repair of the road to occur within the existing alignment and for the road to be restored to "pre-existing grade, condition and character" (Purpose and Need for Carbon River Road Repairs-1998). Records indicated at least 11 different flood events had damaged the road between 1924 and 1996, costing $1.3 to $1.6 million to repairing the Carbon River Road. By 1998, funds were allotted from the Emergency Relief from the Federally Owned (ERFO) Road Program (Purpose and Need for Carbon River Road Repairs-1998) and repair work was completed in February 1999. Just five weeks later, another flood destroyed a portion of the road (The Seattle Times, February 20, 1999). This time, park staff performed the repairs, and by April the road had been reopened as a one-lane width through the damaged area between Falls and Ranger Creeks (The Seattle Times, April 13, 1999). Today, this segment of the road remains narrower than the rest of the five miles of the road. (NPS 2006a:60-61)

c. Use of the Carbon River Area

Traditional recreational activities in the Carbon River area include hiking, picnicking, backpacking, and bicycling the often closed Carbon River Road, camping, and climber access to the upper mountain. Some fishing occurs within these waters as well. When the road was open the Carbon Glacier was one of the most accessible in the park and has the lowest terminus of any of Mount Rainier's glaciers (having retreated only about 1.6 miles since the last measurements were obtained in the early 1990s) (Nylan 2001).

Trails/Access

Several trails exist in the Carbon River/Ipsut Falls Campground area.

Carbon River Rainforest Loop Trail (0.3 miles): This trail tread is constructed of nearly 40 percent split-cedar boardwalks or bridges (approximately 2,640 square feet), and an on-ground trail (approximately 4,340 square feet) where elevated above normal water levels. The total disturbed area consists of approximately 0.16 acre, with the typical tread width three feet and the typical bridge width four feet. Interpretive signs along the trail explain the ecology of the area. The trail winds through an old growth forest wetland near the Carbon River Entrance to the park. A short (137 feet) section (stops 5-8 on the current nature trail) is located on land owned by the U.S. Forest Service (White River District, Mount Baker-Snoqualmie National Forest).

Green Lake Trail (1.8 miles): This trail begins where Ranger Creek intersects the Carbon River Road and extends to Green Lake, cirque.

Chenuis Falls trail (0.2 miles): This trail begins at the Chenuis Falls picnic area and extends to Chenuis Falls.

Northern Loop Trail (16.8 miles): The Northern Loop Trail is an historic routing of the Wonderland Trail that used to take the Wonderland Trail through Spray Park instead of Ipsut Pass.

Wonderland Trail (93 miles): The Wonderland Trail circumnavigates Mount Rainier. The trail follows much of the proposed route of the originally proposed "round-the-mountain" road. Where roadway was built, the trail was usually later rerouted away from the road. First blazed during a series of outings sponsored by The Mountaineers, the trail was established by 1915, when a large outing followed the entire route around the mountain, just below the glacier line. The trail was later incorporated into NPS master plans. The Wonderland Trail is, in fact, many trails. Most trails in the park intersect the Wonderland Trail, and most backcountry structures are accessible along its route or within short hikes off-route. The trail is a very wide trail and as an historic trail is identified as a corridor ten feet wide. It was originally built for stock use, much of it constructed or improved by the Civilian Conservation Corps (CCC) during the 1930s. Great attention to detail with a nearly excessive number of water crossing features and scenic views were incorporated into its design. As noted in the NHLD National Register nomination: "The overall experience of the trail, however, retains most of its character; and most of the trail retains the basic locations that still bring it to a large number of glacier snouts, flower fields, scenic parks, waterfalls, canyons, and other scenic attractions of the park."

A**ccess to the Carbon Glacier (3.5 miles from Ipsut Creek Campground):** Access to the Carbon Glacier is via the Wonderland Trail past Ipsut Creek Campground, across a suspension bridge onto the north side of the Carbon River Valley. The glacier is located alongside the trail as it heads up past the Dick Creek backcountry camp. The Carbon glacier is the lowest elevation glacier in the continental U.S. Dayhiking access to it has been a highlight of the visitor experience in the Carbon River area since construction of the Carbon River Road.

At the parking area beyond Ipsut Creek Campground, is the Wonderland Trailhead giving access to the Wonderland Trail (including the Carbon Glacier); the Ipsut Falls Trail, located just over 0.25 miles on the Wonderland Trail toward Mowich Lake; and access to the Northern Loop Trail.

Frontcountry Camping

Ipsut Creek Campground is a 22-site campground with two group sites and a relatively small amphitheater. Two bulletin boards and a site selection / bulletin board also exist. There are two restrooms. Although the campground has historically been open year round (depending on snow levels), traditionally the potable water supply for the public campground has been in operation only during the summer months, usually undergoing winterization in mid-September. Camping is first-come, first-served.

Picnicking

A small picnic area, with approximately five picnic tables is located in the campground. Several tables are also available at the Carbon River Entrance and at Chenuis.

Backcountry Camping

Backcountry campsites are available relatively close to Ipsut Creek Campground - at Carbon River (just before the swinging suspension bridge) and at Dick Creek (just after the Carbon glacier terminus). In addition, backcountry camping is permitted in cross-country areas located 0.25 mile from the nearest trail. Additional designated backcountry campsites are located toward Mowich Lake and throughout the park.

Visitor Information

The Carbon River Ranger Station provides limited visitor information during the summer months. Information is also provided via bulletin boards at the Carbon River Entrance, in the campground (2), and at Wonderland Trailhead, as well as through trail signs.

14. Wilderness

In 1988, Congress designated approximately 97 percent (228,480 acres) of Mount Rainier National Park as wilderness. Park wilderness includes a wide array of undisturbed lands encompassing ancient rainforest, pristine rivers and brilliant subalpine meadows. Park wilderness values include natural, ecological, geological, cultural, scenic, scientific and recreational opportunities. Natural quiet and natural darkness are also considered wilderness values. The Washington National Parks Wilderness Act (1989) established a wilderness boundary that generally begins two hundred feet from the center line of paved roads and developed areas and one hundred feet from the center line of unpaved roads, including the Carbon River Road. Designated wilderness is located on the southern edge of the Carbon River Road from park entrance to west of Chenuis and then on both sides of the road east of Chenuis, with the boundary beginning 100 feet from the centerline of the road.

Non-wilderness developed areas are present throughout the park and include visitor facilities such as visitor centers, campgrounds, and picnic areas. They also include overlooks and trailheads along major roads. Most utility sites, such as water system intakes and other small facilities are also noted in the wilderness designation and associated Wilderness Management Plan (1989) as continued acceptable uses. In the Carbon River area, designated wilderness is located on the southern edge of the Carbon River Road from park entrance to west of Chenuis and then on both sides of the road east of Chenuis, with the boundary beginning 100 feet from the (unmarked) centerline of the road.

Park wilderness offers a wide array of scenic, natural and ecological values. Park wilderness encompasses the full extent of the diversity of the Mount Rainier landscape of glacial ice and snow, old growth forests, river headwaters, streams and waterfalls, abundant wetlands, summertime flower-filled subalpine meadows, and rock scree slopes with perennial snow patches. Park wilderness is and has been an ongoing object of scientific study. As the highest active Cascade volcano, exhibiting near-record snowfall and the greatest single-peak glacial system in the continental United States, Mount Rainier offers outstanding opportunities to understand vegetation, wildlife, fire ecology, catastrophic geologic events – including lahars, glacial outburst floods and volcanic eruptions – snow, ice and other water resources. These resources afford excellent opportunities to study ecosystem structure, function, processes and components across the breadth of this volcanic landscape.

Park wilderness cultural resources are also outstanding. As a premier National Historic Landmark District (NHLD), the best example of implemented NPS planning in the early twentieth century, the park offers an outstanding opportunity to understand park related human impacts. In addition, it contains an unparalleled collection of rustic architecture accompanied by naturalistic landscape architecture. The Wonderland and Northern Loop trails are included as part of the NHLD. The park's human history is spread over nearly 8,500 years and offers glimpses into the distribution of people across a high mountain landscape over centuries of ecological changes in climate and topography.

Park wilderness also offers a range of recreational experiences – including camping, hiking, mountain climbing, backpacking, photography, picnicking, and a host of winter activities, including snowshoeing, cross-country skiing, sliding and snowboarding.

Most wilderness use occurs from June through September, especially on weekends and sunny days. During other months and many summer weekdays (except during the peak season), few people are encountered in the vast majority of the wilderness area (NPS 2002). There remain, despite heavy seasonal visitation, outstanding opportunities for solitude.

In addition to the GMP zoning, the Wilderness Management Plan (WMP) (NPS 1989, as amended 1992) uses management areas to enable operational efficiency in management. WMP areas include trail, cross-country and alpine areas. The park contains 37 designated trailside camps, 41 cross-country areas, and 19 alpine areas (including 4 alpine camps); each with varying limits for overnight use (described in the 1973 Backcountry Management Plan and Environmental Assessment and 1989 WMP as amended). The 37 trailside camps contain 25 group sites and 127 individual sites. The cross-country areas have limits that specify the number of parties or the allowable number of people and vary from one to five parties (5 to 25 people in summer and12-60 people in winter). Three relatively large areas, comprising approximately 41 percent of the park remain unlimited with respect to overnight camping. The alpine areas, including Camps Muir, Schurman, Curtis and Hazard, have similar overnight limits – from two parties to 110 people. In addition, there are a number of no camping areas and zones, including any location within ¼ mile of a designated trail or road, the Butter Creek Research Natural Area, and the Paradise, Sunrise/Burroughs Mountain and Longmire areas in summer.

These limitations have allowed a large number of visitors to camp in the park, while protecting the resources they come to enjoy. Through the limits, impacts are concentrated into durable trailside and alpine camps, while dispersing use among the cross-country and alpine areas and increasing opportunities for solitude.

Wilderness Visitor Experience / Resource Impacts: According to visitor use studies, most wilderness visitors take walks or hikes (98.9 percent), but of these only eight percent camped or backpacked overnight in wilderness (Vande Kamp *et al.* 1999). The other 92 percent engaged in day use only or camped in the frontcountry. Of the total number of wilderness visitors 25.4 percent also reported staying in a developed campground (Vande Kamp *et al.* 1999). In the 2000 visitor use survey, 79 percent of visitors reported taking a hike. Of those 89 percent reported hiking near developed areas and 32 percent in wilderness (Simmons *et al.* 2001). When this data is combined with information on the length of hike (shorter than two hours, between two and four hours or more than four hours), 41 percent reported taking a hike shorter than two hours, 44 percent took a hike between two and four hours and 30 percent took a hike longer than four hours, it seems that there may be a lack of understanding about the park wilderness boundary since most hikes longer than two hours would likely have entered wilderness, except perhaps in the Paradise area.

One study (Vande Kamp *et al.* 1999) found that only about 40 percent were aware of the area's wilderness designation and that most visitors sampled (75.9 percent) expected a scenic rather than a wilderness experience (15.8 percent). When compared to the actual experience, most visitors (71 percent) had the type of trip they expected. Forty-one percent expected a wilderness trip, but had a scenic trip and 21.8 percent expected a scenic trip, but had a wilderness trip (Vande Kamp *et al.* 1999). The 1999 study also examined the types of damage to park resources by park visitors. Categories included: off-trail hiking or social trails, trash/litter, unspecified erosion, and other. Nineteen percent of visitors reported unacceptable damage. Of this percentage, most (57.5 percent) saw off-trail hiking or social trails, 20.8 percent saw trash/litter, and 9.4 percent saw unspecified erosion. Another 12.2 percent saw something else unacceptable.

Administrative improvements in wilderness include signs, patrol cabins, trail shelters, fire lookouts, toilets, approximately 37 designated camps with site markers and access trails and a system of nearly 300 miles of designated trails containing culverts, bridges, puncheon, rock and log-lining and other historic and non-historic constructed features. Over time, there have been changes in the number of wilderness camps, the number of sites (including individual and group sites), the type of toilet and its location and the location of the camps.

Human impacts in wilderness can occur from visitors traveling through or camping in sensitive areas, or from the removal or placement of waste or objects. Recreational use impacts in Wilderness have been monitored since the 1970s and in some areas, damage to natural resources has been significant. Programs such as *Leave No Trace*, train wilderness visitors to take nothing from wilderness and to leave nothing behind – including, food, waste, gear, or garbage. This program helps educate wilderness visitors to avoid the creation of tent platforms, campfires, wind blocks, shelters, and that they minimize their impact on area vegetation by staying and traveling on snow and other well-traveled or hardened surfaces as much as possible.

15. Wild and Scenic Rivers

Approximately eight miles of the Carbon River are eligible for inclusion in the national wild and scenic rivers system (NPS 2002:30), however no suitability study has yet been completed. As noted in the eligibility memo, additional designation as part of the wild and scenic rivers system would not provide additional protection because they are protected 1) because of their location in the park and 2) because of inclusion in wilderness (NPS 1990:3). While the wilderness inclusion is true of Segment 1 (from the Carbon Glacier to Ipsut Creek Campground), only a portion of Segment 2 is located in wilderness.

Table 28: Carbon River Wild and Scenic River Eligibility

Carbon River

Resource Value	Value Rating 0	1	2	3	4
Scenic				X	
Recreational				X	
Geologic			X		
Fish and Wildlife			X		
Historical			X		
Cultural	X				
Other					

As shown in Table 28: *Carbon River Wild and Scenic River Eligibility*, the initial evaluation identified the following outstandingly remarkable values for the Carbon River: scenic, recreational, geologic, fish and wildlife, and historical. Two of these values were rated "3" (scenic and recreational) and three were rated "2." Segment 1 (outside the proposed project area) from the origin at the Carbon Glacier was found eligible under the wild category. Segment 2 (within the proposed project area) beginning from Ipsut Creek Campground to the park entrance was found eligible under the scenic category.

The following information was contained within the evaluation (NPS 1990) and was true at that time.

Identification

The Carbon River is listed and evaluated in the Washington State Scenic River Assessment, September, 1988. It is also listed and discussed in River Recreation in Washington, An Initial Inventory and Assessment, May, 1986.

Evaluation

General Setting: The Carbon River originates from the Carbon Glacier, at an elevation of about 3,500 feet, and continues for about 9.5 miles, exiting the park at an elevation of about 1,750 feet. It is fed by glacier and snow melt. The river, within the park is a wide, cascading, boulder strewn river, subject to great fluctuations influenced by rainfall and temperature. Five miles of the river are paralleled by the Carbon River Entrance Road, as it enters the park and continues to Ipsut Campground. An additional 2.5 miles of road have been abandoned over the years. The majority of this abandon[ed] roadway has been reclaimed by the river. Ipsut Campground (31 sites), [is] accessible to vehicles, [and] lies on the bank of the river. The remainder of the park development at Carbon River Entrance, including the entrance station, ranger station, and maintenance area, are also located adjacent to the river. The river is crossed by a footlog at Chenuis Creek, and by a suspension bridge below the glacier on the Wonderland Trail. One backcountry camp is located adjacent to the river, 2.9 miles above Ipsut Trailhead.

Flood control structures have been placed to protect portions of the entrance road between the entrance and Ipsut Campground, and around the entrance and maintenance complex.

Eligibility Determination: [Outstandingly Remarkable] Values

- *Scenic*: Some outstanding views of Mount Rainier are available. The river passes through old growth forests, and an unusual example of inland rain forest at the park entrance.
  Value rating- 3
- *Recreational*: Hiking, camping and nature viewing are the principle recreational pursuits.
  Value rating- 3
- *Geologic*: Typical glacial stream, displaying a steep gradient, wide streambed with braided, ever-changing streams.
  Value rating- 2
- *Fish and Wildlife*: Anadramous fish inhabit the lower river, below the park boundary. There is no current evidence that these fish do or do not enter the park to spawn. Spotted owl habitat exists along the river, and spotted owls have been heard, although no pattern of their presence has been established. Typical wildlife species are found in the area.
  Value rating- 2
- *Historical*: The entrance road, abandon[ed] above Ipsut Campground provided historic access. An abandoned copper mine is located along the river, and a portion is open to the public as an interpretive device.
  Value rating- 2
- *Cultural*: No cultural sites are known to exist. However, no extensive survey of archeological or cultural sites has been conducted.
  Value rating- 0

Report of Eligibility/Ineligibility Findings
State: Washington
Park: Mount Rainier National Park
River: Carbon River

A. Length of River Within Park: 8 miles
B. Eligible Mileage within Park: 8 miles
C. Status of Adjacent segments: Downstream segment found eligible by USFS.
D. Classification: Wild and Scenic
E. Outstandingly Remarkable Values: See attached
F. Project proposals: None known
G. Inholdings A1ong River: None
H. Percentage of Watershed within Park: 20%
I. Videotape Coverage: No
J. Other Relevant Information: None

16. Park Operations

Two people work at the Carbon River Ranger Station regularly. In addition, a number of permanent and seasonal staff work in the area periodically, including law enforcement, maintenance, resources and trails personnel. Current facilities are noted in other sections, but primarily consist of a ranger station, a maintenance garage, trails storage area and visitor parking and camping facilities.

Since the 2006 flood, approximately $100,000 has been spent to create an informal hiking and bicycling trail. This trail costs approximately $10,000 to $15,000 per year to maintain.

The recently acquired Thompson property, located approximately 2.5 miles from the Carbon River Entrance and is the intended location (per the GMP) of overnight camping and other visitor facilities. The Marsh property, which is on the west side of the Thompson property is located approximately two miles from the Carbon Entrance and is currently owned by Pierce County. It is intended to become part of the park when Congress appropriates the funds to purchase it (approximately $4 million). The USFS owns approximately 600 acres of land between the park and the Thompson property. USFS will continue to manage the land but will manage it as part of the park, except for allowing hunting.

Ranger station is staffed year around. The seasonal trail crew normally operates out of here from April till November. Maintenance staff provides services during the summer months. Carbon River seasonal ranger staff generally begins work in late spring till fall. Ranger staff,(backcountry, LE , and general rangers patrol area roads, trails campgrounds in the Carbon / Mowich areas on a regular basis.

17. Socioeconomics (Local Population and Economy)

Gateway communities in the northwest corner of the park include Wilkeson and Carbonado. Located in Pierce County, Washington, both communities may be accessed from State Route 165 (Highway 410), which begins at Buckley and continues south to Mowich Lake. About four miles south of Carbonado, State Route 165 intersects the Carbon River Road. Where State Route 165 continues southeast to Mowich Lake, the Carbon River Road heads east to the entrance of the park.

From Wilkeson it is approximately 6 miles south and then east to the Carbon River Entrance. Carbonado is just about two miles south of Wilkeson, 11 miles from the Carbon River Entrance.

Carbonado

Carbonado was reported to have 495 persons in the 1990 Census of Population, increasing to 584 in 1996 and 621 in 2000. Of the 200 households which reported, 48 percent had children under 18, 68.5 percent were married couples, 21 percent were non-families and 8 percent were someone living alone age 65 years or older. Approximately 34.9 percent of the population was under 18, 2.2 percent 18-24, 29.8 percent 25-44, 20.5 percent 45-64 and 7.1 percent 65 or older. In 1990, the median age of Carbonado's residents in 1990 was 28.9 years; in 2000, it was 30 years. In 1990, the proportion of the population age 65 and over was 12.3 percent, compared to 10.5 percent for Pierce County. According to the *Town of Carbonado, Comprehensive Land Use Plan* (1995) no industrial growth is expected, and Carbonado will likely continue to attract commuters and retirees in search of a small town with a rural lifestyle and affordable housing.

Carbonado's economy historically developed around coal mining and timber. As both industries declined over the years, changes in the population and economic base have shifted the town into more of a bedroom and retirement community. The town's median income in 1990 was $25,938, which was about 15% lower than the Pierce County median household income of $30, 412. In 2000, the median income for a household was $50,250, and for a family was $55,909. The per capita income for the town decreased to $16,135. The unemployment rate in 1990 approximated that of Pierce County's. In 2000, about 1.4 percent of families and 4..0 percent of the population were below the poverty line, including 2.9 percent of those under age 18 and none of those age 65 or older.

Locally, there is very little retail business, and the only establishment is the Carbonado Tavern. The largest employer is the Carbonado Historical School District which employs about 20 people. There are a modest number of residents that are self-employed, while a large number of the work force commutes to work in Puyallup, Enumclaw, Buckley, Tacoma, or the Kent Valley.

According to the *Economic Development Element* of the town's comprehensive plan, the town's goals are to promote the development of cottage industries and appropriate retail businesses that serve Carbonado residents.

Wilkeson
The population of Wilkeson was reported as 366 persons in 1990, growing to 407 persons in 1996 and decreasing to 395 people in 2000. The *Town of Wilkeson Comprehensive Land Use Plan* (1995) indicates that the population is expected to reach 838 persons by the year 2012. The median age of the Wilkeson population in 1990 was 32.9 and the proportion of the population age 65 and over was 11.9 percent. By 2000, the median age of the Wilkeson population was 35 and the proportion of the population age 65 and over was 9.4 percent. Both 1990 figures were slightly higher than the county average. Age bracketing in 2000 shows 0.4 percent under the age of 18, 10.4 percent from 18-24, 28.1 percent from 25-44, 21.8 percent from 45-64, and 9.4 percent 65 or older.

As with Carbonado, coal mining and timber were historically the main sources of income for the town. Changes in population and the economy have similarly formed Carbonado into a bedroom and retirement community and population growth is expected to be from commuters searching for a rural lifestyle.

Based on US Census data for 1990, the median household income in Wilkeson was $33,125, which is slightly higher than the Pierce County median household income of $30,412. By 2000, median income in Wilkeson had risen to $44,375. Per capita income was $17,481. The unemployment rate in 1990 in Wilkeson approximated that of Pierce County's. In 2000, two percent of families and four percent of the population had incomes below the poverty level, none of which were comprised of children under 18; however 18.2 percent of those were individuals 65 or older.

The City of Wilkeson has very modest tourism-oriented facilities and services. There are no lodging facilities, although there is a single private campground known as Sunset Lake Camp. Other businesses include a gas station, small grocery store, two taverns, and several gift shops within the town site. Unlike Carbonado, however, the economic goals of the town include actively promoting tourism opportunities throughout the community, especially in the central business district.

Chapter V: Environmental Consequences

This chapter describes the impacts of each alternative on park resources, including cumulative impacts. "Methodology" introduces key background material for the analysis presented in the "Environmental Impact Analysis" section. Similar to Chapter III: Alternatives, this chapter contains an *Impact Comparison Chart* (Table 34) to compare the differences in projected impacts among the alternatives.

A. Methodology

NEPA requires that environmental documents disclose the environmental impacts of the proposed federal action, reasonable alternatives to that action, and any adverse environmental effects () that cannot be avoided should the proposed action be implemented. (In this document, *effects* and *impacts* are used interchangeably.) This section analyzes the environmental impacts of project alternatives on affected park resources. These analyses provide the basis for comparing the effects of the alternatives. NEPA requires consideration of context, intensity and duration of potential impacts, indirect impacts, cumulative impacts, and measures to mitigate impacts. In addition to determining the environmental consequences of the preferred and other alternatives, *NPS Management Policie*s (NPS 2006) and Director's Order-12, *Conservation Planning, Environmental Impact Analysis, and Decision-making* (NPS 2000) require analysis of potential effects to determine if actions would impair park resources. The basis for understanding the analysis within this chapter is provided below.

1. Definitions

Context of Impact: The context is the setting within which impacts are analyzed – such as the project area or region, or for cultural resources – the project area or area of potential effects.

Type of Impact: The type of impact is a measure of whether the action will improve or harm the resource and whether that harm would occur immediately or at some later point in time.

- **Beneficial**: The impact would improve the resource or the quality or quantity of the resource.
- **Adverse**: The impact would harm or deplete the resource or its quality or quantity.
- **Direct**: The impact would be caused by and occur at the same time and place as the action.
- **Indirect**: The impact would be caused by the action, but would occur later in time, at another place, or to another resource.

Duration of Impact: Duration is a measure of the time period over which the effects of an impact persist and may be short-term (quickly reversible and associated with a specific event such as construction during project implementation); or long-term (reversible over a much longer period, or may occur continuously based on normal activity).

Area of Impact: Impacts may be localized, detectable only in the vicinity of the activity, or widespread, detectable on a landscape or regional scale.

Intensity of Impact: In this document, the intensity of impacts is measured using the following scale: negligible, minor, moderate, and major. These are defined collectively for the resource impact topics below. In addition, determinations of effect for actions that would affect threatened or endangered species comply with Section 7 of the Endangered Species Act (no effect; may affect, not likely to adversely affect; and may affect, likely to adversely affect), while determinations of effect for cultural resources comply with Section 106 of the National Historic Preservation Act (no historic properties affected, no adverse effect, and adverse effect).

Impact Mitigation: Impacts have been assessed under the assumption that proposed measures to minimize or mitigate the impact would be implemented. The following terms identify the way to change the intensity of impacts or to change the resource condition following impacts. Project actions can:

- **Avoid** conducting management activities in an area or at a time that affects the resource;
- **Minimize** the type, duration or intensity of the impact to an affected resource; and
- **Mitigate** the impact by:
  - **Repairing** localized damage to the affected resource immediately after an adverse impact;
  - **Rehabilitating** an affected resource with a combination of additional management activities;
  - **Compensating for** a major long-term adverse direct impact through additional strategies designed to improve an affected resource to the degree practicable.

2. Impact Analysis

Except where noted within the environmental impact analysis sections (and where noted associated with special status species and cultural resources), the following definitions are the same for all resource impact topics.

Context of Impact*:* Changes were considered within the Carbon River Valley in Mount Rainier National Park or regionally (applicable to air quality, special status species, cumulative impacts etc.).

Duration of Impact*: Short-term:* These impacts are often quickly reversible and associated with a specific event such as construction during project implementation, occurring for a period of less than one to five years. *Long-term:* These impacts are reversible over a much longer period, may occur continuously based on normal activity, or may occur for more than five years.

Methodology*:* Most impacts were assessed qualitatively, based on the best professional expertise of Mount Rainier National Park and other NPS and FHWA staff. Some impacts, where quantities were known were assessed quantitatively and projected across the alternatives.

Type of Impact*:* Beneficial impacts would improve the quality of the resource, while adverse impacts would harm or change the quality of the resource.

Intensity of Impact for Resource Analyses
Note: Special Status Species and Cultural Resources impact determinations are formally determined under the Endangered Species Act (Section 7) and the National Historic Preservation Act (Section 106), respectively.

- **Negligible**: Measurable or anticipated degree of change would not be detectable or would be only slightly detectable. Localized or at the lowest level of detection.
- **Minor**: Measurable or anticipated degree of change would have a slight effect, causing a slightly noticeable change of approximately less than 20 percent compared to existing conditions, often localized.
- **Moderate**: Measurable or anticipated degree of change is readily apparent and appreciable and would be noticed by most people, with a change likely to be between 21 and 50 percent compared to existing conditions, may be localized or widespread.
- **Major**: Measurable or anticipated degree of change would be substantial, causing a highly noticeable change of approximately greater than 50 percent compared to existing conditions, often widespread.

Note: Cultural resources impacts are also initially characterized as noted above, however the conclusion follows the format below, and makes a formal determination of effect under Section 106 of the National Historic Preservation Act. In accordance with National Park Service Management Policies (2006), the analysis in this Environmental Assessment fulfills the responsibilities of the National Park Service under Section 106 of the National Historic Preservation Act.

Intensity of Impact for Special Status Species

- **No Effect**: The project (or action) is located outside suitable habitat and there would be no disturbance or other direct or indirect impacts on the species. The action will not affect the listed species or its designated critical habitat (USFWS 1998).
- **May Affect, Not Likely to Adversely Affect**: The project (or action) occurs in suitable habitat or results in indirect impacts on the species, but the effect on the species is likely to be entirely beneficial, discountable, or insignificant. The action may pose effects on listed species or designated critical habitat but given circumstances or mitigation conditions, the effects may be discounted, insignificant, or completely beneficial. Insignificant effects would not result in take. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not 1) be able to meaningfully measure, detect, or evaluate insignificant effects or 2) expect discountable effects to occur (USFWS 1998).
- **May Affect, Likely to Adversely Affect:** The project (or action) would have an adverse effect on a listed species as a result of direct, indirect, interrelated, or interdependent actions. An adverse effect on a listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions and the effect is not: discountable, insignificant, or beneficial (USFWS 1998).

Intensity of Impact for Cultural Resources

- **No effect**: There are no historic properties in the Area of Potential Effect (APE); or, there are historic properties in the APE, but the undertaking will have no impact on them.
- **No adverse effect:** There will be an effect on the historic property by the undertaking, but the effect does not meet the criteria in 36 CFR Part 800.5(a)(1) and will not alter characteristics that make it eligible for listing on the National Register. The undertaking is modified or conditions are imposed to avoid or minimize adverse effects. This category of effects is encumbered with effects that may be considered beneficial under NEPA, such as restoration, stabilization,

rehabilitation, and preservation projects. Under the terms of the 1999 PA, data recovery can mitigate affect to archaeological properties that are eligible for listing on the NR under criterion d. However, some archaeological sites are eligible as traditional cultural places under criterion A, and such mitigation may not be sufficient or appropriate.

- **Adverse effect:** The undertaking will alter, directly or indirectly, the characteristics of the property making it eligible for listing on the National Register. An adverse effect may be resolved in accordance with the Stipulation VIII of 1999 Programmatic Agreement, or by developing a memorandum or program agreement in consultation with the SHPO, ACHP, American Indian tribes, other consulting parties, and the public to avoid, minimize, or mitigate the adverse effects (36 CFR Part 800.6(a)).
- **Significant Impact**: An impact to a National Register historic property would be considered significant when an adverse effect cannot be resolved by agreement among SHPO, ACHP, American Indian tribes, other consulting and interested parties, and the public. The impact will diminish the integrity of location, design, setting, materials, workmanship, feeling or association characteristics that make the historic property eligible for inclusion in the National Register Historic Places. The resolution must be documented in a memorandum or programmatic agreement or the FONSI.

3. Cumulative Impact Analysis

The Council on Environmental Quality (CEQ) describes a cumulative impact as follows:

> A "Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (Regulation 1508.7).

The cumulative projects addressed in this analysis include past and present actions, as well as any planning or development activity currently being implemented or planned for implementation in the reasonably foreseeable future. Cumulative actions are evaluated in conjunction with the impacts of an alternative to determine if they have any additive effects on a particular resource. Because most of the cumulative projects are in the early planning stages, the evaluation of cumulative impacts was based on a general description of the project. These projects are included in the cumulative effects analysis presented in this chapter. (See Appendix 6: *Cumulative Impacts Project List*.)

4. Impairment

In addition to determining the environmental consequences of the preferred and other alternatives, NPS *Management Policies* (NPS 2006) and Director's Order-12 (NPS 2001) require a determination of whether proposed actions would impair park resources. Impairment is a term from the 1916 act creating the NPS (the Organic Act) and is defined as an impact that would harm park resource or values

- *necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park, or*
- *key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or*
- *identified in the park's general management plan or other relevant NPS planning documents as being of significance.*

Whether an impact would result in impairment depends on the particular resource affected; the severity, duration and timing of the impact; and the direct, indirect and cumulative effects of the impact. If an action is determined to result in impairment, the action may not be approved.

In this document, determinations of impairment are provided in the conclusion section under each applicable natural and cultural resources impact topic for each alternative. Impairment determinations, however, are not made for the following resource categories (if used) land use, health and safety, visitor use, maintenance, operations, socioeconomic resources and other non-natural or cultural resources topics. A summary of the analysis related to the preferred alternative is also provided in Appendix 10.

The following excerpts from NPS *Management Policies* (NPS 2006) define impairment and highlight the difference between an impact and impairment.

Section 1.4.3 The NPS Obligation to Conserve and Provide for Enjoyment of Park Resources and Values

> The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. This mandate is independent of the separate prohibition on impairment and applies all the time with respect to all park resources and values, even when there is no risk that any park resources or values may be impaired. NPS managers must always seek ways to avoid, or to minimize to the greatest extent practicable, adverse impacts on park resources and values. The laws do give the Service the management discretion, however, to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, so long as the impact does not constitute impairment of the affected resources and values.
>
> The fundamental purpose of all parks also includes providing for the enjoyment of park resources and values by the people of the United States. The enjoyment that is contemplated by the statute is broad; it is the enjoyment of all the people of the United States and includes enjoyment both by people who visit parks and by those who appreciate them from afar. It also includes deriving benefit (including scientific knowledge) and inspiration from parks, as well as other forms of enjoyment and inspiration. Congress, recognizing that the enjoyment by future generations of the national parks can be ensured only if the superb quality of park resources and values is left unimpaired, has provided that when there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is to be predominant. This is how courts have consistently interpreted the Organic Act.

Section 1.4.4 The Prohibition on Impairment of Park Resources and Values

> While Congress has given the Service the management discretion to allow impacts within parks, that discretion is limited by the statutory requirement (generally enforceable by the federal courts) that the Park Service must leave park resources and values unimpaired unless a particular law directly and specifically provides otherwise. This, the cornerstone of the Organic Act, establishes the primary responsibility of the National Park Service. It ensures that park resources and values will continue to exist in a condition that will allow the American people to have present and future opportunities for enjoyment of them.
>
> The impairment of park resources and values may not be allowed by the Service unless directly and specifically provided for by legislation or by the proclamation establishing the park. The relevant legislation or proclamation must provide explicitly (not by implication or inference) for the activity, in terms that keep the Service from having the authority to manage the activity so as to avoid the impairment.

Section 1.4.5 What Constitutes Impairment of Park Resources and Values

> The impairment that is prohibited by the Organic Act and the General Authorities Act is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts.

An impact to any park resource or value may, but does not necessarily, constitute an impairment. An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park, or
- key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or
- identified in the park's general management plan or other relevant NPS planning documents as being of significance.

An impact would be less likely to constitute an impairment if it is an unavoidable result of an action necessary to preserve or restore the integrity of park resources or values and it cannot be further mitigated. An impact that may, but would not necessarily, lead to impairment may result from visitor activities; NPS administrative activities; or activities undertaken by concessioners, contractors, and others operating in the park. Impairment may also result from sources or activities outside the park.

Section 1.4.6 What Constitutes Park Resources and Values

The "park resources and values" that are subject to the no-impairment standard include: the park's scenery, natural and historic objects, and wildlife, and the processes and conditions that sustain them, including, to the extent present in the park: the ecological, biological, and physical processes that created the park and continue to act upon it; scenic features; natural visibility, both in daytime and at night; natural landscapes; natural soundscapes and smells; water and air resources; soils; geological resources; paleontological resources; archeological resources; cultural landscapes; ethnographic resources; historic and prehistoric sites, structures, and objects; museum collections; and native plants and animals; appropriate opportunities to experience enjoyment of the above resources, to the extent that can be done without impairing them; the park's role in contributing to the national dignity, the high public value and integrity, and the superlative environmental quality of the national park system, and the benefit and inspiration provided to the American people by the national park system; and any additional attributes encompassed by the specific values and purposes for which the park was established.

Section 1.4.7 Decision-making Requirements to Identify and Avoid Impairments

Before approving a proposed action that could lead to an impairment of park resources and values, an NPS decision-maker must consider the impacts of the proposed action and determine, in writing, that the activity will not lead to an impairment of park resources and values. If there would be an impairment, the action must not be approved.

B. Environmental Impact Analysis

1. Air Quality Impacts

Alternative 1 Impacts

Access to / Use of the Area: In this alternative, visitors would continue to park at the entrance and along the road up to the Carbon River Maintenance Area, therefore ongoing impacts to air quality would continue from visitor travel to the Carbon River area. As during other periods of closed Carbon River Road access to Ipsut Creek Campground, this travel would continue to be reduced from historic levels. Although it is likely that visitors are being displaced to other areas of the park, there are no data regarding where they are being displaced to or how much additional travel that displacement involves. Up to 120 cars have been observed in official and non-sanctioned parking areas at the entrance since the flooding in 2006. This amount is reduced from a total of approximately 225 parking spaces (entrance; Old Mine, Green Lake and Chenuis trailheads; Ipsut Creek Trailhead; Ipsut Creek Campground; and roadway overflow parking near Ipsut) formerly used when the road was open. Because visitors can now only drive to the entrance, rather than along the five miles of the road to and from the campground and Ipsut Creek

Trailhead, it is likely that long-term air quality impacts have been reduced since the 2006 flood closure of the road.

Air quality impacts would continue to be long-term, localized and minor in the vicinity of the Carbon River area and widespread and minor from potential visitor displacement to other park areas, especially if visitors return to these areas after first arriving at Carbon River. These adverse impacts would be combined with ongoing minor localized beneficial effects from decreased vehicle use. Overall there would continue to be decreases in both exhaust emissions and in airborne particulates because of less dust released from travel over the shorter open paved portion of roadway. There would also continue to be long-term beneficial impacts from reduced road grading and other impacts associated with maintaining the longer unpaved roadway, such as from periodic road rehabilitation (including maintaining road side ditches). Based on use of the road since its closure, there would continue to be negligible long-term localized impacts from the ongoing use of all-terrain vehicles to transport supplies and equipment and to patrol the area because of the limited number of trips per day. Negligible long-term adverse impacts would also continue to occur from bicycles causing dust to rise as they traversed the trail.

Trail Construction: With potential annual reconstruction of the trail, there would be ongoing negligible to minor adverse impacts on air quality from repeatedly fixing some sections of trail after they were damaged during annual winter and spring flooding or larger events. Short-term negligible to minor adverse impacts could also occur from excavation associated with replacement of existing intermittent or perennial stream culverts with fish passage culverts. Because the trail would continue to be constructed of mostly native soil and rock, there would be negligible to minor impacts from use and transport of these materials. If imported materials were used over time, there could be additional negligible to minor adverse effects from use and transport of these materials.

Facility Construction: There would be negligible to minor adverse effects from transport and reconstruction of the Ipsut Creek Patrol Cabin at the entrance.

Facility Removal: Removal of entrance facilities would have short-term minor to moderate localized adverse effects as building foundations were excavated, removed and used as unpaved parking areas.

Erosion Protection Measures: Construction of erosion protection measures, including logjams in the riverbed near the entrance and maintenance area would require use of native materials from the vicinity and/or imported materials (rock and wood). Dislodging these as native materials or transporting these as imported material would result in short-term negligible to minor localized adverse impacts. Construction of the logjams would also have localized minor short-term impacts on air quality from emissions.

Restoration: Passive restoration of 14-16 feet of the remaining roadway (from the Old Mine Trailhead to Ipsut Creek Campground) and removal of physical features of the road and obsolete infrastructure over time would have long-term beneficial effects from conversion of denuded and/or recovering areas to vegetated areas.

Impacts from Elements Common to Alternatives 2-5

Parking / Access to the Area: Impacts would be similar to Alternative 1; however, because the road would be open to the Old Mine Trailhead, instead of the maintenance area, there would be additional exhaust emissions from vehicle travel to the turnaround (sometimes for repeated trips to pick-up and drop-off passengers), a localized long-term minor adverse impact on air quality.

Facility Construction: There would be localized negligible to minor adverse impacts from constructing the vehicle turnaround and limited parking at the Old Mine Trailhead, from reconstructing the entrance arch, from adding a fence around the weather station, radio tower/shed and eventually from relocating the historic CCC garage to the boundary expansion lands. These impacts would be associated with vehicle travel, excavation and use of materials and equipment (particulate and exhaust emissions).

Facility Removal: Removal of entrance and maintenance area facilities would result in ground disturbance, including minor particulate and exhaust emissions. Removal of obsolete infrastructure from Ipsut Creek Campground and along the road would require numerous trips via all-terrain vehicle and/or helicopters, causing additional negligible to minor localized emissions.

Erosion Protection Measures: Impacts would be the same as in Alternative 1 plus there would be negligible to minor impacts from constructing up to three grade control structures on Ranger Creek and an unnamed tributary near Chenuis prior to and from removal of the large culverts in these areas.

Road, Trail and Erosion Protection Measures Construction: The use of helicopters, excavators, chainsaws, and other motorized equipment would introduce increased air pollutants and greenhouse gases in the project area over the course of approximately four work seasons. Project work would be conducted during the snow-free season (generally from April through October or November). Air pollutants and greenhouse gases would be emitted associated with road and trail construction, as well as from construction of bank erosion protection structures and helicopter use. Overall, the duration of helicopter use over the approximately four years of project implementation would be brief, and is estimated as multiple flights at each site for a period of two to three days.

Alternative 2 Impacts

Access to / Use of the Area: Most actions and impacts associated with access to the area would be the same as *Impacts from Elements Common to Alternatives 2-5*. These would include continuation of long-term minor impacts from travel to the area and negligible adverse impacts from use of the trail by hikers and bicyclists and administrative all-terrain vehicles. In addition, because the trail would be improved (and therefore suitable for more people) in Alternative 2, it would likely draw a greater number of visitors, an indirect adverse effect. As a result, impacts attributed to use of the trail and travel to the area could increase slightly, but would remain minor.

Trail Construction: In addition to actions and *Impacts from Elements Common to Alternatives 2-5*, there would be short-term localized minor to moderate adverse impacts on air quality from importation or use of native materials for trail construction, including from new culverts, gravel, wood, steel I-beams and other materials. Replacing the informal, narrow trail in Alternative 1 would require additional trail width, fill and construction materials. Approximately 500 cubic yards of fill would be procured from either the vicinity of the trail or from outside the park. It would be used to construct an estimated 900 feet of turnpike trail and 1,200 feet of trail underlain with gabion mattress along with gabion bridge abutments for approximately 10 trail bridges, and for other areas needing fill. Use and transport (if needed) of this fill would result in negligible to minor localized impacts to air quality from particulate and exhaust emissions.

Facility Construction: Negligible to minor short-term adverse impacts would occur from transport and reconstruction of the Ipsut Creek Patrol Cabin at the campground parking or Ipsut Trailhead parking area and from construction of a small visitor contact station at the entrance. In addition, there would be minor localized adverse impacts from constructing three group sites in the former Ipsut Creek campground parking or Ipsut Trailhead parking area.

Facility Removal: In addition to actions and *Impacts from Elements Common to Alternatives 2-5*, if, over the long-term, the Ipsut Creek road bridge becomes obsolete for public trail use or if it further impedes hydrological conditions, it would be removed. If this occurs, actions and impacts would likely be similar to Alternative 5, with saw-cutting and jack-hammering the bridge into loads for transport by all-terrain vehicle trailer or helicopter, a short-term minor to moderate adverse impact.

Erosion Protection Measures: In addition to *Impacts from Elements Common to Alternatives 2-5* there would be additional short-term minor to moderate localized adverse impacts from construction of road humps, log cribs and a buried groin.

Construction of the series of 5-9 grade control humps located along the intact section of Carbon River Road between the entrance and the Old Mine Trailhead and another 15 along other parts of the trail / road would result in additional exhaust emissions during construction and release of particulates during construction from the movement of native soil and rock and/or logs or from the transport of these if imported from outside the park. Similarly, there would be the same kinds of impacts (exhaust and particulate emissions) from construction of approximately 29 span log drops in the Falls Creek channel and up to seven log cribs and one buried groin structure at various points along the road. These proposed structures, which vary from 50 to nearly 400 feet long would require excavation and fill with river rock and logs to retain the road / trail. Additional impacts could occur from procuring logs from the logjam at Ipsut Creek Bridge for erosion protection measures. Overall impacts would be localized, short-term and minor.

Restoration: There would be beneficial effects from the reestablishment of native plants from the removal / restoration of approximately 15 individual and one group campsites and from restoration of the Chenuis and Green Lake Trailhead parking areas, depending on how quickly native vegetation returned. Over time, without maintenance, there would be additional passive restoration of the Carbon River Road corridor, especially where the river continued to effect changes in the road, contributing to additional beneficial effects on air quality.

Alternative 3 Impacts

Access to / Use of the Area: In addition to impacts similar to Alternative 1 and the same as *Elements Common to Alternatives 2-5*, there would be additional exhaust emissions and release of particulates from allowing public vehicle travel over the unpaved road to the Chenuis turnaround, a long-term localized minor to moderate adverse impact on air quality. Ongoing negligible adverse impacts would continue from use of the road for hiking and bicycling. Because the road would be open to Chenuis, thereby making more Carbon River area visitor experiences possible, more visitors would likely be drawn to the Carbon River area. Impacts would likely be smaller than, but similar to, those that occurred during the times the road was open over the past 80 years. Fewer impacts would be expected because of the continued closure of Ipsut Creek Campground to drive-in camping and because of the continued closure of the remaining portion of the road.

Road Construction: In addition to actions and *Impacts from Elements Common to Alternatives 2-5*, replacing the informal, narrow trail in Alternative 1 with a new one lane road with turnouts would require reconstruction of the road through several sections of loss, including filling the gully through the Falls Creek washout area and filling another washout area at Milepost 3.5, where more than two lanes of the road are missing. This would require approximately 10,000 cubic yards of large angular rock and fill primarily procured from outside the park. Crossing of approximately nine drainages would use either large open-bottomed culverts or box culverts or another appropriate means to facilitate fish passage. As in Alternative 2, other drainage ditch culverts would be replaced as needed. Use of materials from the surrounding area and importation materials for road construction would have minor to moderate localized adverse effects on air quality from release of particulates and from exhaust emissions from vehicles and equipment.

Trail Construction: Impacts from construction of the trail from Milepost 3.6 to Milepost 5.0 would be similar to Alternative 2, short-term and negligible to minor; however there would be fewer impacts from only two trail bridges and no turnpike or gabion mattress trail sections, therefore requiring less native fill.

Facility Construction: In addition to actions and impacts from *Elements Common to Alternatives 2-5*, impacts associated with reconstruction of the Ipsut Creek Patrol Cabin at the Ipsut campground or trailhead parking area and constructing a small visitor contact station at the entrance would be the same as in Alternative 2. There would also be construction of a vehicle turnaround and reconfiguration of the parking area at Chenuis. Combined, these actions would have short-term minor to moderate adverse impacts on air quality.

Facility Removal: In addition to actions and impacts from *Elements Common to Alternatives 2-5*, there would be short-term minor adverse impacts from emissions related to the removal of Ipsut Creek Bridge. These impacts would be related to demolition of the bridge by heavy equipment and then from hauling it out in pieces, first to Chenuis via ATV and then outside the park via trucks.

Erosion Protection Measures: In addition to actions and impacts from *Elements Common to Alternatives 2-5*, impacts would be similar to Alternative 2 for construction of six of the seven erosion protection measures (no log crib would be constructed at Milepost 3.459), however only four road humps, rather than 20-24 would be constructed. Instead, greater impacts would occur from construction of an additional 2,600 feet of log crib at Falls Creek and a section of log crib at Milepost 2.995. There would also be additional impacts from constructing eight flow deflection logjams. Because the road would eventually be open to Milepost 3.6 (Chenuis), heavy equipment could be used to construct more robust erosion protection measures and its use would increase both exhaust and particulate emissions in this Alternative. Overall impacts would be localized, short-term and minor to moderate.

Restoration: There would be beneficial effects from the reestablishment of native plants from the removal / restoration of approximately 15 individual and one group campsites, depending on how quickly native vegetation returned. Beneficial and additional negligible adverse effects would occur from restoration of 1.6 miles of 10-feet of historic roadway between Chenuis and Ipsut, depending on how quickly native vegetation returned. In addition, there would be restoration of a portion of the Ipsut Creek Trailhead parking area or campground depending on whether group campsites are co-located as part of the campground or trailhead parking area, an additional beneficial effect on air quality.

Alternative 4 Impacts

In addition to actions described above under *Elements Common to Alternatives 2-5*, the following impacts would occur.

Access to / Use of the Area: In addition to impacts similar to Alternative 1 and the same as *Elements Common to Alternatives 2-5*, there would be additional exhaust emissions and release of particulates from seasonal / weekend shuttle travel on the road, a long-term minor adverse impact on air quality. If sufficient parking became available, this alternative would likely draw the greatest number of visitors, and impacts from those visitors driving to the area would rise and return to near conditions that were present when the road was open, thereby increasing access impacts from minor to moderate.

Road Construction: As in Alternative 3, replacing the informal, narrow trail in Alternative 1 with, in this case a new one lane road to Milepost 4.4 would require reconstruction of the road through several sections of loss, not only the gully in the Falls Creek washout area and at Milepost 3.5, as in Alternative 3, but also through two additional areas of road loss, including a section where the river and the road are at the same elevation up to another area where more than two lanes were lost, near Milepost 4.4. This would require approximately 8,560 cubic yards of large angular rock and fill, procured from outside the park. As in Alternative 3, crossing of approximately nine drainages would use either large open-bottomed culverts or box culverts or another appropriate means to facilitate fish passage. As in Alternative 2, other drainage ditch culverts would be replaced as needed. Use of materials from the surrounding area and importation materials for road construction would have moderate, primarily localized adverse effects on air quality from release of particulates and from exhaust emissions from vehicles and equipment.

Trail Construction: Impacts from construction of the trail from Milepost 4.4 to Milepost 5.0 would be similar to Alternatives 2 and 3, with short-term and negligible to minor impacts; however there would be fewer impacts from trail construction because there would be greater impacts from road construction.

Facility Construction: In addition to actions and impacts from *Elements Common to Alternatives 2-5*, impacts associated with reconstruction of the Ipsut Creek Patrol Cabin at the campground parking area or the Ipsut Creek trailhead parking area and constructing a small visitor contact station at the entrance would be the same as in Alternative 2, with minor to moderate adverse impacts on air quality.

Facility Removal: Actions and impacts would be the same as Alternative 3.

Erosion Protection Measures: Impacts would be similar to but greater than Alternative 3, from potential construction of one log crib that could also be constructed in conjunction with another flow deflection logjam, one road hump (rather than four) and two additional logjams and one log crib. Overall impacts would remain localized, short-term and minor to moderate.

Restoration: There would be beneficial effects from the reestablishment of native plants from the removal / restoration of approximately 10 individual and one group campsites, depending on how quickly native vegetation returned. Beneficial and additional negligible adverse effects would occur from restoration of 0.6 miles of 10-feet of historic roadway between Milepost 4.4 and Ipsut, depending on how quickly native vegetation returned.

Alternative 5 Impacts

In addition to actions described above under *Elements Common to Alternatives 2-5*, the following impacts would occur.

Access to / Use of the Area: Initially, impacts would be the same as Alternative 1. Later, impacts would diminish to negligible because there would be no bicycling allowed on the new trail (through wilderness) and this would likely result in a different array of and many fewer visitors accessing the area.

Trail Construction: Construction of approximately 5.2 miles of new trail in wilderness would take five years or more, depending on funding. During this time impacts on air quality would be locally negligible to minor.

Facility Construction: Impacts from reconstruction of the Ipsut Creek Patrol Cabin in conjunction with the new campground in the boundary expansion area would be short-term and minor, similar to other alternatives, however, these impacts would not occur until acquisition and planning for these areas was complete. Therefore they would be part of environmental analysis associated with other boundary expansion facilities. Once the reroute trail was complete, a new backcountry campsite would be reconstructed elsewhere along the trail and the few sites retained at Ipsut Creek Campground (see *Restoration*) would also be restored.

Facility Removal: Actions and impacts would be the same as *Elements Common to Alternatives 2-5* plus additional impacts from saw-cutting and jack-hammering Ipsut Creek Bridge into pieces that would either be hauled out via all-terrain vehicle trailer (approximately 3,000 loads) or would be crated and hauled out via helicopter (approximately 40 trips), a short-term minor to moderate localized adverse effect on air quality.

Erosion Protection Measures: Actions and impacts would be the same as *Elements Common to Alternatives 2-5*. In addition, there would be impacts from 5-9 road humps constructed between the entrance and Old Mine Trailhead and potentially another series of humps along a section of roadway that would be preserved as part of the trail. As in Alternative 2, impacts would include exhaust and particulate emissions from construction, a short-term minor adverse effect.

Restoration: Impacts would be the same as in Alternative 1 (long-term beneficial) from passive restoration of 3.8 miles of road (14-15 feet wide) between the Old Mine Trailhead and the Ipsut Creek parking area, including from restoration of parking areas at Green Lake and Chenuis. There would be additional beneficial effects from stabilization of disturbed areas and revegetation of approximately 26 individual sites in Ipsut Creek Campground. As noted above, once wilderness trail construction was complete the other four individual and one group sites would also be restored.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts to air quality include:

- Chipping or mulching vegetation on site rather than disposing of it offsite or burning it.
- Spraying water over exposed soil, particularly during dry conditions to minimize fugitive dust.
- Covering trucks transporting cut or fill material along highways to reduce or eliminate particle release during transport.
- Encouraging contractor and NPS employees to travel in groups to and from the project site to the extent possible (rather than in multiple separate vehicles).
- Revegetating bare and staging areas as soon as possible (upon final grading or when staging area is no longer in use).
- Minimizing the extent of vegetation removal.
- Encouraging the use of local labor sources and large-volume material delivery where possible to minimize trip generation during construction activity.
- Using low VOC paints, solvents and other chemicals in building construction.
- Restricting idling of construction vehicles and equipment to no longer than 15 minutes when not in use.
- Using a biodiesel fuel mix rather than traditional diesel fuel.
- Minimizing use of administrative ATVs.

Cumulative Impacts: Over time, in the region, human impacts such as the development of roads, businesses and housing have contributed to increasing vehicle travel to obtain goods and services and to access recreational experiences. In Washington, as elsewhere, population increases have resulted in dramatic increases in the number of vehicle miles traveled. In addition, these increases associated with vehicle travel have been coupled with increases in the number of industrial, commercial and other vehicle sources of pollution. With the passage of the federal and state clean air acts, emissions controls have been implemented on stationary and mobile sources of air quality degradation. Washington has been proactive in establishing vehicle emissions standards for urban areas. Over time, these standards have changed and have resulted in moderating the effect of ever increasing population and industry.

In the park, existing adverse impacts to air quality (vehicle traffic, campfires, power generation) would not increase as a result of the proposed actions under the alternatives described herein, nor would there be changes to existing long-term regional beneficial effects, such as carpooling and public transportation. Therefore, when added to the impacts of other actions that could occur in the park that would affect air quality, including other construction, transportation and restoration projects, Alternatives 1-5 would contribute negligible to minor localized short-term adverse and beneficial effects. Adverse impacts would result from construction and would be short-term, while long-term beneficial effects would result from less use of the Carbon River Road, including from shortening the length of access and/or from shuttle use (Alternative 4). Long-term beneficial effects would also result from a substantial reduction in the use of private vehicles on most of the road under Alternatives 1-2 and 4-5. These beneficial effects would include a reduction in dust regeneration from diminished travel on the trail / roadway. Regional air quality would not be affected by the proposed actions under the alternatives described herein.

Conclusion: Overall, impacts to air quality from Alternatives 1 and 5 would be negligible to minor, while impacts from Alternative 2 would be minor and impacts from Alternatives 3 and 4 minor to moderate. Most moderate impacts under Alternative 4 would be short-term, while moderate impacts under Alternative 3 would be long-term from continued use of the Carbon River Road by private vehicles. Impacts would continue to occur from access to the area (Alternatives 1-5), and from both construction (Alternatives 2-4) and use of the area (Alternatives 3 and 4). There would be long-term beneficial effects from restoration in Alternatives 1, 2 and 5, and long-term beneficial effects in all alternatives from an overall reduction of vehicles on the roadway. Compared to existing conditions, these impacts would remain localized and would not be detectable over ambient conditions except in the vicinity of the roadway. There would be no impairment of air quality or air quality related values from the implementation of actions in Alternatives 1-5.

2. Geology / Soils Impacts

Alternative 1 Impacts

Unimproved Trail: There would continue to be localized negligible to minor impacts on geology and soils from ongoing reconstruction of the trail through or adjacent to the washout areas using native soil and rock. Impacts would include excavating, mixing, moving and replacing soils to work on the trail and its associated trail bridges and culverts. Because the existing road washout sections would likely continue to channel floodwaters, they could deepen and widen and would affect the trail alongside them, which would continue to require maintenance and periodic reconstruction. The Falls Creek and Ipsut Creek channels would also continue to be affected by natural erosion, additional flooding, and from more unstable trees falling into them. Erosion would also likely continue in bite sections where one to two lanes of the road are gone and where the trail has been rerouted, causing the need for additional reroutes of the trail. If the channels stabilized by the accumulation of debris within them or by the river moving back toward the northern part of its floodplain, the need for repeated trail construction and the impacts associated with it could diminish.

Carbon River Road: There would continue to be negligible adverse effects on soils, including compaction from driving the roadway and use by bicycles, hikers and administrative all-terrain vehicles. Periodic resurfacing of the road up to the maintenance area would also contribute to compaction and erosion. Additional localized minor adverse effects would occur from excavation associated with replacing existing corrugated metal culverts with fish-friendly open bottom, box culverts or trail bridges and from cleaning existing culverts.

Facility Construction: A small area would be excavated for the foundation of Ipsut Creek Patrol Cabin near the Carbon River Entrance and would have minor adverse effects from displacement of soils and the addition of fill in a previously disturbed area on the south side of the road.

Facility Removal: As called for by the GMP, other buildings at the Carbon River Entrance would eventually be removed upon construction of facilities in the boundary expansion area, contributing to long-term localized beneficial effects on soils and geology from decreasing the amount of impermeable surface area and from allowing portions of these areas to revegetate (while other portions became parking).

Erosion Protection Measures: Excavation into the riverbank or river channel near the entrance and maintenance area to construct four logjams and two rock barbs to stabilize the area would augment two naturally formed logjams and change the existing profile of deposited river sediment, causing localized minor to moderate adverse effects on geology and soils at each logjam location. Large rock would be used to tie the barbs into the bank, with the barbs constructed of jetty-sized rocks or rocks and logs with attached rootwads. For the logjam, logs with rootwads would be anchored into the channel or along the river bank to deflect oncoming flows riverward. There would be minor to moderate localized adverse effects from construction of the barbs or logjams (from excavation, importation of rock and/or logs for fill and from compaction). These would be coupled with long-term beneficial effects from bioengineering (planting within the excavated bank) and reuse of excavated soils. Soil productivity may also be retained because the logjams and/or barbs would reduce the rate of erosion, which, if not implemented, would continue to result in the loss of soil and riparian vegetation as the riverbank erodes.

Impacts from Elements Common to Alternatives 2-5

Carbon River Road: Actions would be similar to Alternative 1, with ongoing negligible to minor adverse effects from compaction and erosion of soils from use of the road. Instead of maintaining the road to the maintenance area, however, slightly more of it, up to the Old Mine Trailhead Turnaround, would be maintained. The turnaround would require excavation, leveling and grading of the area encompassing the road and the existing 5-car parking lot and designating a drop-off / pick-up area and accessible parking. As in Alternative 1, additional excavation would be necessary to replace round corrugated metal culverts located in intermittent or perennial drainages with open-bottom or box culverts or trail bridges. Because these areas have previously been excavated, effects would be localized and negligible to minor.

Facility Construction: Carbon River Entrance: Reconstruction of the Carbon River Entrance Arch and construction of a small visitor contact station would involve excavation for the foundations of these structures. Areas of excavation for the arch would be approximately 3 x3 feet (four areas) and 12 x15 feet for the visitor contact station. Contact station impacts would occur in previously disturbed soils at the entrance where the former fee booth was located. The arch would be constructed on its former footprint near the park boundary. Combined impacts from construction of these buildings would be long-term, localized and minor.

Ipsut Creek: Construction of backcountry toilets at Ipsut Creek Campground would also have long-term minor adverse impacts on soils from excavation and placement, while removal of the vault toilets would have long-term beneficial effects. Negligible adverse effects would occur from construction of a wayside exhibit at Ipsut Creek Trailhead.

Maintenance Area: Expanding parking would cause localized minor adverse effects on soils from the addition of compacted surfacing and from mixing the soil profile, decreasing water storage capacity and infiltration. Additional negligible impacts to soils would occur from construction of river-view interpretive exhibit and from potential fencing of the weather station, and radio tower/shed.

Boundary Expansion Area: Relocating the historic CCC garage to an as yet undetermined location on boundary expansion property would disturb an area of approximately 1,200 square feet, a long-term minor adverse effect on soils from excavation, grading and placement.

Facility Removal: There would be localized minor disturbance (excavation and grading) of previously disturbed soils and geology to remove existing buildings and structures from the Carbon River Entrance and maintenance area, and once the buildings had been removed to expand parking (including the placement of fill). Additional negligible to minor localized disturbance to soils and geology would occur from the removal of obsolete structures, such as asphalt, bumper stops, signs, the chlorinator building and vault toilets from Ipsut Creek Campground. These would be combined with long-term beneficial effects.

Erosion Protection Measures: Actions and impacts (localized minor to moderate adverse and beneficial) would be the same as Alternative 1 for construction of four logjams at the entrance / maintenance area. In addition, there would be minor adverse impacts from the construction of grade control structures on Falls Creek, Ranger Creek and an unnamed tributary near Chenuis to minimize sedimentation associated with the removal of two very large culverts.

Restoration: Although the area of restoration (primarily the roadway and some campsites) would vary among alternatives, the kinds of impacts would be similar. Long-term beneficial effects would occur from scarification of some areas in preparation for active or passive restoration. Removal of compacted surfaces (including campsites, portions of the roadway and parking areas) by removal of remnant surfacing, such as paving, and by scarifying these areas in preparation for active or passive revegetation would have localized long-term beneficial effects on soils from allowing infiltration, the resumption of soil-forming processes, and plant growth.

Alternative 2 Impacts

Improved Trail: Overall an area 10 feet wide by five miles long (6.06 acres) could be affected by reconstruction of an improved trail. Most of this area, however, remains existing roadway and would not be modified initially, in order to retain its historic appearance as a road corridor. Therefore, in the short-term, an estimated 1.2 miles currently affected by flood damage (approximately 1.45 acres) would be modified as an improved trail. Approximately 500 - 1,000 cubic yards of native soil and rock would be used and 1,000 – 1,500 cubic yards of material would be imported to construct the trail (approximately half of this would be for the trail surface). Over time, however, it is likely that some of the remaining intact roadway would also be affected by future flooding and would then be reconstructed as an improved trail. Construction of the formal trail would have short- and long-term minor to moderate adverse impacts.

Where possible this improved trail would be reconstructed as a 10-foot wide corridor. If ten feet could not be achieved, narrower sections could be reconstructed. Over time, this narrowing of the improved trail and its conversion to a less formal trail would occur if the river continued to affect the current washout channels near Falls Creek and between Chenuis and Ipsut Creek or other existing intact sections of road. If the existing zone between the wilderness and the road was further narrowed by flooding, the trail could become even narrower to avoid impacts to wilderness but to retain it outside of wilderness to facilitate continued bicycle use. As a result, after the current trail construction, additional minor to moderate localized impacts to soils and geology could occur from additional reconstruction of sections of trail.

Carbon River Road: Actions and impacts associated with maintaining the Carbon River Road up to the Old Mine Trailhead Turnaround would be the same as *Impacts from Elements Common to Alternatives 2-5*.

Facility Construction: In addition to *Impacts from Elements Common to Alternatives 2-5*, there would be long-term minor adverse impacts from reconstruction of the Ipsut Creek Patrol Cabin in the former campground parking area, including excavation and placement of fill and the structure.

Facility Removal: In addition to *Impacts from Elements Common to Alternatives 2-5*, there would be removal of 15 individual and one group sites from Ipsut Creek Campground, a long-term beneficial effect on soils from scarification and revegetation (see below).

Erosion Protection Measures: In addition to *Impacts from Elements Common to Alternatives 2-5*, there would be minor localized adverse impacts from excavation and fill coupled with long-term beneficial effects from reducing soil erosion in and alongside the roadway from construction of 5-9 road humps on the road up to the Old Mine Trailhead and another 15 along the trail and/or road up to Milepost 4.4. Impacts would include excavation of existing soils within the road profile and their replacement with river cobble and/or logs to create areas resistant to head-cutting erosion. In the event of water coursing down the road, the road humps would help to prevent major erosion damage from reaching facilities via the roadway. The humps would be 8 -10 feet wide with gradual ramps up to 200 feet long and would span the road and extend over the sides in length.

In addition, there are currently approximately 29 logs spanning the Falls Creek channel that could be dropped into the channel. These logs would be used to create small check dams to decrease the velocity of future floodwater down the channel and to aid in sediment deposition on the upstream side, thereby slowing erosion of the channel and its banks. Localized effects would be short- and long-term, minor and adverse from excavation and log placement and long-term, and beneficial from retaining soils within the channel and along its banks.

Construction of approximately six log-crib walls and one buried groin would have localized minor to moderate adverse effects on soils and geology from excavation of existing riverbed and adjacent soils and replacement with constructed fill from river cobble and logs. Approximately 1,700 linear feet of riverbank would be affected from the placement of these retaining structures. Long-term beneficial effects on soils would also result from preventing additional erosion of soils in the areas where these cribs and groin would be placed.

Restoration: There would be negligible to minor adverse effects coupled with long-term beneficial effects on soils from restoration of previously disturbed campsites in Ipsut Creek Campground and from some restoration of the Green Lake, Chenuis and Ipsut Creek trailhead parking areas. Approximately 0.25 acres of former parking areas (Chenuis and Green Lake Trailheads) would be restored. Campground restoration at Ipsut Creek would include removal of 15 individual and one group sites.

Alternative 3 Impacts

Carbon River Road / Trail: In addition to maintaining the road up to the Old Mine Trailhead Turnaround, a portion of the remaining road alignment would be reconstructed as a one lane road with turnouts to accommodate private vehicles up to a turnaround at Chenuis. An area approximately 1.5 miles long by 12 feet wide (approximately 2.9 acres) would be affected for the road. Construction of the Chenuis turnaround and parking and construction of approximately eight turnouts along the road would affect up to another 0.5 acres. Repairs to the roadway and improvement of parking would require the importation of approximately 10,000 cubic yards of fill. Excavation, grading, and use of native and imported fill, would affect native soils and geology through placement and compaction, with localized minor to moderate impacts, more than in Alternatives 1 and 2. With additional flooding, imported materials could be mixed with native materials and could move downstream changing the character of soils and geology in other locations, adding more widespread impacts.

There would also be impacts from constructing an improved trail (10 feet wide and 1.4 miles long, or about 1.7 acres) between Chenuis and the Ipsut Creek Trailhead. Because a portion of this area is existing roadway, trail construction would comprise approximately 0.4 miles, a long-term localized minor adverse effect.

As in Alternative 1, there would be additional long-term impacts from routine maintenance of the road surface (3.6 miles, rather than 1.2 miles), including road shoulder, ditch and culvert maintenance. This would cause localized displacement and erosion of soils, a long-term negligible to minor adverse effect occurring over time.

Facility Construction: In addition to impacts from Alternative 2, there would be construction of interpretive waysides at Chenuis, a long-term negligible adverse effect.

Facility Removal: In addition to impacts from Alternative 2, there would be minor to moderate adverse and long-term beneficial effects on soils from removal of the Ipsut Creek Bridge.

Erosion Protection Measures: Actions and impacts would be similar to Alternative 2, except that only four road humps (an estimated 1,200 square feet) would be constructed with minor localized adverse effects; one additional very large log crib would be constructed (2,600 feet x 15 feet or 0.90 acres); and eight additional flow deflection logjams would be constructed. Construction of the flow deflection logjams would occupy approximately 3,600 square feet each, or a total of approximately 0.66 acres of river channel. Combined, the series of erosion protection measures in Alternative 3 would affect nearly two acres plus a similar area associated with short-term construction impacts, causing long-term localized moderate adverse effects.

Restoration: Possible obliteration of the remaining roadway (12 feet between Chenuis and Ipsut) as well as the Ipsut Creek Trailhead (except for the proposed cabin location and access) would have short-term negligible to minor adverse effects coupled with long-term beneficial effects on approximately two acres for the roadway and 0.3 acres for the Ipsut Creek Trailhead and campground parking area, where soils would be stabilized, and fill and other surfacing removed. Additional negligible to minor adverse and beneficial effects would occur from the removal / restoration of approximately five individual campsites.

Alternative 4 Impacts

Carbon River Road / Trail: As in Alternative 3, excavation, grading, compaction and importation of fill would affect soils and geology over the length of the repaired roadway (approximately 5.0 acres) with minor to moderate localized adverse impacts and could also affect areas downstream during future flooding with more widespread impacts on soils and geology.

Facility Construction: Impacts would be the same as Alternative 3.

Facility Removal: Impacts would be the same as Alternative 3.

Erosion Protection Measures: Actions and impacts would be the same as in Alternative 3 except that instead of direct effects to nearly two acres, construction of potentially another logjam associated with a log crib, one road hump instead of four and two additional logjams and a log crib wall would affect soils and geology over approximately three acres (not including short-term effects associated with construction) a long-term moderate adverse effect.

Restoration: As in Alternative 3, possible obliteration of the remaining roadway (in this case between Milepost 4.4 and Ipsut) as well as campground and trailhead parking areas would have short-term negligible to minor adverse effects, coupled with long-term beneficial effects on soils. There would be fewer adverse and beneficial effects from restoration of a shorter area of roadway than in Alternative 3 (0.75 acres) and similar adverse and beneficial effects from restoration of campsites.

Alternative 5 Impacts

Carbon River Road / Trail: Short-term actions and negligible to minor impacts would be the same as Alternative 1 to continue to maintain the unimproved trail until the wilderness reroute trail was available and the same as *Impacts from Elements Common to Alternatives 2-5* to maintain the road up to Milepost 1.2 (Old Mine Trailhead turnaround).

Wilderness Trail: Construction of the approximately 5.2 mile long wilderness reroute trail would have minor to moderate localized adverse effects on soils and geology along its route, an area of approximately 1.9 acres. Within this area and where needed for cut and fill slopes for the trail outside of it (on side-slope terrain), there would be excavation of native materials to mineral soil and casting aside of excavated materials, causing mixing of the soil profile and changes in erosion and compaction. While large outcrops and trees would be avoided by trail construction, smaller outcrops could be blasted during construction, causing localized minor adverse effects on geology.

Facility Construction: In addition to *Impacts from Elements Common to Alternatives 2-5*, Ipsut Creek Patrol Cabin would be relocated to an unknown location on boundary expansion property and would have minor localized adverse effects on soils and geology from excavation, compaction and placement. There would also be minor adverse impacts on soils and geology from eventual construction of a new backcountry campsite.

Facility Removal: Actions and impacts would be similar to Alternatives 3 and 4, however, removal of the Ipsut Creek road bridge would be done using concrete saws and jackhammers and then the parts would either be hauled out via all-terrain vehicle trailer or via helicopter. In addition, instead of removal of four or five individual and/or group campsites, there would be initial removal of 26 individual sites and later removal of all of the remaining sites (4 individual and one group) upon construction of a new backcountry camp nearer to the new wilderness trail.

Erosion Protection Measures: Actions would be the same as in *Impacts from Elements Common to Alternatives 2-5*.

Restoration: Restoration impacts would initially be similar to Alternative 1, with passive restoration of five miles of trail (14-15 feet wide). In addition, as in Alternatives 1 and 2, there would be some restoration of the parking areas at the Green Lake, Chenuis and Ipsut Creek trailheads and the campground parking area (approximately 0.2 acres) as well as of the campsites noted above. Over time, restoration would likely have long-term beneficial effects soils and geology from removal of compaction (scarification) and revegetation.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts to geology / soils include:

- Locating staging areas where they will minimize new disturbance of area soils and vegetation.
- Minimizing ground disturbance to the extent practicable.
- Using mats or plywood to minimize soil compaction impacts in sensitive fine-grained or other soils.
- Salvaging topsoil from excavated areas for use in re-covering source area or other project areas.
- Not leaving excavated soil at the base of trees, and providing tree protection if needed for specimen trees.
- Restoring project areas through scarifying, and/or native seeding or planting.
- Importing weed-free clean fill.
- Clearing and grubbing only those areas where construction would occur.
- Using vegetable oil in place of hydraulic fluid in heavy equipment.
- Minimizing construction along water courses during periods of heavy precipitation.
- Minimizing driving over or compacting root-zones.

Cumulative Impacts: Compared to the Nisqually Watershed, the Carbon River area has had little habitat modification. Impacts have largely remained along the fairly narrow Carbon River Road corridor, widening at the beginning to allow for parking and administrative facilities and at the end to encompass Ipsut Creek Campground and along the way to encompass the various restoration projects that have occurred over the years. Although the road formerly penetrated nearly to the snout of the Carbon Glacier, it has been many decades since that corridor was available to vehicles. Over time, there has continued to be a gradual withdrawing of facilities. Combined, past actions have had localized minor to moderate, long-term adverse impacts on soils due to an increase in the amount of impervious surface, decreased infiltration, soil compaction, loss of soil moisture and loss of organic soil horizon spread over the narrow developed area in the Carbon River Road corridor. All alternatives would contribute negligible to minor adverse effects and beneficial effects. Alternative 1 would continue to contribute short-term negligible to minor adverse and have long-term beneficial effects on soils and geology from passive restoration. Alternative 2 would contribute negligible to minor short-term adverse and localized long-term beneficial effects. Alternatives 3 and 4 would contribute minor to moderate adverse effects and long-term beneficial effects. Alternative 5 would contribute minor to moderate short-term adverse effects and long-term beneficial effects.

Conclusion: Alternative 1 would have negligible to minor short- and long-term adverse and beneficial effects. Alternatives 2-5 would have short-term negligible to moderate adverse effects, minor long-term adverse effects and localized long-term beneficial effects. Short-term moderate adverse and long-term minor effects would be associated with construction of new facilities. Moderate adverse effects would be greatest in Alternatives 3 and 4 from the construction of erosion protection measures and reestablishment of the road and fewest in Alternatives 1 and 5. Beneficial effects would be greatest in Alternatives 5, 2 and 1, with fewer beneficial effects in Alternatives 3 and 4 from less overall restoration. There would be no impairment of geology or soils resources or values from the implementation of Alternatives 1-5.

3. Water Resources Impacts

Overview
Because the riverbed has risen due to ongoing sediment deposition upstream, partially attributed to changes in the Carbon Glacier, the Carbon River floodplain is expanding toward the road. Light Detection And Ranging (LiDAR) an optical remote sensing technology that measures properties of

scattered light to find range and/or other information from a distant target was used to analyze the floodplain and river channel morphology. The prevalent method to determine distance to an object or surface is to use laser pulses. Like the similar radar technology, which uses radio waves, the range to an object is determined by measuring the time delay between transmission of a pulse and detection of the reflected signal. LiDAR maps show that the current elevations of terrain in the Carbon River Valley tilt south toward the road. As a result, portions of the road are likely to continue to function as side channels of the Carbon River and Ipsut Creek during high flows. In 1996, the Falls Creek area was scoured out by the river to depths of up to ten feet. In 2006, when floodwaters rose in the floodplain they "found" the Carbon River Road again in two areas, scouring two large gullies in the road (in the Falls Creek and Ipsut Creek areas) and eroding several other areas or bites along the banks of the road. The road corridor offers few impediments to water flow, due to its smooth surface and lack of standing and downed trees. Because of this, it also allows floodwaters to increase in velocity, increasing erosion and subsequently, sedimentation and turbidity.

In future flooding, large gully-like channels could continue to be created where the river "finds" and traverses the road corridor, leading to major areas of erosion and the loss of large trees as they are undermined and fall into the new channel(s). Over time, it is also possible that large trees falling into the channel could act as check dams and could trap sediment and other debris, leading to some channel filling. This could cause the river floodwaters to seek and find another path around the filled section, either back toward the main channel or further away from it.

As shown by LiDAR and engineering surveys, it is possible that other areas of the road adjacent to the river could be affected in the future, including the area below Chenuis, where water flow has begun to flow behind a bedrock knob through the forested area on the south side of the road, leaving the road in this area vulnerable to additional loss (Chapter III, Figure 13: *Unnamed Channel Intersection with Road Upstream of Knob*). In other areas, sections of the edge of the road have continued to slough off as high water flows along the toe of the road slope. Where the road is constricted by bedrock in its floodplain, such as in narrow sections just above Chenuis and just above Falls Creek, it is likely that the river would continue to flow back toward its left bank (looking downstream) when it meets these obstructions, continuing to flow toward the road and eventually causing additional damage to it.

Over time, as the river brings additional material downstream, some new flood channels would be abandoned as they fill with sediment and others would be occupied. Where old flood channels have been abandoned, these would eventually begin to allow soil formation and acquire vegetation. Over time, revegetation of the former roadbed would increase sediment filtering and soil infiltration. At the same time, portions of the former roadbed and/or other areas nearby would lose vegetation and become part of the active river floodplain.

Left in their current condition, the gullied areas of roadway would likely continue to channel water during high flow periods in spring and fall. Remaining "buffer" areas of forest between the road and the river would likely diminish over time, causing additional loss of the roadway. Because of the wide braided area traversed by the Carbon River in the Falls Creek area, if the location where the Carbon River entered the roadway was blocked, there are several other places where the river could divert toward the road. While the riverbed in the vicinity of Falls Creek is full, the valley is not and will continue to be scoured and deposited upon by the river as it braids back and forth across its floodplain (Geomax 2008).

Alternative 1 Impacts

Physical Hydrology: There would continue to be ongoing minor to moderate adverse effects on hydrological processes from the original construction of the Carbon River Road within the floodplain / channel migration zone of the Carbon River. Because portions of the unimproved trail / road corridor would continue to be lower than the river, they would continue to be affected by flooding, especially as the Carbon River bed continues to rise (aggrade). In Alternative 1, these dynamic conditions would continue to result in the need to reconstruct the unimproved trail within or adjacent to the Falls Creek and Ipsut Creek washout areas and along other parts of the road corridor as future damage occurs.

Ongoing reconstruction of the unimproved trail would likely occur regularly, perhaps annually or even twice annually, as normal spring and fall flooding combined with future major flooding continues to affect the area, a long-term minor adverse effect.

The trail itself would have negligible to minor adverse effects on hydrology because it would not be structurally reinforced. Because the road has remained generally unpaved (except for the first mile and some portions within Ipsut Creek Campground) and because the road was essentially constructed over native soil and rock, with little constructed road fill (except where repaired in recent decades), the majority of eroded materials would continue to be primarily of native origin.

Actions along the first 1.2 miles of road would include cleaning out culverts and increasing their size where necessary to facilitate water passage, a long-term beneficial effect. There would be negligible to minor long-term adverse effects on hydrology from replacement of culverts with other water passage devices on perennial and intermittent streams. Other beneficial and adverse effects on hydrology would come from actions that increase or decrease soil permeability, causing or decreasing runoff. These actions would include removal or construction of buildings and structures and compaction related to ongoing use of the trail / road surface for hiking, bicycling and administrative all-terrain vehicles.

Reconstruction of the Ipsut Creek Patrol Cabin at the entrance would add impermeable surface area and slightly increase nearby runoff, a long-term negligible to minor adverse effect. At the same time, as other obsolete structures from the campground and roadway were removed over time, there would be long-term beneficial effects from removing impermeable areas and structures that alter surface flow and from reducing the amount of hardened surface area, increasing infiltration.

Initial construction of two barbs (which would later be reconstructed as a logjam) and augmentation of an existing logjam at the entrance, as well as construction of three additional logjams would have long-term minor localized adverse effects on streamflow from altering the way floodwaters would move in these areas. With the structures, floodwaters would be directed away from currently eroding banks toward the opposite shoreline. Because the structures would be located at the current bank of the floodplain which is dry during existing normal flows, they would not affect current normal river flow. If the river did move toward this bank, however, they would affect normal flows in the same manner as flood flows, by directing water away from the eroding bank but would have minor to moderate adverse effects.

Alternative 1 would also continue to eliminate the need for emergency repairs associated with maintaining the Carbon River Road from periodic flood damage and erosion, resulting in long-term beneficial effects to hydrology, channel morphology, and floodplain functions from allowing the river to occupy areas within and adjacent to the road. Additional long-term beneficial effects would be realized from passive restoration of 14-15 feet of the historic road corridor, where not used as part of the trail.

Water Quality: Existing impacts on water resources would continue. The ongoing effects of retaining public facilities and public access alongside the Carbon River would continue to have localized negligible to minor long-term adverse effects by continuing to alter the passage and quality of overland water flow through these areas.

Natural background sedimentation would occur as material continues to erode naturally and out of riverbanks adjacent to the road / unimproved trail. As shown by the dynamic riverbed, where the Carbon River channel changes constantly, braiding across its floodplain, the Carbon River has a naturally high background level of sediment transport because of its glacial origin and because of the presence of its watershed origin on the steep, unconsolidated slopes of a volcano. Ongoing flooding and natural river flows therefore also routinely and periodically cause bank erosion, mass-wasting (landslides) and changes in the river channel, with short-term minor to moderate adverse effects.

Surfacing along the road / trail could continue to be eroded during flooding and could affect water quality by increasing sedimentation / turbidity during flooding and by contributing hydrocarbons and other chemicals associated with motor vehicles from former use of the road by public vehicles and from current intermittent use of the road by all-terrain vehicles.

Contaminants in stormwater from hardened surfaces or the gravel road can adversely affect water quality, including the amount of dissolved oxygen in the water, turbidity, and pH, which in turn can adversely affect biological resources. Because the unimproved trail would continue to be made of native materials and the road allows infiltration because it is not paved (except for remnants at the campground and along the first mile) and because the road is separated from the river in many places and there is a relatively high volume of water in the river, it is likely that potential impacts from contamination would be negligible to minor, especially because road use by public vehicles above Milepost 1.2 has not occurred since 2006.

There would continue to be dust generated along the first 1.2 miles of the road and to a lesser extent along the remaining portions of road and unimproved trail. To the extent that this dust coated adjacent vegetation next to the road, it would continue to wash away during storms, entering water. Sedimentation related to ongoing unimproved trail repairs would also continue as use of the unimproved trail by hikers, bicyclists and administrative all-terrain vehicles create and erode fine material, washed into nearby water during rain and snowmelt. In addition, there would likely continue to be ongoing inputs of sediment and gravel as additional parts of the road and trail were eroded during future flooding. Impacts from sedimentation would likely range from negligible (associated with dust and fine material) to locally moderate (where additional parts of the road or trail along riverbanks were eroded).

Localized flooding due to undersized, damaged, or clogged culverts and poor drainage conditions under the road can also cause sedimentation. Poorly located or plugged culverts could continue to cause rapid erosion of road fill during floods, contributing to additional road failure and resulting in disturbed soil being carried into nearby channels, which could adversely impact water quality. Adverse impacts would be primarily localized, short- to long-term and minor, since most eroded material would be sand and gravel, not silt or clay and because of the high volume of water already carrying a large, natural sediment load during flooding.

Over the long-term, it is likely that road-related sources of sediment would diminish or be eliminated; depending on how quickly additional parts of the Carbon River Road are reclaimed as part of the floodplain. Until then, it is likely that erosion of the road could continue to add large quantities of sediment, with short-term minor to moderate localized adverse effects on water quality. As portions of the washed out roadway stabilized, these sources of sediment would diminish and as noted earlier, the deep gullies could be filled in by natural check dam formation within them. Where vegetation reestablished and allowed sediment filtering and additional plant establishment, erosion would lessen in some areas, except during large floods, a long-term beneficial effect.

In addition to the effects of erosion from flooding on water quality, there would be potential short-term minor impacts to water quality from construction or removal of facilities, such as from loosening hardened soils or removing paving, during excavation or restoration (scarification, planting or seeding) activities. Excavation and transport of fill materials, whether from nearby or outside the area could also contribute impacts to water quality from inadvertent loss during transport of these materials or from initial placement (until they were stabilized).

<u>Floodplains</u>: There would be minor to moderate adverse effects on floodplain values in Alternative 1 from the placement of four erosion protection measures (three logjams and a series of two rock barbs converted to a logjam at the Carbon River Maintenance Area); and from farming of rock and cobble in the active channel of the Carbon River for use in these erosion protection structures. Beneficial effects would occur from removal of most facilities at the Carbon River Entrance; removal of vault toilets and formal car camping from Ipsut Creek Campground; eventual conversion of 3.8 miles of road within the channel migration zone of the Carbon River to an informal trail; and from modifications to undersized culverts.

Logjams are designed to be self-mitigating and self-sustaining, which means the structure is designed to remain a part of the landscape for the long-term. Aside from three rock barbs built following flooding in 2004, these would be the first major structures built in the Carbon River reach within the park boundary in the attempt to prevent short- and long-term infrastructure damage.

To construct the four logjams (including two rock barbs) near the maintenance area and to avoid trucking in hundreds of cubic yards of material, much of the ballast to support them would be removed from the riverbed above the ordinary high water mark using heavy equipment. This would temporarily disrupt the natural process of sediment deposition and transport, a short-term minor to moderate adverse effect given ongoing inputs from upstream materials.

Under Alternative 1, existing development in the Carbon River floodplain at the Carbon River Entrance would be removed pending construction of facilities in the boundary expansion area, resulting in short-term beneficial impacts from removal. To accommodate visitor use, however, the vault toilets and parking would be retained and the Ipsut Creek Patrol Cabin moved to the entrance to serve as a visitor contact facility. Increasing the size of the natural logjam behind the vault toilets at the entrance and adding another logjam would help prevent bank erosion from accelerating and damaging these facilities in future flooding. Placement of the cabin on a foundation on the south side of the road would also decrease its susceptibility to flooding, a long-term beneficial effect. Similarly the logjams near the maintenance area, located in the floodplain would help to prevent additional bank erosion that would cause further damage to the facilities (weather station and CCC garage) located there.

Although Ipsut Creek Campground would continue to be used, its use would continue to be reduced because of the inability to drive to the campground, a long-term beneficial effect. There would, however, also continue to be long-term minor adverse effects from use of the campground. Although "consideration of closing the camp in late fall and early winter during the rain-on-snow flood period," was suggested in the *Geologic Hazard and Floodplain Management* report (Riedel 1997) for the GMP, this has not occurred. Instead, campers are informed of the high hazard location of the campground (as also recommended by that report). No "contingency evacuation plan, approved by the regional safety officer" (another recommendation), however, has yet been created.

Although portions of the Carbon River Road and campground would continue to be within the regulatory floodplain, no statement of findings would be needed to allow these to remain or the Carbon River Entrance facilities (relocated patrol cabin and parking) to be constructed because these are excepted actions under the Floodplains Management Guideline. A *Floodplains Statement of Findings* however is needed for construction of the proposed logjams at the entrance and maintenance area that would help protect the first mile of the Carbon River Road. These structures would be located in the wide flat valley wall to valley wall area wherein the floodplain could expand. The logjams would therefore have a potential long-term moderate adverse effect from limiting that expansion across the existing roadway toward the south valley wall. In previous analysis (NPS 1997), the administrative structures at the Carbon River Entrance were found to be outside of their regulatory floodplain (100-year), however, flooding (less than two feet at very low velocities) was noted in that report that affected entrance structures based on recollection of staff. This flooding was attributed not to the Carbon River, but rather to June Creek, a tributary stream that enters the Carbon River at the entrance. The report noted that future bank erosion would likely threaten portions of the area in the future (NPS 1997) and that the absence of volcanic tephra and the presence of floodplain soils indicated that larger floods might occasionally have inundated the site.

<u>Wetlands</u>: There would be impacts to wetlands from the construction of four logjams in the entrance and maintenance areas. Each of these structures would be approximately 60 x 60 feet, for a total of approximately 0.5 acres of impacts to existing areas of river cobble in the Carbon River bed. Beneficial impacts would occur from enhanced areas of large woody debris comprising 0.5 acres.

Much of the area surrounding the Carbon River Road corridor is also considered wetlands, according to the wetland classification system used by the NPS. Because the road corridor would continue to be used for the informal trail in most places, there would be few impacts to the areas surrounding the road. In Alternative 1, the informal trail would continue to be rerouted through intermittent riverine wetland areas adjacent to the former road corridor now occupied by the Carbon River in the Falls Creek area and by Ipsut Creek near Ipsut Campground ,. Where culverts exist in side tributaries, these would be replaced over time with larger culverts or with trail bridges, with short-term minor and long-term beneficial effects. Informal trail routed outside of the former road prism totals approximately 4,224 linear feet, or about 0.58 acres for a 6 foot wide trail.

Although repair of the trail within the road prism is not considered as an impact of the proposed action to wetlands, new impacts to wetlands would comprise 0.9 acres. These impacts would be mitigated by providing fish passage through the previously impassable Ranger Creek culvert and hanging culvert area on an unnamed tributary near Chenuis.

Impacts from Elements Common to Alternatives 2-5

Physical Hydrology: Impacts would be similar to Alternative 1. As in Alternative 1, public access facilities (the trail and/or road) along the Carbon River would remain vulnerable to additional flooding and erosion and would both affect river flow and be affected by it, especially during future flooding a long-term minor to moderate adverse effect. Construction of a formal turnaround and some accessible parking along with a passenger drop-off / pick-up area near the Old Mine Trailhead at Milepost 1.2 would result in additional surfacing and compaction, and could slightly increase the rate at which water runs off in this area, a long-term negligible to minor adverse effect on hydrology.

As in Alternative 1, long-term beneficial effects would result from the removal of buildings at the entrance and maintenance area and from the removal of the vault toilets and other obsolete structures from Ipsut Creek Campground. These beneficial effects, however, would be slightly offset by the construction of new, smaller structures at the entrance (including the visitor contact station), by the conversion of the remaining area to parking at the entrance and maintenance area, and by the construction of new backcountry toilets at the campground. Additional negligible to minor adverse effects would occur from reconstruction of the historic CCC garage later on the boundary expansion lands, which would undergo additional separate environmental analysis as part of the proposed development of boundary expansion lands after these have been acquired.

Short- and long-term negligible to minor adverse effects would occur from the construction of grade control structures on Ranger Creek and an unnamed tributary near the knob below Chenuis. These structures would also have short- and perhaps long-term beneficial effects from reducing sedimentation associated with the removal of the large culverts on these tributaries (see Water Quality below).

As in Alternative 1, there would be long-term beneficial effects on hydrology from cleaning out and/or replacing round corrugated metal pipe culverts at intermittent and perennial streams with fish-friendly or box culverts or trail bridges.

Water Quality: As in Alternative 1, existing impacts on water resources would continue. These would include ongoing effects from retaining public facilities and public access alongside the Carbon River (altering the passage and infiltration of water); the potential for petroleum contaminants from former public use of the road and from public vehicle use of the first 1.2 miles of the road; potential erosion of the road /trail along riverbanks or from head-cutting during flooding (causing sedimentation); dust generation from driving the first 1.2 miles of road and from other ongoing public use (washed into water during storms); natural background sedimentation; as well as localized sedimentation from poorly functioning or located drainage structures. Where the public access route (either the improved trail in Alternatives 2-5) or the road (Alternatives 3-4) was rerouted around washed out sections of roadway, those parts of the road would likely continue to erode and add potentially large amounts of sediment to the river.

As noted above, there would also be short-term minor adverse effects and long-term beneficial effects from constructing grade control structures to reduce a flush of sedimentation when the very large culverts on Falls Creek, Ranger Creek and a nearby tributary were removed. Whether the beneficial impacts would be long-term would be dependent on how much sediment was released following initial culvert removal compared to sediment released over time with high flows.

Long-term minor adverse effects would result from runoff over new parking areas at the entrance and in the former maintenance area, which could pick up petroleum contaminants from vehicles.

Floodplains: The primary adverse impacts to the floodplain associated with Alternative 2-5 are impacts from installing new bank erosion measures that would limit the channel migration and floodplain utilization of the Carbon River. Other adverse impacts include reconstructing a trail or road in the floodplain, prevention of channel avulsion, and the prevention of floodplain sedimentation that could lead to additional flooding and channel movement.

As in Alternative 1, to construct the logjams near the entrance and other noted erosion protection structures and to avoid trucking in thousands of cubic yards of material, much of the ballast (cobble rock) to support the erosion protection structures would be removed from the riverbed using heavy equipment. This would temporarily disrupt the natural process of sediment deposition and transport, a short-term minor to moderate adverse effect given ongoing inputs from upstream materials. To make the structures robust, some require large amounts of farmed material from the riverbed. Impacts would be minor in Alternatives 1 and 5 and moderate in Alternatives 2-4 (with a large increased use of materials in Alternatives 3 and 4).

Several actions in the plan would also enhance floodplain values and mitigate some of the impacts of retaining a road or trail in the floodplain. These include 1) focusing NPS facilities and contact areas at the entrance and (later) on boundary expansion lands rather than along and within the active floodplain (all alternatives), 2) removal of vault toilets and formal car camping facilities at Ipsut Creek campground and replacement with a smaller campground footprint (all alternatives); 3) conversion of up to 3.8 miles (Alternatives 1, 2, and 5), 1.4 miles (Alternative 3), or 0.6 miles (Alternative 4) of the roadway to a trail within the floodplain; and 4) removal of undersized culverts and stabilization of stored mobile sediment upstream of the culverts (Alternatives 2-5). These actions would contribute to a more natural floodplain.

Wetlands: The following actions common to Alternatives 2-5 would affect wetlands:

- Construction of four logjams (including initial construction of two barbs) at the entrance / maintenance area;
- Replacement of inadequately sized intermittent and perennial stream culverts with "fish friendly" culverts or trail bridges; and
- Construction of grade control structures on Falls Creek, Ranger Creek and the unnamed tributary near Chenuis.

Logjams: As in Alternative 1, there would be impacts to wetlands from the construction of four logjams in the entrance and maintenance areas. Each of these structures would be approximately 60 x 60 feet, for a total of approximately 3,600 square feet each of impacts to existing areas of river cobble in the Carbon River bed. Combined, these logjams would therefore affect up to 0.5 acres, a long-term minor adverse effect and would require preparation of a Wetlands Statement of Findings for the preferred alternative because they would exceed the 0.10 acres of additional impacts allowed for by the Wetland Management Guideline when repairing a former facility. These impacts would also require 1:1 compensation (restoration) which would be provided by improving fish passage on several creeks (see below).

Culvert Modifications: All action alternatives would also have long-term beneficial effects from replacing existing culverts inadequate for fish passage with "fish friendly" culverts or trail bridges. Although replacement would have short-term negligible to minor adverse effects these would be coupled with long-term beneficial effects, restoring some previous impacts.

Grade Control Structures: Alternatives 2-5 call for the removal of two very large culverts and their replacement with either trail bridges (Alternatives 2 and 5) or improved fish passage structures (Alternatives 3-4), an undertaking that would potentially release a large amount of sediment into the stream channels where these culverts are located. To minimize sedimentation that could potentially affect fish, the action alternatives would also include construction of grade control structures in Ranger Creek and the unnamed tributary (hanging culvert) near Chenuis. There is also a possibility that structures would be constructed on a tributary in the Falls Creek area if further investigation finds sediment storage in this area. Removal of the culverts would have long-term beneficial effects from allowing for fish passage up both tributaries to the next closest natural fish barrier, opening approximately 0.5 miles of stream for fish use on Ranger Creek, 0.25 miles of stream for fish use on the unnamed tributary, and 0.25 miles in the Falls Creek area for a total of 1.8 acres, a long-term beneficial impact that could compensate for the loss of wetlands from the logjams and new trail construction noted above.

Construction of road humps would not affect wetlands. These would be constructed within the road corridor and would direct flow off the road during future flooding. Construction of the Old Mine Trailhead turnaround would also be wholly within the existing road prism and trailhead parking area and would not affect wetlands.

Alternative 2 Impacts

<u>Physical Hydrology</u>: In addition to impacts from Alternative 1 and *Impacts from Elements Common to Alternatives 2-5*, there would be other minor adverse impacts from maintaining an improved trail in the Carbon River Road corridor. Unlike the unimproved trail, which would be overlain on firm and soft sediments with native materials, the improved trail would have a constructed base, primarily of native materials. This constructed base would both be more resistant to erosion, particularly where it was comprised of turnpike or metal gabion baskets and susceptible to being dislodged during future flooding. The resistance of the improved trail would alter water flow in the vicinity of the trail and the non-native materials could, if dislodged, wash downstream, hanging up on trees and large woody debris in the floodplain, changing water flow in the river.

Although the proposed improved trail would primarily be constructed above the ordinary high water mark of the Carbon River outside the gullies and bites that have formed, its construction would also affect areas below this mark, especially where the river is higher than the road. Over time, additional impacts from construction of new sections of improved trail, where more sections of the historic road were damaged could contribute to additional changes in water movement on the edge of or within the river floodplain, depending on where the trail was constructed / rerouted. These adverse effects associated with water flow in and around the improved trail would be minimized by the construction of a permeable sub-base for the trail, allowing some infiltration of water underneath the trail where it passes through unstable areas near the river, such as in the Falls Creek washout area and in sections where the trail is lower than the river.

Construction of the structures at the entrance and construction of the Ipsut Creek Patrol Cabin in the campground parking area would have negligible to minor adverse effects on hydrology from impermeable surfacing associated with the placement of these structures.

In addition to *Impacts from Elements Common to Alternatives 2-5*, a series road humps would be constructed to prevent additional head-cutting and to allow water to move off the first 1.2 miles of road, without serious damage to it. There would be minor to moderate adverse effects on hydrological processes from the placement of these road humps from changing the way stormwater moves over and off the road. Localized effects would be minor associated with structures located away from the river channel and minor to moderate associated with structures placed directly adjacent to the river channel.

Structures along the road would affect how water reaches the tributaries and the river through infiltration. Structures located along the edge of the river channel would cause water to flow around them, primarily during flooding, a long-term minor to moderate adverse effect, but would also have long-term beneficial effects by preventing additional riverbank / road corridor erosion.

There would be minor adverse effects on stream flow from the construction of span log check dams in the Falls Creek channel (former roadway). The span logs would slow down floodwater flow and cause the water to drop sediment as it crested these structures, minimizing the potential for additional widening and deepening of this section of former roadway that becomes part of the river during high flows. Effects would be minor to moderate, short- and long-term and both adverse and beneficial from changing water flow, limiting additional erosion and potentially allowing the river to occupy its natural floodplain, rather than the eroded channel of the road.

In addition, there would be long-term minor to moderate adverse effects on stream flow from construction of seven erosion protection structures, including six channel lining log cribs and one cross-road buried groin. The log cribs would prevent the river from expanding its channel migration area and widening its floodplain in the vicinity of the structures, unless the river entered the road / trail corridor upstream of the structures, rendering them ineffective. The buried groin would prevent head-cutting down a section of road currently being threatened where the river flow is currently directed. Approximately 1,700 linear feet of road along the river bank would be affected by the log cribs and groin, and another 1,000 – 2,000 linear feet in the road could be affected by a series of road humps, some of which would extend to the edge of the road, where the road is adjacent to the edge of the floodplain.

Long-term beneficial effects on hydrology would be contributed by some restoration of the Chenuis and Green Lake trailhead parking areas and from restoration of some individual and group campsites from increasing natural vegetation in these areas that would limit future erosion.

Long-term minor to moderate adverse effects on hydrology from obstructing water flow during flooding would be contributed by the retention of the Ipsut Creek Bridge, particularly if water flow in the vicinity of Ipsut Creek changed again. If additional impacts to hydrological conditions were observed, arrangements would be made for the bridge to be removed, a long-term beneficial effect. Because the removal would later take funding and staffing away from other park priorities, it is likely, however that the bridge would remain for some time after effects had been noted, a long-term minor to moderate adverse effect.

<u>Water Quality</u>: In addition to *Impacts from Elements Common to Alternatives 2-5*, there would be the potential for negligible to minor or moderate localized adverse effects from sedimentation from initial construction of the improved trail, later maintenance to it and later reconstruction of additional washout areas. There would also be negligible impacts from use of the improved trail by hikers, bicyclists and administrative all-terrain vehicles. Construction would involve the use of equipment and other handwork that would disturb soils and vegetation. Where soils remained exposed or were not stabilized, there would be the potential for fine material to be washed into nearby water during rain and snowmelt.

Constructing rock-filled wire gabions would require procurement of rocks from within the vicinity and the additional importation of a gravel fill to top the trail. Although head-cutting may be minimized by locating check dam-like structures within the physical alignment of the Carbon River Road, it is likely that sheet flow will continue to occur and that additional head-cutting locations will arise, thus contributing more sediment to the river. Additional potential water quality impacts could occur from removal of logs from the Ipsut Creek Bridge logjam. In addition, if the bridge later became obsolete or impeded water flow, it would be removed, resulting in short-term minor to moderate adverse and long-term beneficial impacts on water quality.

Additional long-term beneficial effects would occur from some restoration of disturbed areas, including former parking areas and campsites. Eventually, there would be long-term beneficial effects from stabilizing the eroded channels adjacent to the trail, the bite areas where the river has eroded some or all of the former roadway and former parking areas along the road because these would then contribute less sediment to the river during storm water runoff.

Floodplains: Impacts would be similar to Alternative 1 and the same as *Impacts from Elements Common to Alternatives 2-5*, however removal of the facilities at the Carbon River Entrance would likely occur sooner than in Alternative 1, the campground would be smaller than in Alternative 1, and instead of locating the Ipsut Creek Patrol Cabin at the entrance to serve as a visitor contact station, a new visitor contact station would be constructed at the entrance and the cabin relocated to one of the former parking areas near Ipsut Creek Campground. Construction of parking (with associated picnicking), while it would be within the channel migration zone and would have localized minor adverse effects, is an excepted action under the Floodplain Management Guideline.

With the exception of the Falls Creek area, the majority of the NPS road and visitor facilities also lay outside of the regulatory 100 and 500 year floodplains. The Carbon River flows, however, within 10-15 feet of the road between the park entrance and maintenance area as well as along large portion of the roadway from the Chenuis Falls trailhead to Ipsut Creek Campground.

Adverse effects on floodplain values in Alternative 2 would primarily occur as a result of construction of erosion protection measures, use of rock and logs from the floodplain / channel migration zone, construction of the span-log check dams in the Falls Creek area, and short-term impacts from the grade control structures on Falls Creek, Ranger Creek and the unnamed tributary (hanging culvert area) near Chenuis.

Compared to the four logjams at two sites in Alternative 1, there would be erosion protection measures constructed at 10 sites in Alternative 2. These would include logjams, gabion baskets, crib walls, road humps and spanning trees (see description of Alternative 2 in Chapter III: Alternatives). Of these, the logjams, spanning trees, some of the cribwalls, and the gabion basket trail would be within the floodplain / channel migration zone. Other portions of the cribwalls, and the road humps would be within the channel migration zone but not in the floodplain. These structures would have minor to moderate adverse effects on floodplain values that would be mitigated by actions noted in the *Impacts from Elements Common to Alternatives 2-5* section. Mitigation measures would be the same as identified in *Impacts from Elements Common to Alternatives 2-5*.

As in Alternative 1, although portions of the improved trail would continue to be within the regulatory floodplain, no statement of findings would be needed to allow it to remain because it is an excepted action (trails in or adjacent to floodplains). A *Floodplains Statement of Findings* however is appropriate for the entrance facilities and continued use of Ipsut Creek Campground, even though these facilities are technically outside of the 100- and 500-year regulatory floodplains because they have previously experienced impacts from flooding. A draft *Floodplains Statement of Findings* that addresses these and other facilities that are part of Alternative 2 (the currently preferred alternative) is attached to this Environmental Assessment as Appendix 7.

Wetlands: In addition to *Impacts from Elements Common to Alternatives 2-5*, the following impacts related to construction of the trail and erosion protection measures would also occur in Alternative 2 and could affect wetlands:

Trail Construction

- Construction of turnpike (312 feet) and gabion mattress sections (1,170 feet) for the formal improved trail (0.34 acres);
- Elevation of the trail in several sections (660 feet) (0.15 acres);
- Replacement of five culverts with trail bridges and replacement of another four log bridges with wider bridges; and

- Retention of Ipsut Creek Bridge.

Erosion Protection Measures

- Construction of span-log check dams in the Falls Creek and potentially Ipsut Creek road corridor channels;
- Construction of six log crib walls or toe-roughed log crib walls (1,220 feet) within the road corridor (north side);
- Use of gravel and cobble from above the ordinary high water mark in the Carbon River bed.

<u>Trail Construction</u>

Turnpike / Gabion Mattress Construction: Approximately 2,640 feet of new trail in the Falls Creek area and 1,584 feet of new trail in the Ipsut Creek area would be formally constructed as turnpike or gabion mattress to minimize impacts to wetlands. These methods would also be used in other areas near perennial streams or where the Carbon River has affected the former roadway. Because the trail would continue to be constructed adjacent to the washout areas, initial impacts would be the same as in Alternative 1. As informal sections of trail were replaced with these formal sections, intermittent and perennial streams would continue to be bridged. In wetlands (where no channel is evident or where there are crisscrossing channels, such as in the Falls Creek area), the trail would be designed to allow for subsurface water flow using gabion mattresses or turnpike. Total construction of a 10-foot wide formal trail outside of the former road prism and in wetlands would total approximately 4,224 linear feet (42,240 square feet), or about 0.97 acres.

Trail Elevation: Approximately 660 feet of trail would be elevated in some upland areas to allow the trail to meet grade requirements for accessibility. This would not affect wetlands.

Culvert Modifications: Impacts would be the same as in *Impacts from Elements Common to Alternatives 2-5*. In this Alternative, intermittent and perennial stream culverts would be replaced with trail bridges, rather than larger culverts. Direct wetlands impacts would primarily be associated with the construction of trail bridges over intermittent or perennial streams, including from the placement of bridge abutments.

Ipsut Creek Bridge: Short-term minor to moderate adverse impacts would continue to occur from allowing Ipsut Creek Bridge to remain in what is now a side-channel area. In addition, if the Ipsut Creek Bridge became obsolete, however, there would likely be short-term minor to moderate adverse impacts on wetlands combined with long-term beneficial impacts from removing the bridge.

<u>Erosion Protection Measures</u>

Span-Log Check Dams: Locating erosion protection measures in the Falls Creek washout channel by dropping fallen trees already in the channel would have some impacts on this intermittent riverine wetland. Up to 300 hundred square feet each (approximately 20 x15 feet) or about 0.20 acres would be affected by the placement of approximately 29 existing trees in the channel to serve as check dams to retain sediment and stabilize the channel. These check dams would be constructed wholly within the former road prism which is now a 6-10 foot-deep river channel, which supports intermittent flows (which may be changing to perennial flows) as a side channel of the Carbon River.

Log Crib Walls: Construction of log crib walls would occur where the Carbon River has taken a "bite" out of the road, either of one or both lanes. In one location, the bite also extends through both lanes into former upland forest. These log crib walls would be constructed in dry conditions and would be excavated within the former prism of the road. Actions would not extend past the existing riverbank connection point. Construction of these log crib walls could affect up to 5-10 feet of area on the road side of the former riverbank. These six affected areas would be 750 square feet, 1,500 square feet, 3,000, 3,600, 3,750, and 5,700 square feet (approximately 18,300 square feet or 0.42 acres) and would have minor to moderate adverse effects on forested and riverine wetlands but would be constructed wholly within the former road prism to allow for trail passage, and therefore are considered to be repair actions and not additional impacts to wetlands.

Farming of Gravel and Cobble: Use of gravel and cobble from river bars above the ordinary high water mark of the river would occur to support construction of erosion protection measures. Because the materials would come from above the ordinary high water mark and because access would be in the dry over one area (see threatened and endangered species section) there would be no effect on wetlands.

Alternative 3 Impacts

Physical Hydrology: In addition to *Impacts from Actions Common to Alternatives 2-5*, there would be localized minor to moderate adverse impacts on hydrology from reconstructing a one-lane road with turnouts through the washout section at Falls Creek, and the bite areas near Chenuis. With this larger physical structure (a one-lane road instead of a trail), there would be a need to import fill (angular rock) to reclaim the large gully in the vicinity of Falls Creek, a long-term localized minor to moderate adverse effect. If the reclaimed roadway lasted through additional flooding in this area, erosion could occur on either side of it or could scour away the smaller surface materials. Reconstruction of the road within the washout area could also allow for this area to be washed out again in another large flood (as happened in 1996 and 2006) or a small flood (1998) and for the material within it to spread downstream, increasing imported rock and gravel in the Carbon River channel, a potential long-term minor to moderate localized adverse effect.

Impacts from constructing a formal trail above Chenuis would be the same as in Alternative 2, with a 10-foot wide trail passing through the same areas. Over time, if a road to Chenuis was unable to be maintained, that section would also be constructed as an improved trail and would have the same construction methods and impacts as Alternative 2.

In addition to *Impacts from Actions Common to Alternatives 2-5*, and construction of six of the seven erosion protection log cribs and buried groin and log span check dams in Alternative 2, construction of an additional two log cribs (Milepost 1.457 and 2.955) and eight flow deflection logjams could affect an additional 1,000 linear feet of river bank, for a total of 5,300 linear feet, long-term moderate adverse effect.

Water Quality:

In addition to *Impacts from Actions Common to Alternatives 2-5*, there would be additional potential for impacts from private vehicle travel over the roadway. Vehicles traveling over the road typically leave behind petroleum products, such as oil and pulverized rubber. There would be a greater possibility for these contaminants in this alternative because 3.6 miles of the road would be open to private vehicle travel, rather than 1.2 miles. Because the road would continue to be unpaved (allowing filtering of contamination); because traffic on the road would be low, compared to other roadways; because the road is away from the river in some places; and because there is a relatively high volume of water in the river, it is likely that there would be long-term, but minor adverse effects.

As in Alternative 2, there would also be potential short-term impacts to water quality from construction, including excavation, fill and grading. Unlike in Alternative 2, construction would involve the use of heavy equipment and would occur over a wider area (one lane road plus turnouts). Although the road would be 12 feet wide, turnout areas would likely encompass the additional original eight feet of the road (for a total of 20 feet) to achieve a safe passing area.

Similar to *Impacts from Actions Common to Alternatives 2-5*, another turnaround would be constructed at Chenuis, requiring clearing, grading and fill to create the turnaround and expanded parking area.

As in other alternatives, because the road is mostly unpaved, dust would be generated during dry periods and would continue to coat adjacent vegetation and to wash off into the surrounding area, during storms, a long-term negligible to minor adverse effect, depending on the degree to which it was filtered, before entering the river or other waterways. Dust generation in Alternative 3 would also be greater than in Alternatives 1 or 2 because of the greater length of roadway traveled by private vehicles.

Construction impacts would be similar to Alternative 2, but would be greater from the reconstruction of a greater physical area through the Falls Creek washout area and in the vicinity of Chenuis Falls. Moving or removing downed trees from the former roadway, now a flood channel, would have localized minor to moderate adverse impacts on water quality.

As in other alternatives, there would be long-term beneficial effects from stabilization of eroded areas, from some restoration of former parking areas and from removal / restoration of some campsites.

<u>Floodplains</u>: Impacts would be the same as in *Impacts from Elements Common to Alternatives 2-5*. In addition, reconstruction of the road and continued use of other parts of the existing road would continue to affect floodplain values in the Falls Creek area. These adverse effects on floodplain values would be similar to Alternative 2, however, instead of 10 sites affected by erosion protection measures, there would be 18 sites affected with short- and long-term moderate to major adverse effects. More logjams and cribwalls would be constructed in more places. In addition the span log check dams in Alternative 2 through the floodplain at Falls Creek would be replaced by a more robust structure alongside and within the channel area that would allow retention of and reconstruction of the road. Because it is uncertain whether this structure would hold, there would be more adverse effects from its construction as well as long-term cumulative adverse effects associated with the likely need for additional actions in this area.

As a result, much of the draft Floodplains Statement of Findings describing actions in Alternative 2 (Appendix 7) would be the same for Alternative 3, including the number of sites in Ipsut Creek Campground (group sites, however would be located by combining sites, rather than at Ipsut Creek Trailhead). If Alternative 3 was eventually selected, the statement would be revised to cover Alternative 3 actions as part of the Finding of No Significant Impact (FONSI) (if applicable).

<u>Wetlands</u>: Impacts would be similar to Alternative 2, except that instead of constructing turnpike / gabion mattress trail and check dams through the Falls Creek area, this area would be filled. As a result, impacts would include:

- Filling of a portion of the Falls Creek channel (within the road prism) and construction of a 2,600-foot long complex crib wall or complex roughened large rock toe (0.89 acres);
- Filling of an area within the road at Milepost 3.1 to 3.4 (528 feet, 0.12 acres);
- Filling of an area within the road at Milepost 3.6 to 3.7 (550 feet, 0.13 acres);
- Construction of eight additional engineered logjams (0.66 acres);
- Construction of 0.3 miles of formal trail near Ipsut Creek (0.36 acre);
- Replacement of Ipsut Creek Bridge with a log trail bridge; and
- Construction of a rock-filled log crib wall at Milepost 2.955 instead of the crib wall at Milepost 3.459.

Fill Areas: Additional road fill, although it would occur within the former prism of the road in three locations would adversely affect wetlands that have developed in these areas, since the road washed out. As a result, approximately 0.89 acres of riverine wetland at Falls Creek would be filled with approximately 9,560 cubic yards of native and imported soil and rock, and two other areas comprising approximately 528 and 550 feet would also be filled, a long-term moderate to major adverse effect that would not be considered an additional impact to wetlands under the Wetlands Management Guideline because these areas would be wholly within the road prism and would be for the purpose of repairing the road.

Logjams: In addition to the four logjams in Alternatives 1 and 2 comprising impacts to 0.5 acres, there would be impacts to wetlands from the construction of eight additional logjams. As in Alternatives 1 and 2, each of these structures would be approximately 60 x 60 feet. The twelve total logjams would comprise an area of approximately 43,200 square feet or 0.99 acres of impacts to existing areas of river cobble in the

Carbon River bed. This would comprise a long-term moderate to major adverse effect since these would be constructed within the floodplain of the Carbon River, requiring a Wetlands Statement of Findings and 1:1 compensation for these impacts.

Ipsut Creek Bridge: There would be short-term minor to moderate adverse impacts on wetlands combined with long-term beneficial impacts from removing the Ipsut Creek Bridge and replacing it with a log trail bridge.

Crib Wall Construction: Constructing a log crib wall at Milepost 2.955 instead of Milepost 3.459 would likely have fewer adverse effects and would be within the former road prism, an excepted action from the Wetlands Management Guideline.

Alternative 4 Impacts

Physical Hydrology: In addition to impacts from Alternative 3, there would be impacts between Milepost 3.6 and Milepost 4.4 from reconstructing a one-lane shuttle road, resulting in additional long-term minor to moderate adverse effects.

Impacts from construction of erosion protection measures would be similar to Alternative 3, however there would likely be three fewer road humps and the potential for one additional logjam associated with one of the log cribs as well as two other logjams and an additional log crib wall. Altogether, 5,500 linear feet of river bank could be affected, a long-term moderate adverse effect.

Water Quality: Impacts would be similar to Alternative 3, however because private vehicles would not be allowed on the roadway and because shuttle use would occur primarily during peak use periods, there would be fewer potential water quality impacts from vehicle contaminants and dust generation. Use of the road would be more like the improved trail in Alternative 2, except on weekends, holidays and during the summer when the shuttle was running. Construction impacts, however, would be greater than in Alternative 3 as a result of the additional 0.8 mile length of the road (to Milepost 4.4, rather than Chenuis at Milepost 3.6). As in Alternative 3, there would eventually be long-term beneficial effects from stabilizing the eroded channel and other areas along the road because these would then contribute less sediment to the river during stormwater runoff.

Floodplains: Impacts would be the same as in *Impacts from Elements Common to Alternatives 2-5*. In addition, reconstruction of the road and continued use of other parts of the existing road would continue to affect floodplain values in the Falls Creek area. These adverse effects on floodplain values would be similar to Alternatives 2 and 3, however, instead of 10 sites affected by erosion protection measures (in Alternative 2) and 18 sites affected (in Alternative 3), there would be 21 sites affected with short- and long-term moderate to major adverse effects. More logjams and cribwalls would be constructed in more places. As in Alternative 3, the span log check dams in Alternative 2 through the floodplain at Falls Creek would be replaced by a more robust structure alongside and within the channel area that would allow retention of and reconstruction of the road. Also as in Alternative 3, because it is uncertain whether this structure would hold, there would be more adverse effects from its construction as well as long-term cumulative adverse effects associated with the likely need for additional actions in this area. Compared to Alternative 3, there would also be five additional campsites retained in Ipsut Creek Campground.

As a result, much of the draft Floodplains Statement of Findings describing actions in Alternative 2 (Appendix 7) would be the same for Alternative 4. If Alternative 4 was eventually selected, the statement would be revised to cover Alternative 4 actions as part of the Finding of No Significant Impact (FONSI) (if applicable).

Wetlands: Impacts associated with Alternative 4 would be similar to Alternative 3 except for the following actions:

- The proposed complex crib wall or toe-roughened crib wall at Milepost 3.939 could be a cribwall and/or a flow deflection logjam;
- Two additional logjams at Milepost 3.674 and Milepost 3.712; and
- Log crib wall construction at Milepost 3.750.

Logjams: As a result, impacts to wetlands from logjam construction could rise to 57,600 square feet or 1.32 acres, and would remain a moderate to major adverse effect on wetlands requiring a Wetlands Statement of Findings and 1:1 compensation for these impacts.

Log Crib Wall: The additional log crib wall at Milepost 3.750 would, as with other crib walls would have minor adverse effects and be constructed wholly within the prism of the road, and would therefore be an excepted action from the Wetland Management Guideline.

Alternative 5 Impacts
Physical Hydrology: Impacts would be the same as Alternative 1 until the wilderness reroute trail was constructed. Afterwards, there would be long-term beneficial effects from allowing the river to occupy its floodplain and channel migration zone without the impediment of a trail or road. The wilderness reroute trail would have localized, negligible to minor long-term adverse effects on Carbon River tributary streams, where these were crossed.

Water Quality: Impacts would be the same as Alternative 1, plus additional minor localized impacts would occur from construction of the reroute trail. Since the reroute trail would be well-separated from the Carbon River, water quality impacts from its construction would primarily affect local tributary streams and seeps along its route, instead of the river.

Floodplains: Impacts would initially be the same as in Alternative 1; however there would be 26 fewer individual campsites at Ipsut Creek Campground. Eventually, the downsized backcountry campground would be relocated and only parking, picnicking and a one-room visitor contact facility would remain at the Carbon River Entrance, a long-term minor adverse and beneficial effect from removal of facilities within the floodplain.

Wetlands: Alternative 5 impacts would be the same as *Impacts from Actions Common to Alternatives 2-5*. Additional beneficial effects would also result (following minor adverse effects) from removing the Ipsut Creek Bridge.

Additional short- and long-term minor adverse effects would result from construction of the reroute trail through a small number of tributary streams. Construction of the trail would bridge some tributary streams and would affect small new wetland areas for footlog abutments.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts to water resources (including floodplains and wetlands) include:

- Army Corps of Engineers (ACOE) recommended Best Management Practices would be followed to minimize potential impacts to water quality.
- Environmental Protection Agency (EPA) *Permanent Culvert Installation, Replacement and Removal Provisions* would be followed to reduce sedimentation impacts from construction activities.
- Locating staging and stockpiling areas located away from the Carbon River.
- Delineating staging areas to prevent incremental expansion of the staging area.
- Covering stockpiled fine-grained soil and rock near surface water and if overwintered with a breathable, water repellent fabric, such as silt fence, anchored around the perimeter.

- Using temporary sediment control devices such as filter fabric fences, sediment traps, or check dams as needed during culvert removal / replacement.
- Identifying the area to be cleared to define extent and clearing only those areas necessary for construction.
- Minimizing the amount of disturbed earth area and the duration of soil exposure to rainfall.
- Using bioengineering to stabilize riverbanks where erosion protection measures are employed.
- Minimizing soil disturbance and re-seeding or revegetating disturbed areas as soon as practical.
- Retaining silt fencing in disturbed areas until stabilization (by reseeding or revegetation).
- Using native duff and topsoil to cover exposed soil as soon as practical.
- Installing protective construction fencing around, adjacent to, or near wetland and/or riparian areas that are to be protected or other erosion control measures to protect water resources in the project area.
- Avoiding machinery use below the wetted perimeter of water bodies (work would be done from the bank) where possible. If not possible, dewatering of the channel would occur according to measures specified in the threatened and endangered species section.
- Using vegetable based hydraulic fluid in heavy equipment.
- Limiting the duration of the in-stream work as much as possible.
- Timing in-stream work to occur at lower flow periods (i.e., work would not occur during heavy river flows).
- Using a Storm Water Pollution Prevention Plan (SWPPP) for construction activities to control surface run-off, reduce erosion, and prevent sedimentation from entering water bodies during construction.
- Developing and implementing a comprehensive spill prevention/response plan that complies with federal and state regulations and addresses all aspects of spill prevention, notification, emergency spill response strategies for spills occurring on land and water, reporting requirements, monitoring requirements, personnel responsibilities, response equipment type and location, and drills and training requirements. Using an oil and hazardous materials spill prevention, control, and countermeasure plan to address hazardous materials storage, spill prevention, and responses.
- Conducting daily inspections of equipment used in the proposed project for fuel, oil, hydraulic fluid and other potential leaks.
- Additional consideration would be given to closing Ipsut Creek Campground during fall rain-on-snow periods.

Cumulative Impacts: Because the road was constructed alongside and within the Carbon River floodplain, there have been a series of cumulative adverse impacts to hydrology, water quality, wetlands and floodplains throughout its history. A portion of the road, primarily in the Falls Creek area lies within the floodplain of the Carbon River. Other portions of the road are very close to the 100- and/or 500-year floodplain and are affected by even moderate flooding. In addition, many areas of the road that have previously been affected by flooding are within or adjacent to the channel migration zone.

Despite the long history of episodic flooding on the Carbon River, the river has few obvious bank erosion protection structures. Buried by aggradation are the extensive log crib walls constructed in the 1930s. While these surface in a few areas (see 8. *Archeological Resources* and 9. *Historic Structures and Cultural Landscapes*), most evidence is currently indiscernible. Remnant structures primarily occur in the vicinity of the current Falls Creek washout area. Historic riprap, however is evident in several areas along the road, including in the vicinity of a steep cutbank along the road below the knob. More recent riprap is evident around the Chenuis Falls picnic area. Riprap and/or bank armoring with log-cribbing currently covers or has previously been constructed along approximately 30 percent of the road length.

Because there are few permanent structures and because the toilets at the entrance area and campground have been converted to vaults there are few ongoing impacts to water quality. Ongoing adverse impacts to water quality, however, have continued periodically associated with road maintenance and bank protection. Future maintenance of the erosion protection structures, roads and trail, would have continued water quality impacts. Former water withdrawal for entrance facilities and for housing has diminished with removal of housing and the water system from the entrance and with conversion from a surface water system at the campground to a well, which has been only intermittently available over the last ten years.

Alternative 1 would contribute minor cumulative adverse impacts on floodplains from four new logjams and two rock barbs at four sites and negligible impacts on water quality. Alternative 2 would contribute moderate cumulative adverse impacts to water quality, wetlands and floodplains (with approximately 1,700 linear feet, an additional six percent, of bank erosion protection structures at 10 sites). Alternatives 3 and 4 would have 5,300, and 5,500 linear feet of bank erosion protection measures, respectively and would contribute an additional 20 percent of bank armoring with structures at 18 and 21 sites, a moderate to major adverse impact on floodplains and wetlands and the potential for additional adverse effects on water quality from maintenance. Alternative 5 would contribute minor cumulative adverse impacts from four new logjams and two rock barbs on hydrology, water quality, wetlands, and floodplains and long-term beneficial effects on floodplains from moving a trail use corridor outside of the floodplain / channel migration zone of the Carbon River, Falls and Ipsut Creeks.

Conclusion: *Physical Hydrology*: Alternative 1 would have ongoing long-term minor to moderate adverse impacts to physical hydrology from retaining the road near the entrance and in other areas. Ongoing informal trail construction and reconstruction of the patrol cabin would contribute long-term negligible to minor adverse effects while construction of logjams would contribute minor to moderate adverse effects. These would be coupled with long-term beneficial effects from removal of facilities in the entrance area, from modifying culverts and from not repairing the road corridor.

Impacts from Alternative 2 would include the ongoing long-term minor to moderate adverse impacts from Alternative 1 associated with retention of the road in some places as well as the long-term beneficial effects from removal of facilities in the entrance area. In addition, Alternative 2 would have short- and long-term negligible to minor adverse impacts from construction of a formal improved trail, and long-term minor to moderate adverse effects from constructing road humps and log-span check dams, retaining Ipsut Creek Bridge and constructing other erosion protection measures that would alter water flow and hydrological processes. Additional long-term beneficial effects would occur from restoration of some portion of the former parking areas along the road.

Hydrological impacts from Alternatives 3 and 4 would be similar to Alternative 2, however there would be additional moderate adverse impacts from reconstructing a drivable road, retaining 3.6 miles in Alternative 3 and 4.4 miles in Alternative 4, and from constructing more erosion protection measures, including logjams and log cribs which would also be greater in Alternative 4 compared to Alternative 3.

Alternative 5 would initially have the same impacts as Alternative 1, but would later have the fewest adverse impacts on hydrological processes from removal of the road and trail within the corridor except for up 1.2 miles. Short- and long-term negligible to minor adverse effects would occur from constructing and maintaining crossings of tributary streams.

There would be no impairment of physical hydrology or values related to it.

Water Quality: Alternative 1 would continue to have long-term negligible to minor, occasionally moderate adverse effects on water quality as material continues to erode naturally out of riverbanks adjacent to the road / unimproved trail related to ongoing expansion of the Carbon River into its channel migration zone near the road / trail. Short-term minor adverse impacts could be contributed from construction of new facilities, including periodic impacts from reconstructing the unimproved trail, while negligible to minor adverse effects would continue to be contributed from use of the trail and road, from dust and from potential previous contamination from vehicle use of the road.

Alternatives 2-5 would continue to have long-term minor to moderate adverse effects from erosion noted in Alternative 1, including additional loss of the trail or road. In addition, there would be short-term minor adverse impacts from constructing grade control structures on Ranger Creek and an unnamed tributary near Chenuis. Alternatives 2-4 would also have short-term increasingly adverse effects from construction of erosion protection measures and from construction of a trail or road, ranging from minor to moderate in Alternative 2 to moderate in Alternatives 3 and 4.

There would be no impairment of water quality or water quality values.

Floodplains: There would be short- and long-term minor to moderate adverse effects on floodplain values in Alternative 1 from the placement of four erosion protection measures (four logjam and a series of two rock barbs converted to a logjam) within the Carbon River floodplain / channel migration zone; and from farming of rock and cobble in the active channel of the Carbon River for use in these erosion protection structures. Beneficial effects would occur from removal of most facilities at the Carbon River Entrance; removal of vault toilets and formal car camping from Ipsut Creek Campground; eventual conversion of 3.8 miles of road within the channel migration zone of the Carbon River to an informal trail; and from modifications to undersized culverts.

In Alternative 2, there would be short-term minor to moderate and long-term moderate adverse effects on floodplain values from placement of new erosion protection structures at 10 sites, farming of rock and cobble in the active channel of the Carbon River for use in erosion protection structures, prevention of channel avulsion, and the prevention of channel overbank sedimentation that would lead to an increased threat of catastrophic flooding. For facilities that remain in floodplain, and with the exception of bank erosion, flood hazards are relatively minor (depth less than about 3.4 feet, velocity less than 4.3 feet per second) and advance warning of hours to days is likely. These impacts are mitigated, to some extent, by several actions that would have beneficial effects from enhancing floodplain values. These include removal of NPS maintenance facilities and most facilities at the park entrance; removal of vault toilets and formal car camping and facilities at Ipsut Creek Campground; conversion of 3.8 miles of roadway within the floodplain to a formal improved trail; and removal of undersized culverts and stabilization of stored mobile sediment upstream of the culverts.

Alternative 3 would have short-term moderate and long-term major adverse effects on floodplain values from placement of new erosion protection measures at 18 sites and from the other actions noted in Alternative 2. Compared to Alternative 2, there would be additional adverse effects from reconstruction of 2,600 feet of road through the Falls Creek washout area and through the bites near Chenuis. Beneficial effects in Alternative 3 would be the same as in Alternative 2 except that there would be conversion of 1.4 miles of road to formal improved trail, compared to 3.8 miles in Alternative 2.

Alternative 4 would have major adverse effects on floodplain values from placement of new erosion protection measures at 21 sites and from the other actions noted in Alternative 2. Compared to Alternative 3, there would be additional adverse effects from reconstruction of 2,600 feet of road through the Falls Creek washout area and through the bites near Chenuis plus additional areas beyond Chenuis. Beneficial effects in Alternative 4 would be the same as in Alternative 3 except that there would be conversion of 0.6 miles of road to formal improved trail, compared to 3.8 miles in Alternative 2 and 1.4 miles in Alternative 3.

Alternative 5 effects would be similar to Alternative 1, with more long-term beneficial effects from discontinuing long-term maintenance on the trail.

There would be no impairment of floodplains or floodplain values.

Wetlands: In Alternative 1, new impacts to wetlands (construction of four engineered logjams) would affect 0.5 acres, with short- and long-term minor adverse effects.

In Alternative 2, new impacts to wetlands would also affect 0.5 acres for the four engineered logjams. In addition, there would be a series of additional impacts to wetlands formed from recent flooding of the Carbon River Road (within the road prism). Effects to these would comprise an additional 0.97 acres. Total impacts to wetlands could comprise up to 1.3 acres, including from fill placed for the trail and within the former road corridor. Long-term beneficial effects would occur from removal of fish-blocking culverts at Falls Creek, Ranger Creek, an unnamed tributary near Chenuis and associated with intermittent and perennial stream culverts along the former road (approximately four other culverts and one road hump would be replaced with new trail bridges), restoring 1.3 acres to fish passage and providing 0.5 acres of large woody debris habitat for beneficial effects totaling 1.8 acres. Overall, approximately six acres of wetlands were likely affected by original construction of the Carbon River Road.

In Alternative 3, new impacts to wetlands from 12 engineered logjams would comprise 0.99 acres. In addition, many of the same impacts in Alternative 2 would also occur. Additional impacts would be caused by construction of crib structures in three other locations, including 2,600 feet in the Falls Creek area and by filling bite and gully areas up to Milepost 3.6. Total impacts to wetlands could comprise up to 2.55 acres, including from fill placed within the former road corridor.

In Alternative 4, new impacts to wetlands from up to 16 engineered logjams would comprise 1.32 acres. One of these could potentially be constructed as a crib wall and there would be impacts from one additional cribwall compared to Alternative 3. Other impacts would be the same as in Alternative 3. Total impacts to wetlands could comprise up to 2.96 acres, including from fill placed within the former road corridor.

In Alternative 5, new impacts to wetlands (construction of four engineered logjams) would affect 14,400 square feet or 0.5 acres. Additional minor adverse impacts would occur in Alternative 5 from new crossings of tributary streams on the reroute trail.

There would be no impairment of wetlands or wetland values.

4. Vegetation Impacts

Alternative 1 Impacts

Unimproved Trail: There would be minor adverse effects on vegetation from continuing to maintain an unimproved trail within or adjacent to the historic road corridor. Impacts from maintaining the unimproved trail would include cutting or trimming vegetation, including small trees, shrubs and forbs, adjacent to the trail as well as periodic removal or modification of downed trees to facilitate trail passage.

Without stabilization of the flood channel within the roadway near Falls Creek and above Chenuis, trees with partially exposed roots along the old shoulder line of the road would likely continue to uproot and fall into the channel or across the trail. Because this area would be maintained as a floodway (to allow flood flow passage of the Carbon River, as soils continued to erode during normal precipitation, additional trees would continue to become undermined. With trees falling into the washout areas, these areas could also begin to stabilize from trees trapping sediment and smaller debris and could begin to host new vegetation that would contribute to additional stabilization. Alternatively, if floodwaters entered the washout area during another major flood event, the erosion process could accelerate and could cause additional tree loss or additional scouring out of the channel.

In other areas, the Carbon River would continue to erode soils at the toe of over-steepened slopes during high flows. Vegetation on the top of these steep banks would also therefore continue to erode and slough off into the main river channel. During future flooding, where soils eroded quickly, additional bite sections could form in river eddy areas. Natural stabilization of these areas, including revegetation, could also begin to occur over time if eroded sections met bedrock or natural logjams formed nearby.

There would also continue to be ongoing minor to moderate adverse impacts from the introduction of non-native plants associated with past projects and activities. Because materials used for the unimproved trail would be from nearby areas in the corridor with little or no imported fill or would be imported, there is a potential for contamination of intact areas with non-native invasive vegetation, a long-term minor to moderate localized adverse effect that would be minimized through mitigation measures, including the selection of fill materials from nearby uncontaminated areas and/or from washing materials such as imported gravel.

Facility Construction: There would be long-term minor adverse impacts from loss of vegetation associated with reconstruction of the Ipsut Creek Patrol Cabin at the entrance to serve as a visitor contact facility.

Facility Removal: Removal of entrance area buildings and road-associated features, such as parking areas, bumper stops and other obsolete infrastructure, as well as vault toilets and other structures from the campground, would have short-term negligible adverse effects from disturbing vegetation and long-term beneficial effects from opening new areas for native vegetation to establish.

Erosion Protection Measures: Continued erosion near the maintenance area could diminish from placement of two barbs in the floodplain near the maintenance area that could be reengineered as a logjam and from placement of two barbs and four engineered logjams near the entrance and the maintenance area to redirect flow away from the bank back toward the center of the floodplain away from the entrance facilities. Placement of these structures would have short-term minor adverse and long-term beneficial effects from loss of additional vegetation along the riverbank and from decreasing erosion.

Campground: There would continue to be minor adverse effects from continuing to maintain a campground within an old-growth forest at Ipsut Creek. Campground impacts would include occasional removal or trimming of vegetation near campsites, ongoing hazard tree management according to the *Hazard Tree Plan* and its *Finding of No Significant Impact* (FONSI) (NPS 2010), including removal or retention of trees and closure of affected campsites. Under the Hazard Tree Plan, some campsites where very large defective trees are located would continue to remain closed until the trees fell. In other alternatives, these campsites would likely be among those permanently closed and restored.

Restoration: Over time, unused areas of the road could begin to acquire vegetation as trees and shrubs began to establish in areas where no or low use occurred. Because there would no longer be maintenance of the road prism under this alternative, this vegetation would continue to establish and could eventually result in a narrowing of the portions of the road corridor that have not been affected by flooding. There would also be less removal of natural tree fall alongside the road, since there would be less need for access. Vegetation could also begin to establish in protected areas adjacent to fallen trees. Combined, these would be long-term beneficial effects.

Impacts from Elements Common to Alternatives 2-5

Facility Construction: There would be a series of negligible to minor adverse effects from the construction of a small visitor contact station at the Carbon River Entrance and from reconstruction of Ipsut Creek Patrol Cabin in the Carbon River area (Alternatives 2-4), at the entrance (Alternative 1) or in the boundary expansion area (Alternative 5). Although the locations for the patrol cabin would be different, the impacts would be similar, with potential impacts to vegetation in a small footprint. Similarly construction of the visitor contact station in the former location of the fee booth would have minor adverse impacts on vegetation that would be slightly greater in Alternatives 2-4 compared to Alternative 5.

Because expansion would occur in the existing footprint, negligible adverse impacts on vegetation would occur from conversion of the trailhead parking area at the Old Mine to a vehicle turnaround. Conversion of the former built areas at the Carbon River entrance to parking would have long-term localized minor to moderate adverse effects on vegetation from loss of vegetation between and surrounding buildings in this highly disturbed area. Construction of new backcountry toilets at the campground would have negligible adverse effects on vegetation.

Erosion Protection Measures: In addition to impacts from Alternative 1 (barbs and logjams at entrance and maintenance area), proposed removal of the very large culverts at Ranger Creek (120 inches) and the tributary at the Chenuis Trailhead (72 inches) would affect vegetation at the location of the culvert and upstream where grade control structures would be located to trap this sediment from flushing out completely once the culverts are removed. These actions would have short- and long-term minor adverse effects.

Facility Removal / Restoration: Long-term beneficial impacts would occur from passive revegetation of some former parking areas and campsites (varies among alternatives) as well as from removal of obsolete infrastructure, such as vault toilets, parking bumpers, and asphalt, and from scarifying hardened surfaces. Removal of the Carbon River Ranger Station, two sets of campground vault toilets, the water system chlorinator building, Ipsut Creek trailhead parking area, obsolete signs, asphalt and other infrastructure, and removal and/or replacement of perennial and intermittent stream culverts would have short-term negligible to minor adverse and long-term beneficial impacts on vegetation. Relocation of the CCC garage to boundary expansion lands would have long-term beneficial effects in the Carbon Area (since use of this area would be converted to parking) and long-term minor adverse effects from its later reconstruction at an unknown location. Removal of the Ipsut Creek Bridge under Alternatives 3-5 and its potential removal under Alternative 2 would also have short-term minor adverse and minor to moderate long-term beneficial impacts on vegetation from restoring vegetation in a floodplain / riparian wetland.

Alternative 2 Impacts

Improved Trail: There would be minor to moderate short-term and long-term beneficial and adverse impacts on vegetation from constructing an improved trail within or adjacent to the Carbon River corridor in washout areas. Impacts would be similar to Alternative 1 except there would be a potential for less long-term maintenance with the improved trail. Other impacts from both alternatives would include altering or removing vegetation in and alongside the trail. Under the current design, approximately 15 trees between 10 and 24 inches and 29 trees less than 10 inches would be removed (Table 29). As areas continue to erode before stabilization, additional trees could also be affected. In addition there would be removal of some very large (24-60 inches) stumps and cutting through some very large logs. In some areas, stabilization measures would likely result in impacts to currently undisturbed forested areas.

As in Alternative 1, because the large flood-created gully at Falls Creek and where Ipsut Creek and the Carbon River combined would not be filled and would instead be used as floodways to accommodate continued high flows, large trees would likely continue to fall but could stabilize over time as other debris and sediment were trapped. Stabilization would be aided from the creation of some check dams using large fallen logs in the Falls Creek area to increase sediment deposition. Grade control structures (rock-filled trenches) placed at intervals along the road would help to minimize additional vegetation loss through head-cutting erosion and undercutting of tree roots.

Although the undamaged road prism would no longer be maintained by heavy equipment and roadside ditches and other features could begin to fill, where not needed to maintain the trail, there would be ongoing maintenance of vegetation along the roadsides to maintain the general character and width of the undamaged sections of road. This would primarily include removal of trees and shrubs, a long-term minor adverse effect on vegetation. It is likely, however, that shade tolerant forbs would also establish along the edges, with long-term beneficial effects, especially where use became concentrated in another area for the trail.

As in Alternative 1, ongoing minor to moderate adverse impacts would continue to occur from the introduction of nonnative plants associated with past projects and activities. A variety of nonnative invasive plants are found along the existing road (see Chapter IV: Affected Environment). Non-native Plants take advantage of trails, water, wind, roads, people, importation of fill, and vehicles as dispersal mechanisms to colonize new areas. Since most noxious and nonnative invasive species have a competitive advantage in disturbed areas, areas denuded by construction, or left unfinished would be the most likely places for invasive plants to become established. As a result, disturbed areas would be minimized and where possible, revegetation would occur immediately following construction. Most areas in Alternative 2, as in Alternative 1, however would undergo passive, rather than active revegetation, with limited planting or seeding taking place.

Additional minor adverse impacts could also occur where fill was imported to create the improved trail. For the most part, however, materials used for the improved trail would be native materials. Where imported materials were used, best management practices would be used to ensure that invasive plant free fill materials were obtained and that areas where they were used were monitored over time to minimize threats from non-native plants. Where native materials were used, these would be obtained from weed-free areas or the areas would be treated prior to removal of the materials.

Facility Construction: In addition to *Impacts from Elements Common to Alternatives 2-5*, there would be long-term minor adverse impacts on vegetation from the construction of a visitor contact station and arch and from construction of approximately 11 trail bridges (of various length and construction) over the nearly five miles of the trail.

Erosion Protection Measures: In addition to *Impacts from Elements Common to Alternatives 2-5*, there would be short- and long-term minor adverse impacts from placement of grade control structures (approximately 20-24 road humps) at various locations along the road to direct water flow off of it during future flooding. These road humps would lie in the path of and cross the existing road or trail and would primarily affect vegetation along the edges of the roadway.

Existing trees that have fallen into the Falls Creek channel area would be used as span logs to create check dams where they lie. Based on a log survey, there are currently 29 fallen trees that span the channel (nine trees that are 1-2 feet dbh, 10 trees that are 2-3 feet dbh, 4 trees that are 3-4 feet dbh, two trees that are 4-5 feet dbh, and four trees that are 5-6 feet dbh) that could be used over the 2,600 foot length of the washed out section to reduce additional erosion. If additional trees were to fall into the channel, those could be used as well. Whether or not these span logs or others would be used is based on the orientation of the root wad. Those with rootwads on the trail or road side would be incorporated, while those with rootwads on the river side would likely not be incorporated.

There would also be minor short-term adverse and potential long-term beneficial effects on vegetation from placement or log span check dams in the Falls Creek wash out channel, similar to those noted in *Impacts from Elements Common to Alternatives 2-5* at Ranger Creek and the unnamed tributary near Chenuis. These impacts would occur from removal of vegetation during construction and from potential establishment of vegetation from soil retention over time.

There would also be long-term minor adverse and beneficial effects on vegetation from the placement of log crib walls and some fill in bite areas. These log crib walls would reduce erosion of the road prism where the trail passed through the existing road corridor, would help to retain vegetation along steep cut-banks, and would aid in revegetation where major erosion has taken place. Long-term minor to moderate adverse effects would occur from the placement of these structures where vegetation needed to be removed, coupled with long-term beneficial effects from bioengineering (incorporating revegetation into the design of the erosion protection structures) associated with them and from stabilization of eroded sections of roadway. Long-term beneficial and adverse effects on vegetation would occur from the placement of:

- Milepost 3.459: potential log crib or diversion structure,
- Milepost 3.463: potential log crib or diversion structure,
- Milepost 3.939: engineered logjam or log crib wall,
- Milepost 4.470: engineered logjam or crib structure,
- Milepost 4.621: buried groin
- Milepost 4.658: buried log crib wall,
- Milepost 4.802: possible buried log crib wall.

Together these structures would modify approximately 1,700 feet of the left bank (looking downstream) of the Carbon River, with short-term minor and long-term minor to moderate adverse effects on vegetation. Overall effects would be minor to moderate.

Facility Removal / Restoration: In addition to *Impacts from Elements Common to Alternatives 2-5*, there would be long-term beneficial effects from some scarifying of former parking areas at the Chenuis and Green Lake trailheads and possible scarification of 10 feet of roadway where not used for the trail in the historic road corridor in preparation for passive revegetation. This passive restoration would begin natural succession in this wet forest, resulting in colonization and stabilization of the road fill, a decrease in soil compaction, an increase in organic matter and eventually a return to a forested area where trees and shrubs were not removed in the historic road corridor. Restoration / removal of approximately 15 individual and one group campsites would also have long-term beneficial effects.

Active restoration of disturbed areas would occur within Ipsut Creek Campground, in roadside parking areas, and for landscaping around new structures in Alternative 2. If Ipsut Creek Bridge was later removed, there would be short-term minor adverse effects on vegetation, followed by long-term beneficial effects from removal and reestablishment of channel lining riparian vegetation.

Table 29: Estimated Tree Removal in Alternative 2

Location feet (mile)	Species	Size (inches)	Reason
6550 (1.24)	downed log	unknown	to clear exit channel to river
8087	western hemlock	12	to achieve trail width
8312	stump	72	to achieve trail width
8422	western hemlock	8	to achieve trail width
8446 (1.60)	downed log (remove 2 feet)	unknown	to achieve trail width
8485	stump	48	to achieve trail width
8509	western hemlock	6	to achieve trail width
8708	western hemlock	12	to achieve trail width
8708	stump	60	to achieve trail width
9006 (1.71)	snag	10	to achieve trail alignment and width
9258	western hemlock	4 (cluster of 6)	to achieve trail width
9426	downed log (remove 3 feet)	unknown	to achieve trail width
9462	western hemlock	18	improve safety of alignment
9566 (1.81)	western hemlock	6	to achieve trail width
9927	red alder	12	to locate new bridge
10178	white fir	8	improve safety of alignment
10185	western hemlock	6	improve safety of alignment
10226	western hemlock	6 (cluster of 3)	improve safety of alignment
10279 (1.95)	western hemlock	12	improve safety of alignment
10291	snag	12	improve safety of alignment
10307	western red cedar	16	improve safety of alignment
10331	western red cedar	24 (hollow)	improve safety of alignment
18265 (3.46)	western hemlock	3 (2)	improve safety of alignment
18265	red alder	10	improve safety of alignment
18265	western hemlock	6 (2)	improve safety of alignment

18265	red alder	6	improve safety of alignment
18265	red alder	12 (2)	improve safety of alignment
23276 (4.40)	fallen logs	unknown	to achieve trail width
23352	rootwads and downed trees	unknown	to achieve trail width
23465	stumps	24 (2)	to achieve trail width
23657	western hemlock	3-5 (4)	to achieve trail width
23657 (4.48)	stumps	24-36 (2)	to achieve trail width
24168	western hemlock	6	to achieve trail width
24241	stump	36	to achieve trail width
24288	stump	unknown	to achieve trail width
24346	western hemlock	18	to achieve trail width
24346 (4.61)	stump	unknown	to achieve trail width
24416	white fir	12	to achieve trail width
24416	stump	unknown	to achieve trail width
24486	western hemlock	4	to achieve trail width
24496 (4.64)	western hemlock	3	to achieve trail width
24502	western hemlock	4	to achieve trail width
24539	white fir	18	to achieve trail width
24539	stump	unknown	to achieve trail width
24813	western red cedar part of rootwad	48	to achieve trail width
24827 (4.70)	stump	unknown	to achieve trail width
24895	western hemlock	24	to achieve trail width
25053	white fir	8	improve safety of alignment
25053	stump	unknown	improve safety of alignment
25131 (4.76)	western red cedar part of rootwad (cut or move)	48	improve safety of alignment

Alternative 3 Impacts

One Lane Road with Turnouts: There would be moderate adverse and beneficial effects on vegetation from reestablishing a one-lane road with turnouts through washout areas up to Chenuis. Adverse impacts would be related to construction, while beneficial impacts would be related to possible additional retention of trees lining the Falls Creek washout channel, where existing erosion would be stabilized by reconstruction of the road, however where additional erosion into the area would also likely continue to occur.

Short-term minor to moderate adverse effects would also occur from removing vegetation to gain access to the washout areas for reconstruction of the roadway, while long-term beneficial effects would occur from fill placement within the gully that would allow for stabilization of trees on the edge of the gully and prevent ongoing expansion of the gully from causing more trees along the edges to fail. At the same time, there may be long-term minor to moderate adverse effects where trees have had their roots exposed and damaged during and after the flood that would now be exposed to increased root compaction, which could increase their vulnerability. Potential tree loss along the shoulder line of the washout could be reduced. Although some trees within the washout channel would be stabilized, it is likely that a large number of trees alongside and south of it in the Falls Creek area would need to be removed to recreate a one lane road, in addition to constructing a log crib adjacent to it and maintaining a flow channel in a portion of the former roadway. As in Alternative 2, importation of fill could have minor adverse effects, which would be mitigated by the fill being retained as the driving surface and from best management practices to ensure invasive plant free fill and long-term monitoring for nonnative invasive plant establishment. Sterile fill and riprap and planting of native seed following construction would prevent establishment of nonnative, invasive plants.

Improved Trail: Impacts from establishing an improved trail between Chenuis and Ipsut (Milepost 3.6 to 4.8) would be the same as in Alternative 2, with more beneficial effects from restoring some former roadway in that section. As shown in Table 29, no additional trees would be removed past Milepost 4.76. Approximately two trail bridges, however, would be constructed.

Facility Construction: As in Alternative 2, in addition to *Impacts from Elements Common to Alternatives 2-5*, there would be long-term minor adverse impacts on vegetation from the construction of a visitor contact station and arch at the Carbon River Entrance. There would also be a series of long-term minor to moderate adverse impacts from the construction of box culverts, large or open-bottom culverts to reconstruct the road through the Falls Creek washout and the bite at Milepost 3.5 (as in Alternative 2), but also the bites at Mileposts 3.9 and 4.4. These impacts would be minor in the vicinity of small tributary or snowmelt culverts and moderate associated with crossings through Falls Creek, Ranger Creek and the tributary near the Green Lake Trailhead.

Erosion Protection Measures: Actions and impacts would be similar to, but greater than Alternative 2. While the log span check dams would be used in the Falls Creek washout area, there would be no humps. Instead a very long (2,600 feet) complex crib wall with a roughened toe would be constructed. This crib wall would be aligned in part of the washout channel, leaving a smaller floodway with span log check dams alongside it. As a result, reconstruction of the road would include placement of fill in part of the channel, adjacent to the complex crib wall, but would also require removal of trees and vegetation adjacent to the channel to achieve the proposed 12-foot width of the road. Approximately 18 trees from 3-18 inches dbh would be removed, including two trees over 18 inches dbh. Alternative 3 would also decrease erosion along other parts of the road from construction of engineered logjams to redirect flow away from the bank back toward the center of the floodplain, resulting in reduced bank erosion in these areas, a long-term beneficial impact on vegetation.

Instead of removal of the very large culverts at Ranger Creek (120 inches) and the tributary at the Chenuis Trailhead (72 inches) and replacement of trail bridges, these culverts would be replaced on grade with fish-friendly designs, either open bottom or larger or box culverts. As in Alternative 2, grade control structures would be located to trap sediment from flushing out completely once the culverts are removed. As in Alternative 2, these actions would have short- and long-term minor adverse effects on vegetation.

In addition, all of the structures noted in Alternative 2 would also be part of Alternative 3, including:

- Milepost 3.463: potential log crib or diversion structure,
- Milepost 3.939: engineered logjam or log crib wall,
- Milepost 4.470: log crib wall,
- Milepost 4.621: buried groin,
- Milepost 4.658: possible buried log crib wall, and
- Milepost 4.803: possible buried log crib wall.

As in Alternative 2, these actions would have minor to moderate short-term localized adverse impacts to vegetation from construction and long-term minor adverse and beneficial impacts from placement. In addition, there would be a number of additional structures in Alternative 3 at:

- Milepost 1.457: log crib wall,
- Milepost 2.955: rock-filled log crib wall,
- Milepost 2.992: engineered logjam,
- Milepost 3.030: engineered logjam,
- Milepost 3.068: engineered logjam,
- Milepost 3.106: engineered logjam,
- Milepost 3.523: engineered logjam,
- Milepost 3.561: engineered logjam,
- Milepost 3.598: engineered logjam, and
- Milepost 3.636: engineered logjam.

There would be additional short-term minor to moderate adverse impacts from construction of these measures, as well as minor long-term adverse and beneficial impacts from placement. While the logjams would be unlikely to affect vegetation because they would be located along the edge of the unvegetated channel, the log crib walls would be constructed parallel to the alignment of the road and would be anchored on either end into existing vegetated areas and the buried groin would extend across the road, affecting existing vegetation on one side. Together these structures would modify approximately 5,300 feet of the left bank of the Carbon River. Overall effects on vegetation would likely be moderate because areas where these structures would be placed have little vegetation due to the washouts (log cribs) and/or would primarily be in the channel (logjams).

Vegetation adjacent to the washout area would be protected from damage during construction from construction limits located close to the former road shoulder. As much as possible, proposed work, including for replacement culverts, would be designed to avoid remaining trees.

Removal of Facilities / Restoration: There would be long-term localized beneficial effects from restoring approximately fifteen individual and one group campsites at Ipsut Creek. There would be short-term minor adverse effects on vegetation, followed by long-term beneficial effects from removal and reestablishment of channel lining riparian vegetation from the removal of Ipsut Creek Bridge.

Alternative 4 Impacts

One Lane Shuttle Access Road: Impacts would be similar to Alternative 3, with short-term moderate adverse and long-term beneficial effects, except that instead of reconstructing a 12-foot wide road with turnouts, a 10-foot wide road would be reconstructed with a turnaround at Milepost 4.4. As a result of the smaller width there would be fewer direct impacts to vegetation. Alternative 4 however would need to cross three bite areas and the Falls Creek washout and would therefore require more fill (approximately an additional 1,500 cubic yards) than Alternative 3, which crosses one bite area and the Falls Creek washout. Alternatives 3 and 4 would therefore have more indirect impacts from more fill potentially allowing for nonnative invasive plants to establish.

Facility Construction: Actions and impacts would be the same as Alternative 3.

Erosion Protection Measures: Impacts would be similar to Alternative 3 (short-term minor and long-term moderate adverse effects), with construction of the same structures, except that in Alternative 4, there could be construction of up to two additional logjams, a log crib wall in conjunction with another logjam and one, rather than four road humps. The additional logjam would be near Milepost 3.939:

- Milepost 3.674: engineered logjam,
- Milepost 3.712: engineered logjam, and
- Milepost 3.750: log crib wall.

Together these structures would modify approximately 5,500 feet of the left bank of the Carbon River, with short-term minor and long-term moderate adverse effects on vegetation. As in Alternative 3, there would also be long-term beneficial effects from bioengineering associated with the construction of the erosion protection measures. Overall effects would remain moderate.

Facility Removal / Restoration: Impacts would be similar to but fewer than Alternative 3. There would be approximately five fewer restored campsites at Ipsut Creek because the campground would be larger. Unlike in Alternative 3, a portion of the parking areas along the road at Green Lake Trailhead and Chenuis would be restored, but there would be fewer miles of road converted to trail beyond the end of the road (0.6 compared to 1.4 miles in Alternative 3). As in Alternative 3, there would be short-term minor adverse effects on vegetation, followed by long-term beneficial effects from removal and reestablishment of channel lining riparian vegetation from the removal of Ipsut Creek Bridge.

Alternative 5 Impacts
Interim Unimproved Trail: Actions and impacts would be the same as in Alternative 1 from continuing to maintain an unimproved trail in the Carbon River road corridor.

Wilderness Reroute Trail: This new trail that would be a minimum of five miles long would affect existing trees and other vegetation over approximately 1.9 acres (5.2 miles x 3 feet wide). As a result, vegetation removal would be greater than in other alternatives, affecting approximately 200 trees with a maximum dbh of 30 inches. Most trees, however, would be less than 24 inches dbh. Where possible, trees greater than 10 inches would be avoided, but some would necessarily be cut to maintain a reasonable alignment for the trail. This would affect a currently undisturbed area (within the GMP pristine zone) in the unique Carbon River area, a long-term localized moderate to major adverse effect. As in Alternative 2, additional vegetation would be affected by the construction of trail bridges over tributary streams and from the installation of snowmelt drainage culverts.

Erosion Protection Measures: Actions and impacts would be the same as Alternative 1, with up to four logjams between the entrance and the maintenance area (including two that would be constructed as barbs and later modified to be a logjam).

Facility Construction: In addition to *Impacts from Elements Common to Alternatives 2-5*, there would be long-term minor adverse impacts on vegetation from the construction of a one-room visitor contact station in the location of the former fee booth at the Carbon River Entrance, a negligible to minor adverse impact on vegetation. As noted above, there would also be construction of an unknown number of trail bridges along the reroute trail.

Facility Removal / Restoration: In addition to *Impacts from Elements Common to Alternatives 2-5*, there would be a large reduction in the number of campsites at Ipsut Creek, from 21 individual and one group campsites (with an additional 9 sites currently closed) to 4 individual and one group site. As a result, campsites, tent pads, parking areas and other campground infrastructure associated with these would be removed and the areas scarified in preparation for passive revegetation. The remaining campsites would be retained until another location is selected for a backcountry camp along the new wilderness reroute trail, at which time, they too would be closed and scarified. There would be short-term minor adverse effects on vegetation from the removal of the bridge, followed by long-term beneficial effects from removal and reestablishment of channel lining riparian vegetation.

Eventually, in addition to replacement of existing fish passage culverts with better designs for the unimproved trail, there would be removal of all of the fish passage and snowmelt drainage culverts along the unimproved trail and the former road corridor to allow for passive revegetation of this area once the wilderness trail was constructed. As a result, there would be short-term minor adverse impacts on vegetation, followed by long-term beneficial impacts. Without active restoration of the area and reestablishment of topography, these beneficial impacts would be somewhat limited because they would not entirely obliterate the road or trail corridors and it would likely remain visible for decades, similar to other abandoned road corridors in the park, except that evidence of the areas closest to the river corridor would be more likely to disappear.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts to vegetation include measures identified above under soils and geology plus:

- Minimizing construction limits and areas to be cleared, where possible.
- Clearly identifying the construction limits, to prevent expansion of construction operations into undisturbed areas.
- Retaining specimen trees (as identified by park staff) where possible adjacent to erosion protection sites (Alternatives 1-5) and along the wilderness reroute trail (Alternative 5).
- Salvaging plant material, prior to construction, from areas to be disturbed.

- Restoring staging and other temporarily impacted areas following construction.
- Minimize vegetation disturbance during project operations by staging on road and/or shoulder or other disturbed areas.
- Minimize the threat of exotic plant infestations by not gathering native materials from existing infested areas.
- Only importing freshly exposed subsurface materials.
- Covering trucks when transporting materials outside the project area to reduce or eliminate particle release during transport.
- Washing all vehicles having contact with soil or materials that may contain noxious weed seed prior to working in weed free areas or transporting weed free materials.
- Separating contaminated soil from weed free soil and using it for subsurface fill.
- Conducting annual monitoring for potential weed infestation.
- Identifying and controlling exotic plant species infestations prior to construction.

Cumulative Impacts: Over time, there have been a variety of short- and long-term minor to moderate localized adverse impacts to vegetation from operation and maintenance of the facilities at the Carbon River area, including the historic Carbon River Road, area trails and Ipsut Creek Campground. These impacts have included selective logging in the area to construct facilities, such as the historic buildings and structures and former log-cribbing, as well as actions by former private landowners to construct buildings, mine and log in the area. In addition, there have been many incursions by the river during flooding exacerbated by increasing aggradation wherein much of the forest buffer that formerly existing between some sections of roadway and the active river floodplain has been removed. This has been most evident in the last two decades in the Falls Creek area. Although many very large old growth trees were specifically saved during the historic construction of the road, the presence of these trees in the Falls Creek area along the road has led to their an increased loss from flooding relative to what would have been lost naturally because the river followed the road corridor and these trees have been undermined. Other impacts have included damage and loss of trees from visitor impacts and from compaction associated with use of the road and campground, contributing to defects or loss of trees and other vegetation. Alternative 1 would contribute minor cumulative adverse effects, while Alternatives 2-4 would contribute minor to moderate cumulative adverse and beneficial effects and Alternative 5 would contribute moderate cumulative adverse effects from disturbance in a new area and beneficial effects from restoration of the former road corridor over time.

Conclusion: There would be long-term minor to moderate adverse effects and beneficial effects on vegetation from the implementation of Alternative 1. There would be long-term negligible to moderate adverse and localized beneficial effects from construction of the Alternatives (2-4), with moderate to major localized adverse effects in Alternative 5. Beneficial effects would be greatest in Alternative 5, from greater area restoration of the road in the river corridor, followed by Alternatives 1, 2, 3 and 4, while adverse effects would also be greatest in Alternative 5 (from more physical modification of undisturbed vegetated landscape), followed by Alternatives 4, 3, 2 and 1. There would be no impairment of vegetation or its values from proposed actions if implemented in any of the alternatives.

5. Wildlife Impacts

Note: *Additional wildlife impacts are discussed in the special status wildlife (threatened and endangered species) section. Where species have similar life histories, impacts associated with these two sections would also be applicable.*

Habitat modification described below would affect a variety of species, including birds, mammals, amphibians and reptiles, fish and invertebrates, including land and water snails and species of special management concern. Effects would vary associated with the species depending on their life history (birds and mammals would be more likely to flee the area if disturbance occurred whereas invertebrates would be more likely to suffer direct mortality from project actions). Alternatives with greater intact habitat disturbance (Alternative 5) and alternatives with more disturbance within the road corridor (Alternatives 3 and 4) would tend to have more direct and indirect effects on wildlife than would alternatives that primarily affect existing previously modified habitat and a small new area of undisturbed habitat (Alternatives 1 and 2). Overall effects would range from negligible to moderate and would affect individuals but not populations.

Alternative 1 Impacts

Noise and Activity during Construction: There would be disturbance of wildlife associated with ongoing noise and activity from maintenance and rehabilitation of the existing unimproved trail. Above ambient noise would occur throughout project implementation in the late spring through fall. Impacts would include short-term minor adverse effects associated with ongoing removal of non-historic buildings and structures from the Carbon River Entrance and maintenance area and from the reconstruction of the Ipsut Creek Patrol Cabin at the entrance. There would continue to be ongoing effects from an unnaturally increased population of corvids in the area related to area picnicking and camping facilities. Effects on other terrestrial wildlife species would include disturbance during construction activities, diminished presence in the area related to visitor use and disturbance from periodic maintenance activities. Wildlife, particularly medium and large mammals, would tend to avoid construction areas during daylight hours when construction was occurring. During other times, wildlife would be expected to return to the project areas. Some species, such as birds, could also be seen throughout the day. Because a great deal of suitable wildlife habitat would continue to be available in the area, impacts would be short-term, localized and negligible to minor.

Habitat Modification: New impacts would be associated with construction of a series of two proposed barbs that would be converted to a logjam and three additional logjams at the entrance and maintenance area. Approximately 3,600 square feet (0.08 acre) would be directly affected, with additional short-term and indirect effects to another area for access, dewatering and construction limits, with short- and long-term minor to moderate localized adverse effects. Impacts from the construction of these could affect species with life histories in association with water, because they would be constructed within the floodplain. Short-term impacts would include noise and disturbance from construction, while long-term impacts would occur from placement of these below the ordinary high water mark within the Carbon River floodplain. There would be minor adverse and beneficial effects on stream habitat from the downstream eddy effect of barbs. Barbs unnaturally increase the diversity of habitats by increasing the amount of pool habitat compared to the amount of riffle habitat. Pools are less frequently observed on the Carbon River than riffles, which are the most common habitat type in the main channel of the Carbon River. Placement of a bank barbs would create eddies or "pocket pools" upstream and downstream, with approximately 1,000 square feet for a 100-foot long structure. The barbs could also reduce the amount of large woody debris and gravel recruitment from the bank, a long term negligible adverse impact because of the extremely high aggradation rate on the Carbon River and the general lack of large logjams. Because barbs are designed to be overtopped by high flows, the barbs would not cause an increase in flooding of overbank areas. Most of their effect is to direct flow laterally away from the bank, toward the center of the river.

Effects of constructing four small logjams would also deflect and absorb energy to slow bank erosion, and cause local pool formation by creating turbulence that erodes a scour hole into the bed of the stream. The logjams would be composed of logs, anchored, buried or pinned to the river bottom. Their installation would require excavation of the bank and/or river bed. Compared to barbs, logjams offer an advantage of being made from native material that is often far less costly than imported boulders, however if not present in the area, logs may be more expensive to fly in. Logjams also allow for the beneficial effects of large woody debris to be used effectively to create habitat for fish, amphibians, and aquatic insects. As a result, creation of these logjams would have short-term minor to moderate localized adverse effects, affecting water quality and stream organisms in the vicinity of the structure and long-term beneficial effects. Because the logjams would generally be constructed "in the dry" effects on water quality and aquatic life would be minimal but there would likely be a flush of sediment from their construction following the first major rains or floods which would dissipate quickly due to extremely fast infiltration rates in the riverbed.

Restoration: Although no direct restoration would occur in this alternative, major washout areas along the former road corridor would begin to recover soils and vegetation from lack of use, especially where the trail has been rerouted around them or where trail use impacts were concentrated in a narrow corridor in the much wider road corridor, a long-term beneficial effect.

Alternative 2 Impacts

Noise and Activity during Construction: Although the kinds of impacts would be similar to Alternative 1, their magnitude would be greater than in Alternative 1 because of the much larger number of construction activities, including construction of road humps, span logs, construction or reconstruction of two additional buildings and the entrance arch, near-term removal of two additional buildings, and construction of another seven erosion protection measures, including six log crib walls and one buried groin in addition to the four logjams from Alternative1. Combined, impacts from this construction would have additional minor to moderate localized short-term adverse effects on wildlife presence in the area.

Habitat Modification: In addition to impacts from noise and activity during construction of the additional components of Alternative 2, there would be minor to moderate localized long-term adverse effects on wildlife habitat, particularly on the edge of the floodplain and within the channel migration zone of the Carbon River. As a result, installation of these erosion protection measures also has the potential to cause short-term impacts from sedimentation in adjacent or nearby aquatic habitat, should BMPs fail or where water diversions would minimize other adverse effects. Sedimentation can have adverse effects on fish and amphibians occurring in and downstream of affected areas. Because silt barriers would be used and would remain in place during rehabilitation, impacts to wildlife from these measures would be minor and short-term, having no lasting effects beyond construction. The importation of fill materials combined with compaction from construction equipment also has the potential to change the soil's physical and chemical properties and therefore its viability for some organisms. Although mitigation measures would be used, there is a slight possibility that inadvertent spills of fuel, oils or other chemicals used in construction equipment could occur and affect wildlife. Because spill prevention techniques and devices would be used and vegetable based materials would be favored, it is unlikely that these would occur or have lasting effects. Long-term localized beneficial effects could occur over time from eliminating the turbidity, sediment, scour and filling associated with additional erosion of the road edge or surface.

Restoration: There would be long-term localized beneficial effects on wildlife from active and passive restoration of 10-feet-width of remaining road and parking areas (more than 4.8 acres) and additional beneficial effects from restoration of a portion of Ipsut Creek Campground and trailhead parking area. With scarification, these areas would begin to revegetate and provide cover and habitat for small organisms at first, with other wildlife being able to use the areas over time. Because there would be ongoing adjacent visitor use, beneficial impacts would remain small.

Alternative 3 Impacts

Noise and Activity during Construction: Impacts would generally include those associated with Alternative 2, however because only four road humps, but eight additional barbs and one additional log crib wall would be constructed, the same kinds of impacts would occur over a larger area and for a longer time and would therefore be moderate.

Habitat Modification: Impacts would affect wildlife habitat, a larger area than in Alternatives 1 or 2 and would include the same kinds of effects as described in Alternatives 1 and 2. Most work would be conducted "in the dry" and would therefore have minimal opportunity to result in sedimentation, except from the first rains, following construction in unstabilized (revegetated) areas. Overall effects would be long-term, moderate and adverse.

Restoration: Because of the need to maintain wide areas of road below Milepost 3.6 to allow for flexibility in its reconstruction following additional damage and because existing roadside parking areas up to Milepost 3.6 would be retained, there would be fewer areas restored in Alternative 3 compared to Alternative 2. As in Alternative 2, however, the same long-term beneficial effects would occur from restoration of the same areas in Ipsut Creek Campground and parking areas.

Alternative 4 Impacts
Noise and Activity during Construction: Impacts from implementing many of the same erosion protection measures as in Alternative 3, but with 3 fewer humps, two additional logjams and one additional crib wall, would increase, but would remain moderate, affecting wildlife in the same ways as noted in Alternatives 1 and 2.

Habitat Modification: Impacts would affect wildlife habitat, a larger area than in Alternatives 1 or 2 but would include the same kinds of effects as described in Alternatives 1 and 2. Most work would be conducted “in the dry” and would therefore have minimal opportunity to result in sedimentation, except from the first rains, following construction in unstabilized (revegetated) areas. Overall effects would be long-term, moderate and adverse.

Restoration: Actions would be similar to Alternative 3 (beneficial effects), however because more sites would be retained in the campground, there would be less restoration there but more along the roadway from restoration of parking areas.

Alternative 5 Impacts
Noise and Activity during Construction: Initial impacts and actions would be the same as Alternative 1. In addition, there would be impacts from construction of the new wilderness reroute trail that would likely be spread over 3-5 years. Because this area has not been previously disturbed by human activities and is fairly quiet because it is well away from the river and existing activities, there would be above ambient noise and activity related to trail construction. Construction activities would be short-term, localized and minor to moderate, while long-term negligible to minor new impacts from visitor use would occur as well.

Habitat Modification: Construction of approximately 5.2 miles of new trail (36-inches wide) would result in long-term loss of approximately 1.9 acres of currently undisturbed habitat for wildlife. Because the trail would be narrow, impacts would be confined but there would be loss of vegetation from approximately the 1.9 acres, combined with disturbance effects beyond that area to construct primarily side-hill trail, including areas of cut and fill that would likely encompass an additional area of the same size. The removal of vegetation from this area would affect mammals, birds, amphibians and other organisms. Perching birds, in particular, use trees and shrubs for roosting, nesting and food, or to forage for food. Habitat loss in this area would comprise a long-term localized, minor to moderate adverse effect on wildlife, with greater impacts occurring in moist or open areas.

Restoration: Although initially no restoration of the unimproved trail would take place, with completion of the construction of the wilderness reroute trail and closure of the unimproved trail, the area would begin to undergo passive restoration. In addition, there would be scarification of approximately 14-15 feet of the former road corridor where it still exists, closure and restoration of Ipsut Creek Campground except for four individual and one group site and restoration of the former Ipsut and other trailhead parking areas. As a result, restoration would result in long-term negligible to minor and eventually beneficial effects on habitat for wildlife, especially near the river and in the riparian area alongside it.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts to wildlife include:

- Scheduling construction activities with seasonal consideration of wildlife lifecycles to minimize impacts during sensitive periods (e.g., bird nesting and breeding seasons). The timing of the construction of rock barbs and other channel or bank stabilization measures, as well as extraction of large woody debris, could be limited to avoid spawning and other sensitive periods for fish and aquatic wildlife.

- Minimizing the degree of habitat removal (vegetation clearing) by delineating construction limits.
- The park biologist would be notified of the presence of fish or amphibians in the vicinity of project work.
- Instream excavation and use of heavy equipment would be limited to the minimum amount needed.
- Limiting the effects of noise on wildlife habitat through controls on construction equipment and timing of construction activities, such as limiting construction to daylight hours.
- Using spill prevention measures to prevent inadvertent spills of fuel, oil, hydraulic fluid, antifreeze, and other toxic chemicals that could affect wildlife.
- Maintaining proper food storage, disposing of all food waste and food-related waste promptly, in a bear-resistant receptacle and removing all garbage off-site at the end of each working day.
- Placing the rock barbs or logjams from the bank and/or outside the wetted channel.

Cumulative Impacts: As in other protected areas, the combined effects of development in the surrounding area over time, coupled with the purposeful eradication of predators through the early 20th century have contributed to low-level or extirpated wildlife populations of some cornerstone species, including grizzly bears and gray wolves. Past and reasonably foreseeable projects such as rehabilitation of historic structures, changes in visitor use and changes in administrative facilities would continue to have negligible to minor adverse effects on wildlife.

Because there would be a reduction in the number of buildings and primarily short-term negligible to moderate effects from the alternatives, Alternatives 1-5 would contribute negligible to minor cumulative adverse effects with some cumulative beneficial effects. It is unlikely that alternative actions would result in a change in wildlife diversity or populations.

Conclusion: Alternative 1 would have short-term negligible to minor impacts and long-term minor to moderate adverse, combined with some beneficial impacts. Alternative 2 would have short-term minor to moderate impacts and long-term minor to moderate adverse, with some beneficial impacts, Alternatives 3 and 4 would have short-term and long-term moderate adverse impacts, with fewer beneficial impacts. Alternative 5 would have short-term minor to moderate impacts and long-term minor to moderate adverse, coupled with long-term beneficial impacts. There would be no impairment of wildlife as a result of the implementation of Alternatives 1-5.

6. Special Status Wildlife Species Impacts

General Effects Common to Alternatives 1-5 for Listed Fish Species and Habitats (including Bull Trout, Steelhead, Chinook, Bull Trout Critical Habitat and Essential Fish Habitat)

The use of heavy equipment below the bankfull elevation in the Carbon River and its tributaries is proposed for removal of intermittent and perennial culverts and replacement of these with trail bridges (Alternatives 1, 2 and 5) or larger culverts (Alternatives 3 and 4). Other actions that would require construction use of heavy equipment below the bankfull elevation include construction of log span check dams in the former road, now a river overflow channel. This would include construction of log crib walls within the road corridor. To the extent possible this work would be constructed “in the dry” to minimize impacts to listed fish.

The seasonal timing for in channel excavation work (July 16 - August 15 for Ranger Creek and Ipsut Creek, and July 9 to August 22 for Carbon River) would avoid direct impacts to spawning fish and incubating eggs, alevins, and pre-emergent fry. Indirect effects to salmonid eggs and fry may occur during the first season after project implementation as disturbed instream construction sites respond and adjust to increased streamflows during the fall and winter months.

If the above actions occur when water is present or if mitigation measures fail, these actions would result in both direct and indirect effects to listed fish and their habitat. Some effects would be temporary, construction-related and limited in both physical extent and duration. Others would be long-term, lasting for the functional life of the proposed stream bed and stream bank stabilization measures. Among the likely potential effects (as applicable to the alternatives) identified by the draft Biological Assessment (BA) would be:

- Direct short-term effects (i.e., stress, injury and/or mortality) resulting from fish capture and handling operations associated with work site isolation and dewatering.
- Direct short-term effects (i.e., stress and/or injury) resulting from exposure to construction-related turbidity and sediments.
- Indirect short-term effects (mortality and reduced incubation success) associated with stream substrate scouring and deposition in fish spawning areas that result from changes in channel configuration.
- Permanent effects to instream habitat structure, function, and diversity. Proposed actions would inhibit natural channel migration and recruitment of large wood in the affected areas. Erosion protection measures would also result in local scouring and deposition of stream substrates and sediments. Removal of barrier culverts and replacement with bridges or fish-passage culverts would also improve long-term natural stream habitat function and connectivity.

Construction activities also would have the potential to kill or injure a limited number of adult, subadult, and juvenile bull trout, and juvenile steelhead if mitigation measures are unsuccessful. Temporary exposures to turbidity plumes may also disrupt normal fish behaviors (i.e., ability to successfully feed, move, and/or shelter). These exposures may temporarily cause fish to avoid the action area, may impede or discourage free movement through the action area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions.

Alternatives with more instream work or bank protection structures could result in more of the above impacts. The number of erosion protection measures would be greatest in Alternative 4, followed by Alternatives 3, 2, 1 and 5.

If work occurred when water was present, the following effects could occur (as taken from the Draft BA):

- <u>Direct and Indirect Effects to Listed Fish associated with worksite isolation, dewatering, and fish removal</u>:

Work area isolation and dewatering are conservation measures intended to reduce exposure and risk of potential injury associated with increased turbidity and sedimentation, operation of heavy equipment, and placement of rock and large wood. While a small number of individual bull trout and juvenile steelhead may be exposed to stresses resulting from fish capture, handling, and exclusion, these practices have the benefit of reducing more intense exposures and/or exposures that might affect a substantially greater number of individuals. It is possible that a small number of juvenile bull trout and steelhead may be killed or injured when capturing and removing fish from isolated work areas. When in-water work occurs within isolated reaches of streams, fish that avoid capture and rescue are at risk of being crushed or buried during placement of material and operation of equipment in wetted channels. A few juvenile fish (most likely age 0 fry) could avoid capture and die as a result of local work site dewatering and construction impacts.

The total number of fish exposed to worksite isolation and dewatering effects is unknown. For the BA, estimates of stream length and area affected were used to represent these effects. For dewatering and fish handling effects 1.5 x the length of each proposed bank protection structure would be dewatered for work site isolation, and 100 feet for each culvert removal site would require dewatering.

- Direct and Indirect Effects associated with turbidity, sediment, substrate scour and deposition

Construction of bank protection structures and culvert removal cause increased transport of suspended sediment and turbidity, at and below a project site. Worksite isolation and erosion control measures greatly reduce these impacts. Once onsite construction is completed and a worksite is exposed to flowing water, however, there would be increased turbidity released in the project vicinity. Project-related sediment plumes will be of short duration (hours to 1 day), but may occur more than once per project site depending upon stream flow. Following construction, both fine and coarse sediments at the project site would be subject to scouring and deposition which can result in short-term adverse affects (1 season) to downstream fish spawning and rearing habitats. Fish in the vicinity of project sites would be exposed to project-related turbidity plumes. High levels of turbidity can adversely affect fish and have lethal or sublethal effects depending on the sediment concentration and the duration of exposure (Newcombe and Jensen 1996). Based on a number of instream construction projects that have been monitored in western Washington, the USFWS assumes that there would be large levels of suspended sediment and turbidity that are most likely to occur within a distance of 600 feet from instream construction sites (USFWS 2007:124-125). Based on this, 600 feet was used to estimate the areas where fish would most likely be subjected to adverse affects from turbidity plumes.

- Direct and Indirect Effects to Fish from Sediment and Substrate Embeddedness

Fine sediments from turbidity plumes are deposited rapidly below project sites causing short-term increases in substrate embeddedness in deposition areas. Following construction, both fine and coarse sediments at project sites are subjected to scouring and deposition which can result in short-term adverse affects (1 season) to downstream fish spawning habitat. These sediment deposits can adversely affect salmonid eggs, alevins, and age-0 fry if deposited in fish spawning areas through increased substrate embeddedness, or loss of redds due to scouring effects.

The proposed inwater work window occurs in July and August during a period of decreasing flows in the Carbon River. Mean flow levels in the Carbon River and its tributaries are at low levels during the bull trout and Chinook spawning period in September and October. Therefore, fish that spawn directly below construction sites are at risk of having the redds scoured or buried due to changes in the channel configuration, resulting in decreased egg survival and fry emergence rates. Reduction in incubation success is considered a moderate to major adverse affect. Bull trout eggs are most likely to be affected by substrate impacts. Due to the timing of steelhead spawning in the spring, it is unlikely that steelhead eggs would be impacted by changes in substrate. Any changes due to seasonal scouring and deposition would have occurred over the first winter after construction and prior to steelhead spawning. As with turbidity effects listed above, impacts would occur adjacent to project sites and extend 600 feet downstream. This was used to estimate the areas where fish are most likely be subjected to adverse affects from increased substrate embeddedness and substrate scour and deposition effects.

Overview of Direct and Indirect Effects to Fish Habitat

As noted in the draft BA, the following effects could occur from the installation of erosion protection measures in Alternatives 2, 3, and 4:

> Bank protection structures that halt lateral scour and natural channel migration disrupt the natural fluvial process of bank erosion. Bank erosion recruits sediment and wood to the stream, creates and maintains in-stream and floodplain habitats (e.g., side channels), maintains overall aquatic habitat diversity within the stream corridor, and enables the stream to respond to changing conditions within its watershed (SHRG 2004). Much of the large wood that enters the upper Carbon River is transported downstream during flood events and contributes to the formation of logjams and fish

habitat features in the lower watershed. Reduction of large wood in areas of bank protection would adversely affect listed fish critical habitat.

Construction of bank protection structures may require work site isolation, dewatering, and sediment and erosion control measures. Some structures may also require excavation of the bank and channel bed to allow the structure to placed below the potential scour depth of the river and built up from that elevation. Some bank protection structures also are keyed into intact bank areas, resulting in streambank and riparian area disturbance and short or long-term loss of riparian vegetation at construction sites, another adverse affect to listed fish critical habitat.

Rock Barbs: Under Alternatives 1-5, a series of two rock barbs would initially be located from the riverbank adjacent to the maintenance area. These structures are proposed to be recycled later as ballast for an engineered log jam at the same site. Barbs redirect flow away from an eroding bank. Realignment of flow and redistribution of sediment could impact existing fish spawning areas, however this area alongside the maintenance area is generally dry. Decreased bank erosion reduces periodic inputs of gravel and woody debris into the portion of the channel affected by the barbs, which represents a lost opportunity for continued development of habitat complexity along approximately 30 feet near the bank. Riparian function is also impacted by replacing riparian vegetation in this area with barbs, an effect mitigated by bioengineering (replanting within the barbs) (ISPG 2003:6-26). Because of these effects, rock barbs may adversely affect listed fish critical habitat.

Engineered Logjams: Up to four engineered logjams would be placed in Alternatives 1, 2 and 5, 12 in Alternative 3, and up to 15 in Alternative 4. These would result in increasing effects. Engineered log jams result in adjacent scour. The scour at the margin of the jam and the associated downstream deposition moves the location of the main current away from an eroding bank, allowing the bank to be retained.

Engineered log jams offer an advantage over most rock structures such as barbs and groins. As scour holes develop adjacent to the log jam, the interlocking nature of log jams allow them to deform and settle; effectively retaining the structural integrity of the structure (ISPG 2003:6-33). Engineered log jams provide valuable fish and wildlife habitat. Immediately following placement of engineered log jams, there may be temporary, short-term impacts on spawning and rearing habitat. Existing spawning areas may shift or scour; while others may accrete with fines while new spawning areas are forming. It may take the channel a period of time to adjust to the logjams. The long-term habitat benefits of engineered log jams, however, generally outweigh these short-term impacts. The structural and hydraulic diversity that engineered log jams provide creates habitat for a multiple fish species at nearly every stage of life. Engineered log jams create excellent cover, holding and rearing habitats. At the end of the scour hole created by an engineered log jam, spawning habitat may be created. The detritus accumulated by logjams, particularly smaller twigs and leaves that decay rapidly, also serves as a food to some aquatic insects that fish consume (SHRG 2004). Placement of engineered logjams results in unavoidable short-term direct and indirect impacts to listed fish and long-term beneficial effects. Engineered logjams without accompanying riprap banks do not result in long-term adverse affects to listed fish critical habitat because the structures create complex habitat features and are biodegradable.

Modified Drop Structures as Partial Check Dams: Drop structures are low-elevation structures (or that span the entire width of the channel. Check dams are proposed in the Falls Creek channel (Alternative 2) and 2-5 (hanging culvert, Ranger Creek). Check dams dissipate stream energy and cause channel aggradation behind the structures. Proposed check dams in these locations would be constructed with low notches with a maximum drop height of 8 inches to maintain fish passage over the structure. Overall effects of these check dams are unknown. Potential effects to fish habitat include:

- Diversification and improvement of stream habitat complexity due to the placement of large wood into the wetted channel width. These features encourage local scouring and deposition that creates small pool/riffle features, and could ultimately improve the productivity and capability of habitat to support fish.

- During high flow events, check dams could constrict flows and have a damming effect that causes water to back up and scour around the structures, resulting in more severe bank erosion and a widening of the channel. High levels of substrate aggradation in the treated area could also result in a subsequent loss of surface flows during low flow periods, and stranding or mortality of fish trapped in isolated areas.
- Blocked fish passage for juvenile salmonids. In Alterantive 2, the large number of structures could result in one or more structures creating partial or total barriers to fish passage. Annual monitoring would be necessary to ensure fish passage is maintained.

Log Crib Walls and Rock / Log Toe-roughened Structures: Log crib walls can be very effective at controlling bank erosion and can provide relatively permanent protection. This permanent protection, however, eliminates a source of sediment supply and recruitment of large woody debris where these structures are placed, which may affect the natural balance of erosion and deposition within a channel. The alternatives would result in varying lengths of log crib wall, with none in Alternatives 1 and 5 and an estimated 1,220 feet in Alternative 2, 3,820 feet in Alternative 3 and 4,260 feet in Alternative 4.

Crib Walls (proposed in Alternatives 2-4) tend to arrest downstream meander migration and may increase bank erosion upstream and/or downstream from their placement. Because logs have a limited life span and because the river is aggrading, although this effect may last decades, it is not permanent. The reduced roughness characteristics of log crib walls may also have adversely affect adjacent spawning beds, cover and holding habitat. Roughness can be enhanced in the design of a log crib wall by incorporating roughness elements such as rootwads into crib wall construction (ISPG 2003:6-100) as is proposed in the alternatives.

Log and Rock Roughened Toe Structures (proposed as part of Alternatives 3 and 4) harden the bank into a relatively uniform and permanent position and shape, resulting in short-term lost opportunity for sediment supply, recruitment of large woody debris and off-channel habitat. Log toes are considered superior to rock toes in terms of providing habitat elements, and while log toes eventually degrade; rock does not. Fish tend to prefer the complexity of wood structures more than rock, so log toes are the preferred bank-protection option over rock toes. Salmonids are found along riprap banks, but the habitat is not preferred in most cases. Rock toes and revetments with large woody debris have been shown to have more fish abundance than plain rock (ISPG 2003:6-91). Because these structures are designed to halt lateral channel migration, they are considered an adverse affect on listed fish critical habitat.

Gabion Mattresses: Due to equipment limitations along the upper Carbon River Road, gabion mattresses are proposed to replace riprap in the construction of toe-roughened structures in Alternatives 3 and 4. The gabion baskets would be filled with river rock excavated onsite and used in place of boulders in the construction of log and rock roughened toe structures.

Adverse effects can occur from placement of gabions in toe-roughened structures if the stream is undergoing rapid changes in base elevation (down- cutting or deposition), then there is a high risk of failure due to the structures being overwhelmed or flanked (Freeman and Fishenich 2000:3). Considering the rapid rate of lateral scouring occurring along the Carbon River, the risk of gabion failure in this application could be high. The USFS used gabions for bridge abutments on the Carbon River Bridge (Forest Road 7810, located just below the Park boundary) from 1986 to 1996. These gabions were frequently damaged and undermined by high flows on the Carbon River, and ultimately failed (USFS 1998). The gabions for the log toe structures however would be keyed into these structures along the bank of the river in Alternatives 3 and 4.

Other adverse effects attributed to gabions include that gabion baskets can rust and break due to abrasion, resulting in a potential hazard to fish, wildlife and people (CDFG 1998:VII-7). Fish may be injured on the broken rusted wires or become trapped behind mats of vegetation or debris that are wedged in the wire mesh. Because gabions are non-biodegradable, create a potential hazard to fish, and are designed to halt lateral channel migration, they adversely affect listed fish critical habitat.

Gabion mattresses would also be used in a different application as the base for the trail in Alternative 2 and although these could deteriorate during future flooding would not be subjected to stream flow on a regular basis.

Unlike instream gabions, these gabions would not be exposed to high velocity currents and potential damage from floating logs or other debris, which can result in damage to gabions. If damaged however, the wire can be damaged and the protection lost. Gabions must also be protected against impact from large woody debris and sharp objects. These materials tend to distort and break the gabions (Freeman and Fishenich 2000:8).

Excavation of River Rock for Gabion Mattresses: Because of equipment limitations the use of river rock excavated from gravel bars in the active Carbon River channel is proposed for gabion mattresses (for the trail in Alternative 2 and for the toe structures in Alternatives 3 and 4). Excavation of this river rock would be limited to dry gravel bars, although equipment (a small excavator and ATVs with trailers) may need to cross wetted channels to access excavation sites. Equipment crossings would be confined to a single designated point for each site. All channel excavation would be limited to the depth of the adjacent wetted channel elevation. No excavation below the wetted channel elevation is proposed, and all excavation of rock below the bankfull channel width would occur during the approved inwater work season.

The amount of gravel needed for proposed bank protection structures varies by alternative. Alternative 2 would likely have the greatest amount and area of river rock excavation due to the use of gabion mattresses for a portion of the trail base, while Alternatives 3 and 4 would have the most imported fill. Total gravel excavation is estimated at 0.75 acres, in addition to the construction footprint of each structure. Some of the rock needed would also come from within the footprint of proposed structures. Additional rock would be excavated from gravel bars within the braided channel complex. For each cubic yard an estimated average of nine square feet of gravel bar surface excavation was used by the USFWS.

The Carbon River channel annually transports massive amounts of stream bedload and sediment. The proposed removal of gravel is small in comparison and would not result in a major loss of stream substrate material. Effects of gravel excavation would indirectly affect adjacent areas when the channel configuration changes during subsequent high flow events. Bull trout or Chinook redds located in the vicinity of the gravel excavation sites would unlikely because these would be located above the ordinary high water mark. If they were found, these would be scoured or buried as a result of subsequent channel adjustments during high flow events.

Use of /Large Wood from within the Carbon River Channel: Logs from the active Carbon River channel would be moved where possible for use in the construction of bank protection structures. The total number of logs needed varies by alternative, with more needed in Alternatives 3 and 4 than in Alternative 2 and a great deal fewer in Alternative 5. There are currently large deposits of logs and other woody debris located on dry gravel bars in the Carbon River channel. These are locations that collect woody debris over time and often result in the formation of stable, vegetated gravel bars, or result in the formation of debris jams that interact with the channel to create local scour and deposition features. Large wood in the floodplain can be transported downstream during floods and contributes to the formation of logjams and fish habitat features in the lower watershed.

Relocating existing large wood within the channel would not result in a net reduction of large wood within the affected stream reaches. Only logs that are located on dry gravel bars would be moved. No intact logjams interacting with active, wetted channels would be moved, except within the construction footprint of proposed bank protection structures. Due to the limited area involved in the proposed wood relocation, the use of large wood from the Carbon River channel would have minor effects to listed fish critical habitat.

Heavy equipment may need to cross wetted channels to access and transport logs. As with the procurement of gravel or cobble, equipment crossings would be confined to a single designated point for each construction site, and use of heavy equipment in areas below the bankfull channel width would only occur during the approved inwater work season. Adverse impacts associated with heavy equipment crossings and gravel bar disturbance (e.g., substrate and turbidity impacts) are limited to the immediate project areas.

Streambank Disturbance and Loss of Riparian Vegetation: Construction of bank protection structures would result in adverse effects to streambanks, including removal or damage to streamside vegetation while construction activities are occurring, and removal or reshaping of streambank materials during site preparation or project feature installation. Construction of erosion protection structures, including crib walls, however, would primarily occur in areas where riverbank and bank vegetation has already been lost. Nonetheless, there would be potential removal of overhead cover for fish, bank-stabilizing plants, and materials (e.g., rocks and large wood) from installation of erosion protection measures that would result in short-term increases in turbidity and downstream sediment deposition. Removal of stream vegetation may also increase solar radiation and reduce the contribution of terrestrial food to listed fish. Due to the limited amount of vegetation removal proposed, the potential effects to water temperature are considered to be insignificant. For the BA, the USFWS assumed that the extent of adverse impacts associated with the construction footprint for each project site accounts for short- and long-term streambank disturbance effects.

Culvert Removal: As described above under direct and indirect effects to fish, culvert removal is likely to result in unavoidable, short-term adverse affects to fish including mortality of juvenile fish and eggs. Culverts at Ranger Creek and the Chenuis Falls trailhead tributary both have large deposits of sediment that has accumulated above the culverts. The Chenuis Falls trailhead tributary requires the placement of a series of drop structures to reduce channel incision and upstream head-cutting after culvert removal. Even with these structures in place, there is likely to be downstream movement and deposition of sediment after culvert removal. Large scour pools below the culvert outfalls may fill in and eventually attain a profile that is more consistent with the natural profile of these streams. Despite these short term impacts, the removal of barrier culverts is identified as a high priority recovery action in the draft bull trout recovery plan (USFWS 2004:245). Replacing undersized culverts that are partial or full barriers to fish would improve the ability of rearing salmonids to use all available rearing habitat more effectively. Restoring fish passage and access to high quality floodplain tributary habitat would contribute to improved survivorship, population growth and potential for listed fish species recovery.

Chemical Contaminants from Heavy Equipment: Constructing the proposed bank protection structures would require one or more pieces of heavy equipment to enter and operate below the bankfull channel width of the Carbon River. Although mitigation measures would be employed, release of harmful materials (e.g., fuel, lubricants, hydraulic fluid, etc.) is possible. All equipment operating below the bankfull width would also use vegetable-based hydraulic fluid, and no oils, fuels, cleaning agents or solvents, concrete or equipment wash water, slurry, waste, or construction debris would be discharged to surface waters or onto land where a potential to reenter surface waters would exist. With full implementation of the minimization and avoidance measures, effects to water quality due to chemical contamination during construction are unlikely to occur.

Future Flood Damage and Deposition of Road / Trail Surface Fill into the Carbon River: Road segments in the vicinity of the washouts and along other flood damaged areas have a high risk of future floods. There is a high probability that future flooding will damage road segments and deliver additional road or trail surface fill into the Carbon River. Road and trail humps would limit the severity and extent of surface erosion. Considering the magnitude of bedload movement that occurs during high flow events in the Carbon River, there is a high potential for effects of road/trail fill delivery to the Carbon River channel.

Road/trail fill materials delivered to tributary streams (e.g. Falls Creek) would adversely affect fish spawning and rearing habitat.

Long-term Effects of the Carbon River Road and Trail Access Corridor: It is likely that sections of the Carbon River Road / Trail would continue to be subjected to frequent flood damage and delivery of the trail and road surface materials to stream channels, resulting in local sedimentation or aggradation effects. These effects would vary by alternative, but the USFWS has determined that all alternatives would continue to have long-term adverse impacts to listed fish and fish habitat due to the location of portions of the road in the active floodplain. Depending on the severity of the flood damage, some trail sections may be damaged and rebuilt several times over subsequent years. Trail and road humps would reduce the severity of these impacts, but adverse impacts to streambeds would continue to occur. The location of the Carbon River Road in the floodplain has resulted in past and ongoing degradation of listed fish habitat, including passage barriers and chronic deposition of road sediments into key spawning and rearing streams. The Carbon River Road was specifically identified in the draft bull trout recovery plan as a high priority location to minimize or eliminate road-related habitat degradation. The proposed alternatives would result in both short- and long-term adverse and beneficial effects to bull trout and steelhead. The location of the road / trail within the active floodplain and channel migration zone would continue to present a challenge to maintaining access in the corridor while minimizing impacts to listed fish. Continued management of the road for access is expected to continue to cause ongoing adverse effects to listed fish and designated critical habitat.

Alternative 1 Impacts to Listed Fish and Fish Habitat
Alternative 1 includes several actions that require the use of heavy equipment below the bankfull elevation in the Carbon River and its tributaries, resulting in both direct and indirect effects to listed fish and their habitat. In Alternative 1, there would potentially be impacts from constructing two rock barbs and four logjams near the entrance / maintenance area, from removing barrier culverts and replacing these with larger culverts or trail bridges. The short- and long-term impacts to fish habitat associated with Alternative 1 would be substantially less than the impacts associated with Alternatives 2, 3, and 4. Fish impacts in Alternative 5 would be similar to Alternative 1.

These effects from these actions are likely to include the following:

- Direct effects (i.e., stress, injury and/or mortality) resulting from fish capture and handling operations associated with work site isolation and dewatering along 0.11 miles of streams.
- Direct effects (i.e., stress and/or injury) resulting from short-term exposures to construction-related turbidity and sediment along 0.81 miles of streams.
- Indirect effects associated with stream substrate scouring and sediment deposition in fish spawning areas that result from changes in channel configuration along 0.81 miles of streams, including mortality and reduced incubation success for one season in the affected areas.
- Adverse impacts to fish habitat structure, function, and diversity. Proposed actions include bank protection structures that would inhibit natural channel migration, degrade riparian vegetation, and inhibit the recruitment of large wood to stream channels in the affected areas along 0.13 miles of stream channels.
- Long-term beneficial effects associated with restored habitat access to approximately one mile of floodplain tributary streams, including Ranger Creek. Removal of the Ranger Creek culvert would restore access to approximately 0.5 miles of high quality spawning and rearing habitat.

Table 30: Alternative 1: Summary of Total Listed Fish Habitat Impacts along the Carbon River Access Corridor

Location	Adverse stream bank impacts	Worksite isolation / dewatering and fish handling	Extent of adverse turbidity/ substrate impacts	Beneficial effects from restored habitat access
Carbon River Effects limited to channel margin along south bank.	480 feet	360 feet 0.07 mile	1,680 feet 0.32 miles	NA
Falls Creek, Falls Creek tributaries, and Carbon side channel	120 feet	30 feet	1,300 feet 0.25 mile	0.25 mile
Ranger Creek	30 feet	100 feet	630 feet	0.5 mile
Unnamed tributary stream at Chenuis Falls trailhead	60 feet	100 feet.	660 feet in Carbon River side channel	0.25 mile
Ipsut Creek/Carbon side channel	25 feet.	-	-	-
Total Estimated Adverse Impacts for Project	**690 feet 0.13 mile**	**590 feet 0.11 mile**	**4,270 feet 0.81 miles**	**-**
Total Estimated Beneficial Effects for Project	**-**	**-**	**-**	**1 mile**

Alternative 2 Impacts to Listed Fish and Fish Habitat

Alternative 2 also includes several actions that require the use of heavy equipment below the bankfull elevation in the Carbon River and its tributaries. Impacts from constructing two rock barbs and four logjams would be the same as in Alternative 1. In addition, fish barrier culverts would be replaced with trail bridges, including removal of the Falls Creek, Ranger Creek and hanging tributary culverts. To minimize sedimentation associated with these, additional impacts to fish habitat would occur from placement of grade control structures to catch sediment from culvert removal. Other impacts to fish habitat could occur if water was present in any of the log crib wall locations and that water needed to be diverted to avoid direct impacts from construction.

Actions in this and other alternatives would cause both direct and indirect effects to listed fish and their habitat. Some effects would be temporary, construction-related and limited in both physical extent and duration. Others would be long-term, lasting for the functional life of the proposed stream bed and stream bank stabilization measures. Project construction impacts would occur over a period of three to four years, depending on funding and the logistics of project implementation. Impacts would include the following:

- Direct effects (i.e., stress, injury and/or mortality) resulting from fish capture and handling operations associated with work site isolation and dewatering along 0.38 miles of streams. Most of these effects (0.30 mile) would be located along the margin of the Carbon River channel.
- Direct effects (i.e., stress and/or injury) resulting from short-term exposures to construction-related turbidity and sediment along 2.68 miles of streams. Over half of these estimated impacts (1.37 miles) would be located in floodplain tributary streams and side channels.
- Indirect effects associated with stream substrate scouring and sediment deposition in fish spawning areas that result from changes in channel configuration along 2.68 miles of streams, including reduced incubation success for one season in the affected areas. Over half of these estimated impacts (1.37 miles) would be located in floodplain tributary streams and side channels that provide important spawning and rearing habitat.
- Adverse stream bank impacts to fish habitat structure, function, and diversity. The project will construct bank protections structures that will inhibit natural channel migration, degrade riparian

vegetation, and inhibit the recruitment of large wood to stream channels in the affected areas along 0.79 miles of stream channels. Most of these impacts are located in the Falls Creek area, and along the Carbon River.

- Long-term beneficial effects associated with restored habitat access to approximately one mile of floodplain tributary streams, including Ranger Creek. Removal of Ranger Creek culvert would restore access to approximately 0.5 miles of high quality spawning and rearing habitat.

Table 31: Alternative 2: Summary of Fish Habitat Impacts along the Carbon River Access Corridor

Location	Adverse stream bank impacts	Worksite isolation / dewatering and fish handling	Extent of adverse turbidity/ substrate impacts	Beneficial effects from restored habitat access
Carbon River Effects limited to channel margin along south bank.	1,300 feet	1,590 feet 0.30 mile	6,920 feet 1.31 miles	NA
Falls Creek, Falls Creek tributaries, and Carbon side channel	2,650 feet	30 feet	4,500 feet 0.85 mile	0.25 mile
Ranger Creek	30 feet	100 feet	630 feet	0.5 mile
Unnamed tributary stream at Chenuis Falls trailhead	60 feet	100 feet	660 feet in Carbon River side channel	0.25 mile
Ipsut Creek/Carbon side channel	155 feet	195 feet	1,460 feet 0.28 mile	NA
Total Estimated Adverse Impacts for Project	**4,195 feet 0.79 mile**	**2,015 feet 0.38 mile**	**14,170 feet 2.68 miles**	**-**
Total Estimated Beneficial Effects for Project	**-**	**-**	**-**	**1 mile**

Alternative 3 Impacts to Listed Fish and Fish Habitat

Alternative 3 would have substantially more adverse impacts than Alternative 1, 2, or 5 due to the reconstruction of the road over a complex log cribwall structure through the Falls Creek washout. This would result in a substantial change in the channel configuration in the combined Falls Creek/Carbon River side channel, and would result in ongoing, long-term adverse impacts in the Falls Creek area. Impacts from constructing two rock barbs and four logjams would be the same as in Alternative 1, however in addition there would be another eight logjams constructed in this alternative. Instead of replacement with trail bridges as in Alternative 2, fish barrier culverts would be replaced with larger culverts, including in the Falls Creek area and the Ranger Creek and hanging tributary culverts. As in Alternative 2, to minimize sedimentation associated with these, additional impacts to fish habitat would occur from placement of grade control structures to catch sediment from culvert removal. Other impacts to fish habitat could occur if water was present in any of the log crib wall or toe-roughened structure locations and that water needed to be diverted to avoid direct impacts from construction.

- Direct effects (i.e., stress, injury and/or mortality) resulting from fish capture and handling operations associated with work site isolation and dewatering along 1.02 miles of streams.
- Direct effects (i.e., stress and/or injury) resulting from short-term exposures to construction-related turbidity and sediment along 3.42 miles of streams.
- Indirect effects associated with stream substrate scouring and sediment deposition in fish spawning areas that result from changes in channel configuration along 3.42 miles of streams. The effect is mortality and reduced incubation success for one season in the affected areas. Over half of these estimated impacts (1.76 miles) would be located in floodplain tributary streams and side channels that provide important spawning and rearing habitat.
- Adverse stream bank impacts to fish habitat structure, function, and diversity. The project would

construct bank protections structures that would inhibit natural channel migration, degrade riparian vegetation, and inhibit the recruitment of large wood to stream channels in the affected areas along 0.93 miles of stream channels. Most of these impacts would be located in the Falls Creek area, and along the Carbon River.

- Long-term beneficial effects associated with restored habitat access to approximately one mile of floodplain tributary streams, including Ranger Creek. Removal of Ranger Creek culvert would restore access to approximately 0.5 miles of high quality spawning and rearing habitat.

Table 32: Alternative 3: Summary of Fish Habitat Impacts along the Carbon River Access Corridor

Location	Adverse stream bank impacts	Worksite isolation / dewatering and fish handling	Extent of adverse turbidity/ substrate impacts	Beneficial effects from restored habitat access
Carbon River Effects limited to channel margin along south bank.	1,640 feet	1,920 feet 0.36 mile	8,760 feet 1.31 miles	NA
Falls Creek, Falls Creek tributaries, and Carbon side channel	2,740 feet	2,740 feet	4,500 feet 0.85 mile	0.25 mile
Ranger Creek	330 feet	460 feet	3,330 feet	0.5 mile
Unnamed tributary stream at Chenuis Falls trailhead	60 feet	100 feet	660 feet in Carbon River side channel	0.25 mile
Ipsut Creek/Carbon side channel	155 feet	195 feet	1,460 feet 0.28 mile	NA
Total Estimated Adverse Impacts for Project	**4,925 feet 0.93 mile**	**5,415 feet 1.02 mile**	**18,050 feet 3.42 miles**	**-**
Total Estimated Beneficial Effects for Project	**-**	**-**	**-**	**1 mile**

Alternative 4 Impacts to Listed Fish and Fish Habitat

The impacts of Alternative 4 would be similar to Alternative 3, but would include additional bank protection structures along the Carbon River. Alterative 4 would have adverse impacts to listed fish habitat due to the reconstruction of the road over a complex log crib wall structure through the Falls Creek washout. This would result in a substantial change in the channel configuration in the combined Falls Creek/Carbon River side channel, and would result in ongoing, long-term adverse impacts in the Falls Creek area. Other impacts would be similar to Alternative 3 but would include a potential of three more engineered logjams and another toe-roughened crib wall.

- Direct effects (i.e., stress, injury and/or mortality) resulting from fish capture and handling operations associated with work site isolation and dewatering along 1.12 miles of streams.
- Direct effects (i.e., stress and/or injury) resulting from short-term exposures to construction-related turbidity and sediment along 4.05 miles of streams.
- Indirect effects associated with stream substrate scouring and sediment deposition in fish spawning areas that result from changes in channel configuration along 4.05 miles of streams, including mortality and reduced incubation success for 1 season in the affected areas. Less than half of these estimated impacts (1.76 miles) would be located in floodplain tributary streams and side channels that provide important spawning and rearing habitat.
- Adverse stream bank impacts to fish habitat structure, function, and diversity. The project would construct bank protections structures that would inhibit natural channel migration, degrade riparian vegetation, and inhibit the recruitment of large wood to stream channels in the affected areas along 1.05 miles of stream channels. Most of these impacts would be located in the Falls Creek area, and along the Carbon River.
- Long-term beneficial effects associated with restored habitat access to approximately 1 mile of

floodplain tributary streams, including Ranger Creek. Removal of Ranger Creek culvert would restore access to approximately 0.5 miles of high quality spawning and rearing habitat.

Table 33: Alternative 4: Summary of Fish Habitat Impacts along the Carbon River Access Corridor

Location	Adverse stream bank impacts	Worksite isolation / dewatering and fish handling	Extent of adverse turbidity/ substrate impacts	Beneficial effects from restored habitat access
Carbon River Effects limited to channel margin along south bank.	2,280 feet	2,430 feet 0.36 mile	12,100 feet 2.29 miles	NA
Falls Creeks, Falls Creek tributaries, and Carbon side channel	2,740 feet	2,740 feet	4,500 feet 0.85 mile	0.25 mile
Ranger Creek	330 feet	460 feet	3,330 feet	0.5 mile
Unnamed tributary stream at Chenuis Falls trailhead	60 feet.	100 feet	660 feet in Carbon River side channel	0.25 mile
Ipsut Creek/Carbon side channel	155 feet	195 feet	1,460 feet 0.28 mile	NA
Total Estimated Adverse Impacts for Project	**5,565 feet 1.05 mile**	**5,925 feet 1.12 mile**	**21,390 feet 4.05 miles**	**-**
Total Estimated Beneficial Effects for Project	**-**	**-**	**-**	**1 mile**

Alternative 5 Impacts to Listed Fish and Fish Habitat
The impacts of Alternative 5 would be essentially the same as in Alternative 1. The Wilderness Trail location would involve several new stream crossings, but it is likely that these crossings would be located off the valley floor and above the natural distribution of listed fish.

Conclusion: All alternatives may affect, and are likely to adversely affect bull trout, bull trout critical habitat, steelhead, and Essential Fish Habitat for Chinook and coho salmon. The extent of adverse effects varies by alternative, with Alternatives 1 and 5 having the least impacts, and Alternatives 3 and 4 having the greatest impacts. This determination is based on the rationale that proposed actions would result in major adverse effects, including injury or mortality of fish and fish eggs in spawning and rearing habitat in the upper Carbon River and associated floodplain tributaries. Proposed actions would also result in long-term adverse effects to complex stream habitats and processes associated with listed fish critical habitat and essential fish habitat. The beneficial effect of restoring access to approximately one mile of floodplain tributaries is important, but does not negate the "likely to adversely affect" determination associated with other project elements. Adverse effects associated with proposed actions would occur over a period of 3 to 4 years in dispersed locations, and some key spawning habitats would be affected. Long-term adverse affects to fish habitat would also continue to occur as future flood damage scours road and trail surfaces and deposits these materials into spawning tributaries.

All alternatives may affect, but are not likely to adversely affect Chinook salmon and Chinook salmon critical habitat. Given the low numbers of Chinook salmon that currently spawn in the lower Carbon River, it is highly unlikely that Chinook salmon would actually be exposed to adverse effects from this project. Although the upper Carbon River is accessible to Chinook salmon, the probability that these fish are present in the upper Carbon River is very low. The potential for direct effects to spawning adults from turbidity plumes and indirect effects to Chinook salmon redds from channel scouring and sediment deposition is considered to be discountable.

There would be no impairment of listed fish or fish habitat or values.

Impacts Common to Alternatives 1-5 on Listed Mammals

Grizzly Bear, Gray Wolf, Canada Lynx and Fisher

Based on the current distribution and very low population numbers of these species in Washington, these species are not likely to be present in the park, and no confirmed reports of these species have been received in over 50 years. Also, an extensive forest carnivore survey in 2000-2002 failed to detect any of these species (Reid *et al.* 2010). Potential effects such as disruption of denning behaviors or loss of denning or foraging habitat would not occur. Therefore, Alternatives 1-5 would have no effect on the grizzly bear, gray wolf, Canada lynx or fisher.

Impacts Common to Alternatives 1-5 on Northern Spotted Owl

Noise Disturbance: The use of helicopters, excavators, chainsaws, and other motorized equipment would introduce increased levels of sound into the project area over the course of approximately three to four work seasons. Project work would coincide with the northern spotted owl nesting season (March 15 – Sept 30), and would continue into the fall months after the nesting season. Noise and activities associated with road and trail construction, as well as construction of bank erosion protection structures have the potential to disturb spotted owls in the project area. The response of spotted owls to project noise disturbance is not well defined and is variable between individuals.

Spotted owl responses to noise disturbance range from no apparent reaction, to an alert response where the owls are attentive for the duration of the activity; to a flush response (Delaney *et al.* 1999:68). Major disturbance occurs when noise or project activity causes a spotted owl to become so agitated that it flushes away from an active nest site or aborts a feeding attempt during incubation or brooding of nestlings (USFWS 2003:273). Such events are considered important because they have the potential to result in reduced hatching success, fitness, or survival of juveniles. Such adverse effects to spotted owls, however, would only occur if the noise disturbance occurs in very close proximity to an active nest (e.g., within 65 yards for ground-based activities with motorized equipment, or within 800 feet for a very large helicopter, such as the Chinook 47-D).

The Carbon River Road/Trail corridor occurs within the potential home ranges of four spotted owl territories. The site with the closest proximity to the trail is the June Creek activity center, which is located between June Creek and Falls Creek, approximately 0.07 mile from the Falls Creek washout. This site was occupied by a nesting pair of spotted owls and two young in 2010. Spotted owls from these territories may occasionally forage or roost in the forested areas along the road/trail corridor. Because spotted owls do occasionally change nest locations within their core areas, the USFWS used the 0.7 mile-radius core area circles to represent the areas where potential spotted owl nest sites are most likely to occur. Based on the distribution of known occupied and historic spotted owl nest sites in the project area, the USFWS expects that the spotted owl pair in the Falls Creek area may be subjected to adverse impacts associated with noise disturbance from construction activities in the vicinity of the Falls Creek washout.

At Ipsut Creek Campground, the 800 feet helicopter disturbance buffer slightly overlaps the 0.7 mile-radius core area circle for the Ipsut Creek spotted owl site. There is a potential for noise disturbance to occur if the spotted owls at this territory select an alternate nest tree nearer the campground. Helicopter flights at Ipsut Campground would be scheduled to occur after August 6, and would likely not occur until after September 15. Helicopter use that occurs during the latter half of the spotted owl breeding season (Aug. 1 – Sept. 30) would minimally disrupt nesting spotted owls. In the late nesting season, juvenile spotted owls have fledged and are able to thermoregulate, fly short distances, and are no longer completely dependent upon the adults for daily feedings (Forsman *et al.* 1984). A flush response from either an adult or juvenile at this stage of development would not be likely to reduce the juvenile owls' fitness or ability to survive. Therefore the biological effect of potential noise disturbance that occurs during the late nesting season is considered to be insignificant.

Over the proposed four years of project implementation, it would be likely that individual spotted owls foraging or roosting in close proximity to the road could occasionally be flushed away from a foraging perch or a roosting site by project noise and activity. Such flush responses occurring away from an active nest site are considered to be insignificant, because the owls are simply moving away from the source of disturbance, rather than being forced to flush away from an active nest site.

The park has included a daylight operating restriction for project implementation which restricts project work to daylight hours only from April 1 to September 15. Spotted owls are primarily nocturnal, and forage for prey almost exclusively at night, with peak activity levels occurring after sunset and prior to sunrise (Forsman *et al.* 1984). By avoiding project activity during these nocturnal periods, normal spotted owl foraging behaviors would not be disrupted by project activities along the Carbon River Road/Trail.

Blasting for trail realignments: The park has identified several locations along the Carbon River Road/Trail that may require blasting to remove stumps for trail alignments. The noise associated with blasting is highly variable and depends on size of the charge and the material being blasted. The USFWS identified blasts of 2 lbs. or less to have a disturbance radius of 120 yards (USFWS 2003:282). For this project, all blasting activities would be scheduled to occur after August 6. Based on the timing of blasting activities and the current distribution of known occupied and historic spotted owl nest sites in the project area, the effects of blasting to spotted owls would be insignificant.

Recreational use in the Carbon River corridor: The Carbon River corridor currently receives over 30,000 visitors per year. Visitor use may increase over time if access in the corridor is improved. Visitor uses include hiking, camping, and picnicking along trails and at the Ipsut Creek campground. Most visitors stay on or close to trails, so the potential for visitors to encounter spotted owls is limited to those instances when spotted owls may be roosting near a trail. Swarthout and Steidl (2001) studied flush responses of Mexican spotted owls in constricted canyons in the Utah desert in which hikers walked close to roosting spotted owls. They found that 95 percent of flushes by adult and juvenile spotted owls occurred within distances of 24 meters and 12 meters, respectively, of the hikers, and that a 55-meter buffer "would eliminate virtually all behavioral responses of owls to hikers" (p. 312). In this study, spotted owls were apparently much more sensitive to the presence of hikers than what is generally reported for northern spotted owls. This may have been due to the narrow canyon setting in which the study was completed, where the spotted owls were apparently threatened by the close approach of hikers. Spotted owl researchers in the Pacific Northwest report that most spotted owl roosts and virtually all nest sites are located high enough in the forest canopy that spotted owls rarely flush even when someone walks directly under a roost or nest site (USFWS 2003:279). Northern spotted owls can be flushed by hikers that approach within 20 to 30 feet when the owls are roosting close to the ground, but such instances are uncommon (USFWS 2003:279).

Considering the current distribution of known occupied and historic spotted owl nest sites in the project area, it is unlikely that visitors would be hiking directly under active spotted owl nest trees. As with ground-based activities along the Carbon Road/Trail corridor described above, there is a potential for individual spotted owls that are foraging or roosting near trails or campgrounds to be flushed by the close approach of hikers. Flushing a spotted owl from a roost site is considered to be insignificant with no implications for impaired fitness, survival, or reproductive capability.

Habitat effects:
Trail realignments along the Carbon River Road/Trail corridor may indirectly affect spotted owls by removing key habitat elements such as large trees and snags, and understory vegetation. Because spotted owls occupy large territories that encompass thousands of acres of forest habitat, the loss of scattered individual trees within a stand of suitable habitat is considered to be an insignificant habitat modification, because the affected stands would continue to provide suitable habitat for spotted owls roosting and foraging behaviors.

Conclusion: Alternative 1-5 may affect, and would be likely to adversely affect the northern spotted owl, with Alternatives 2, 3, and 4 having the greatest impacts associated with disturbance during the nesting season due to constraints presented by the inwater work season for bank protection structures to minimize effects on listed fish species. This determination is based on the rationale that the timing and duration of project construction activities is likely to result in disturbance and disruption of spotted owl nesting behavior, and is likely to result in an increased potential for nest failure for one pair of spotted owls. There would be no impairment related to northern spotted owls.

Impacts Common to Alternatives 1-5 on Marbled Murrelets
Noise Disturbance: The use of helicopters, excavators, chainsaws, and other motorized equipment would introduce increased levels of sound into the project area over the course of approximately four seasons. Proposed actions would coincide with the marbled murrelet (murrelet) nesting season (April 1 – Sept. 15), and would continue into the fall months after the nesting season has passed. Noise and activities associated with road and trail construction, as well as construction of bank erosion protection structures would have the potential to disturb murrelets nesting in the project area.

There is limited information concerning murrelet vulnerability to disturbance effects. In general, responses to noise disturbance at nest sites have been modifications of posture and on-nest behaviors without flushing or abandoning the nest (Long and Ralph 1998, USFWS 2003, Hebert and Golightly 2006). Unacceptable disturbance occurs when noise or project activity causes a murrelet to become so agitated that it flushes away from an active nest site or aborts a feeding attempt during incubation or brooding of nestlings (USFWS 2003:273). Such events are considered important because they have the potential to result in reduced hatching success, fitness, or survival of juveniles. Adverse effects to murrelets, however, would only occur if the noise disturbance occurs in very close proximity to an active nest (e.g., within 35 yards for ground-based activities with motorized equipment, or within 800 feet for a very large helicopter, such as the Chinook 47-D).

Due to timing constraints required for inwater work, most work at bank protection sites and major stream crossings will occur during the early murrelet nesting season (April 1 – Aug 5). Based on our review of the murrelet disturbance literature, the USFWS expects that murrelets nesting in close proximity to these major construction sites will be exposed to prolonged disturbance that will result in disruption of nesting behaviors, with implications for reduced individual fitness, reduced hatching success, and increased risk of nest predation for any murrelets nesting in close proximity to the construction sites. The acres of nesting habitat exposed to prolonged disturbance vary based on the project footprint and duration. The most intensive disturbance areas will be associated with construction of bank protection structures, and construction of trail through the Falls Creek washout area. Due to the prolonged exposure to construction activities during the early nesting season, murrelets associated with 110 acres of nesting habitat adjacent to the Carbon River Road would have an increased likelihood of nest failure as a result of intermittent project disturbance over three to four years.

Use of motorized equipment along the Carbon River Road/Trail: Based on the disturbance thresholds described above, a 35 yard "disturbance" buffer was mapped along either side of Carbon River Road/Trail to represent the area where murrelets would most likely be disturbed by proximity to motorized equipment. For each mile of the road, there are approximately 25 acres located within the 35-yard disturbance buffer. The total area associated with the disturbance buffer along the Carbon River Road/Trail is approximately 128 acres, but only about 110 acres are actually forested and provide suitable murrelet nesting habitat.

Based on the documented history of murrelet occupancy behaviors in the upper Carbon River watershed, it is likely that all suitable murrelet nesting habitat in the project area is occupied habitat. All murrelets associated with **110 acres** of nesting habitat adjacent to the Carbon River Road/Trail corridor would be subjected to noise and activity of varying degrees of intensity during the late spring through fall over the next three to four years from April 1 through September 15.

In the proposed daily activity schedule for the Carbon River project, work would only occur 2 hours after official sunrise, and would cease 2 hours prior to official sunset during the murrelet nesting season (April 1 to September 15). This restriction would avoid potential disruption to murrelets during their daily peak activity periods for feeding and incubation exchanges. Therefore, based on review of the murrelet disturbance literature, trail crews and contractors travelling to and from work sites in vehicles, on ATVs, or on foot along the Carbon River corridor during mid-day hours are not likely to cause a murrelet to flush off a nest, or cause an adult murrelet to abort a food delivery to a chick.

Due to timing constraints required for inwater work, most work at bank protection sites and major stream crossings would occur during the early murrelet nesting season. Based on review of the murrelet disturbance literature, murrelets nesting in close proximity to these major construction sites would be exposed to prolonged disturbance that would result in disruption of nesting behaviors, with implications for reduced individual fitness, reduced hatching success, and increased risk of nest predation for any murrelets nesting in close proximity to the construction sites. The acres of nesting habitat exposed to prolonged disturbance vary based on the project footprint and duration. The most intensive disturbance areas would be associated with construction of bank protection structures, and construction of trail or road through the Falls Creek washout area. Due to the prolonged exposure to construction activities during the early nesting season, murrelets associated with 110 acres of nesting habitat adjacent to the Carbon River Road would have an increased likelihood of nest failure as a result of project disturbance.

Disturbance from Helicopters: The Thompson Property would be used as a base for helicopter operations. There is no suitable murrelet nesting habitat indicated at this property, so disturbance to murrelets would not occur. The Ipsut Creek Campground and road washouts at Milepost 3.43, 3.93 and 4.47 are identified as helicopter drop sites for equipment and materials. Helicopter work at the Ipsut Campground would be scheduled to occur after the murrelet nesting season, therefore there would be no effect to murrelets from helicopters at this site.

Under **Alternative 2**, helicopter use at the road washouts would likely occur in July, during the early murrelet nesting season. The duration of helicopter use over project implementation is relatively brief, and is estimated as multiple flights at each site for a period of two to three days. If the park contracted a Chinook 47-D, which is a double-rotor helicopter with a 20,000 lb. lift capacity, this is a very loud helicopter with a noise disturbance buffer of 800 feet. Within the general helicopter flight path there is approximately **400 acres** of murrelet nesting habitat within the disturbance buffer, and about 25 acres of murrelet nesting habitat are associated with each of the three helicopter drop sites located at the road washouts for a total of about 75 acres. Nesting murrelets located within an 800 feet-radius of the helicopter flight path and drop sites would potentially flush off a nest in response to helicopter noise. Noise disturbance in the vicinity of the helicopter drop sites is expected to have the highest likelihood of resulting in a murrelet flush response due to prolonged noise and debris movement from rotor-wash (downwash and side-wash) near potential nest sites.

Recreational use in the Carbon River corridor: The potential for visitors to encounter murrelets is limited to those instances when a murrelet may be nesting in a tree directly adjacent to a road, trail, parking area, or campground. There have been reported instances of murrelets flushing off a nest branch while attempting to deliver food to a chick in response to the presence of people on the ground within a distance of 15 – 40 m (Hamer and Nelson 1998:9), but these situations are considered uncommon (USFWS 2003:277). Hebert and Golightly (2006:31) in their study of park trails did not record any instances of murrelet flush responses or detect any significant relationship between murrelets nesting success and proximity to trails and roads. The authors (p. 39) conclude that mitigation in the form of reducing access to trails appears to be unwarranted, but they caution that the established link between human use of trails and campgrounds and increased corvid densities has implications for reduced murrelet nesting success.

Disturbance associated with annual opening of the Carbon River corridor in the spring: Due to the uncertain nature of trail repair work that may be needed to allow visitor and staff access to the project area, there would be ongoing short-term disturbance associated with opening the Carbon River Road/Trail in the spring that could continue to occur at any location within the corridor. Sites that require onsite work for a period of more than two days (such as rebuilding a trail bridge) during the early nesting season would disrupt murrelets nesting within a 35-yard radius.

Increased risk of predation in areas of human activity: The relationship between human activities and predators, and their potential impact on murrelet nesting success has been identified as a major threat to murrelets (USFWS 2010). The risk of predation on murrelet nests by avian predators appears to be highest in close proximity to forest edges and human activity. In many studies, many more predators (especially corvids), occurred in campgrounds, along suburban edges, and in other areas close to human development (McShane *et al.* 2004).

Based on the work by Marzluff and Neatherlin (2006), murrelets nesting in close proximity (within a 1 km radius) to Ipsut Creek campground may have a higher rate of nest predation due to the potential for increased corvid abundance adjacent to campgrounds. Murrelet nesting habitat immediately adjacent to the Carbon Road/Trail between the entrance and Ipsut Creek Campground also would have a high risk of predation due to the long history of recreational use in the corridor. Approximately 500 to 600 acres of murrelet nesting habitat are exposed to increased predation risk due to recreational use in the corridor. This represents about 10 percent of the available murrelet nesting habitat in the upper Carbon River basin.

As a result, effects associated with increased predation risk in the Carbon corridor would continue to occur, and are not likely to change over the current existing levels (but dramatically decreased after flooding in 1996 and 2006. As a result under all alternatives, areas along the road, except at the entrance would become pack-in / pack-out to manage garbage collection.

Loss of potential nesting habitat: Trail realignment along the Carbon River Road/Trail corridor may indirectly affect murrelets by removing key habitat elements such as large trees with potential nest platforms, or trees that provide canopy cover for potential nest platforms. Felling of trees greater than 16 inches diameter would only occur outside the murrelet nesting season, so there is no chance that an occupied nest tree would be felled, or that an adjacent tree providing canopy cover for on occupied nest site would be felled.

It is unknown whether trees identified for felling contain potential murrelet nest platforms, however considering the limited number of trees to be removed and the size classes, the probability that one of these trees is a murrelet nest tree is extremely low. Murrelets in some areas are known to reuse to the same nest trees from year to year, but this appears to be most common in landscapes that have limited nesting habitat, and less common in landscapes with large tracts of available nesting habitat (Burger *et al.* 2009:217). Because there are large stands of suitable nesting habitat within the upper Carbon River basin, the loss of a few individual trees during the non-breeding season would not result in disruption of murrelet breeding behavior in subsequent years.

Alternative 1 Impacts to Murrelets

This alternative would have the fewest nesting season and habitat impacts to murrelets. Inwater work, including the use of heavy equipment and helicopters would likely occur during the early nesting season at **7 locations**, resulting in prolonged nesting season disturbance adjacent to these locations. Helicopter work at Ipsut Creek could be scheduled to occur after the nesting season, and would have no effect to murrelets. Continued use of the road trail corridor would result in continuing adverse impacts to 110 acres of murrelet habitat associated with noise disturbance and an increased risk of predation associated with recreational use along the corridor.

Alternative 2 Impacts to Murrelets

There would be substantially more impacts to murrelets compared to Alternative 1. Work using heavy equipment and helicopters during the early nesting season would occur at **15 locations**, resulting in prolonged nesting season disturbance adjacent to these areas, including the 0.5 mile section of road at Falls Creek. Helicopter work at road washouts between the Chenuis Trailhead and Ipsut Creek would result in noise disturbance to 400 acres of murrelet habitat during the early nesting season. Continued use of the road-trail corridor would result in ongoing adverse impacts to 110 acres of murrelet habitat associated, including from noise disturbance and an increased risk of predation associated with recreational use.

Alternative 3 Impacts to Murrelets
Compared to Alternatives 1 and 2 there would be more impacts to marbled murrelets. Proposed work during the early nesting season would occur at **22 locations**, resulting in prolonged nesting season disturbance adjacent to these locations, including the 0.5 mile section of road at Falls Creek. Other impacts would be the same as in Alternative 2.

Alternative 4 Impacts to Murrelets
More impacts to murrelets would occur in Alternative 4, than in Alternatives 1-3. Work during the early nesting season would occur at **27 locations**, resulting in prolonged nesting season disturbance adjacent to these locations, including the 0.5 mile section of road at Falls Creek. Other impacts would be the same as Alternatives 2-3.

Alternative 5 – Impacts to Murrelets
In addition to impacts from Alternative 1, there would be additional impacts associated with creating a new wilderness trail. This new trail would affect existing trees and other vegetation over approximately 1.9 acres (5.2 miles x 3 feet wide). Trail construction may include minor loss of murrelet nesting habitat. The new trail would result in increased human presence in wilderness areas, and may result in increased predation risk and noise disturbance to 125 acres of murrelet nesting habitat along the new trail route. As with Alternative 1, there would be work using heavy equipment and helicopters during the early nesting season at **7 locations**, resulting in prolonged nesting season disturbance adjacent to these locations. Interim continued use of the historic road corridor would result in continuing adverse impacts to 110 acres of murrelet habitat from noise disturbance and an increased risk of predation associated with recreational use. Eventually the Ipsut Creek Campground would be closed and a new backcountry campground would be developed at another location, resulting in a shift in recreational use away from the historic road corridor and into the wilderness corridor.

Conclusion: Surveys indicate the Carbon River Valley probably supports the highest density of nesting murrelets in the park. Old-growth forest in the park and adjacent areas, including wilderness, provide high quality murrelet nesting habitat that is mostly free from development and the presence of people. The Carbon River Road has a long history of recreational use, and likely supports a higher density of murrelet nest predators. As long as the area is managed for recreational access, murrelets nesting in close proximity to the road and Ipsut Creek Campground would likely have a higher rate of nest failure from predation and human disturbance.

Alternatives 1-5 may affect, and are likely to adversely affect marbled murrelets. Alternatives 2-4 would have the greatest impacts associated with disturbance during the nesting season due to constraints presented by the inwater work season for listed fish species to install bank protection structures. The timing and duration of project construction activities would likely result in major disturbance and disruption of marbled murrelet nesting behavior, and would also likely result in an increased potential for nest failure for murrelets associated with approximately 110 acres of nesting habitat over the project duration. Murrelets associated with approximately 400 acres of nesting habitat would also be exposed to major short-term disturbance associated with helicopter use over one year. The maximum area of disturbance would be 400 acres in one year, because acres exposed to helicopter noise include the 110 acres of habitat located along the Carbon River Road/Trail. These effects would occur in areas that already have increased levels of predation from recreational use in the Carbon River corridor.

The number of murrelets exposed to these adverse effects is unknown. There are approximately 5,600 acres of potential murrelet nesting habitat in the upper Carbon River Valley. Disturbance to 400 acres of represents about 7 percent of the available murrelet nesting habitat. It is likely that the Carbon River

Valley supports an average of 12 pairs of nesting murrelets each year, with an average density of 467 acres of nesting habitat per pair. It is likely that one nesting pair of murrelets per year would be subjected to adverse affects from disturbance, including potential nest failure. Adverse affects would not result in the loss of this small, local population of nesting murrelets because over 90 percent of the nesting habitat in the Carbon River Valley is essentially pristine and located away from the influence of developments and human presence. There would be no impairment related to marbled murrelets.

Impact Avoidance, Minimization or Mitigation Measures
The following protective measures from the biological assessment would be implemented throughout the duration of the project to minimize effects to listed species and water quality.

a. **Minimize Disturbance to Nesting Marbled Murrelets:** (Source: USFWS 2007)

- Felling of large trees in suitable nesting habitat for marbled murrelets would not occur during the marbled murrelet nesting season (April 1 – September 15). Tree felling would not be permitted from April 1 through September 15 to protect nesting murrelets, eggs, and young in stands that are identified as suitable murrelet nesting habitat. Large trees are defined as conifers with a dbh of 16 inches or greater.
- All project activities located would only occur 2 hours afterer official sunrise, and would cease 2 hours prior to official sunset during the murrelet nesting season (April 1 to September 15). This restriction avoids potential disruption to murrelets during their daily peak activity periods for feeding and incubation exchanges.

- Blasting activities would not occur between April 1 and August 5. This restriction avoids potential disruption of murrelets during their early nesting season which includes incubation and brooding of hatchlings.
- All food items would be stored inside vehicles, trailers, or trash dumpsters except during actual use to prevent unnatural attractants to crows, jays, and other wildlife which have been identified as predators of murrelet eggs and young.

Exceptions:
Project activities that require in water work (e.g., culvert removal) may occur during the murrelet nesting season to comply with seasonal restrictions for in water work (July 16 to August 15).

[1]A typical conservation measure is to avoid all construction activities located within the defined disruption distances during the murrelet early nesting season (1 April to 5 August). This measure has not been included here because the park has determined that compliance with this measure is not feasible.

b. **Minimize Disturbance to Nesting Spotted Owls:** (Source: USFWS 2007)

- Felling of large trees in suitable nesting habitat for spotted owls would not occur during the spotted owl nesting season (March 15 – September 30). Tree felling would not be permitted during the nesting season to protect nesting spotted owl, eggs, and young in stands that are identified as suitable nesting habitat. Large trees are defined as conifers with a dbh of 16 inches or greater.
- Blasting activities would not occur between March 15 and July 30. This restriction avoids potential disruption of spotted owls during their early nesting season which includes incubation and brooding of hatchlings.

Exceptions:
Seasonal restrictions may be waived if current spotted owl surveys indicate no spotted owls are nesting within the defined disruption distances from the project construction area.

Project activities that require inwater work may occur during the spotted owl nesting season to comply with seasonal restrictions to protect fish for inwater work (July 16 to August 15).

c. **Minimize Impacts to Bull Trout:** (Sources: USFWS 2007, WDFW and USFS 2005)

Follow the appropriate Washington Department of Fish and Wildlife (WDFW) guidelines for the timing of in-water work. These guidelines are intended to avoid in-water work during periods when salmonid eggs and fry incubate within stream gravels.

- In-water work is restricted to the period of **July 16 to August 15** for all Carbon River tributaries streams such as Ranger Creek (WAC-110-206).
- The extended in-water work season for the mainstem Carbon River is **July 9 to August 22.** This applies to work associated with placement of engineered logjams or other bank protections structures along the Carbon River.
- Fish within construction sites that would be dewatered or isolated from the main water body shall be captured and safely moved from the job site. Fish capture and transportation equipment shall be available on the job site during all in-water activities.
- Any pump used for diverting water from a fish bearing water body shall be equipped with a fish guard to prevent passage of fish into the pump. The pump intake shall be screened with 3/32 inch or smaller mesh. Screen maintenance shall be adequate to prevent injury or entrapment to juvenile fish and shall remain in place whenever water is withdrawn from the water body through the pump intake.

Exceptions:
In-channel work below the ordinary high-water line may occur outside the specified in-water work period in areas that are dry during the proposed work period. Many side-channels and other fish-bearing streams within the Carbon River floodplain are seasonally dry from mid-summer into fall.

d. **Fish Passage Criteria for Instream Structures:** (Sources: WDFW 2004 – *Stream Habitat Restoration Guidelines* and WAC-110-070)

Hydraulic drop is the difference in elevation between the water surface upstream and downstream of the structure. To maintain fish passage for juvenile salmonids, the following hydraulic drop criteria apply:

Drop structures or grade-control structures: The maximum hydraulic drop for instream structures is 0.7 feet (8 inches). This drop height can be achieved by placing notches in structures, or by setting the structure at an angle such that the desired drop height is achieved. The maximum hydraulic drop criteria must be satisfied at all flows between the low and high flow design criteria.

e. **Fish Removal and Dewatering Protocol:** (Source: USFWS 2007)

The following procedures would be used to isolate and dewater sites which require in-water work with heavy equipment. All fish capture, removal, and handling activities shall be conducted by an experienced fisheries biologist or technician.

1) Isolate the Construction Site and Remove Fish

Install block nets at up and downstream locations and leave in a secured position to exclude fish from entering the project area. Leave nets secured to the stream channel bed and banks until fish capture and transport activities are complete. If block nets or traps remain in place more than one day, monitor the nets and or traps at least on a daily basis to ensure they are secured to the banks and free of organic accumulation and to minimize fish predation in the trap.

2) Fish Capture Alternatives

- Collect fish by hand or dip nets, as the area is slowly dewatered.

- Seining – Use seine with mesh of such a size to ensure entrapment of the residing fish.
- Minnow traps – Traps would be left in place overnight and used in conjunction with seining.
- Electrofishing – Prior to dewatering, use electrofishing only where other means of fish capture may not be feasible or effective.

The protocol for electrofishing includes the following:

- If fish are observed spawning during the in-water work period, electrofishing shall not be conducted in the vicinity of spawning adult fish or active redds.
- Only Direct Current (DC) or Pulsed Direct Current (PDC) shall be used.
- Conductivity <100: use voltage ranges from 900 to 1100. Conductivity from 100 to 300: use voltage ranges from 500 to 800. Conductivity greater than 300: use voltage to 400.
- Begin electrofishing with minimum pulse width and recommended voltage and then gradually increase to the point where fish are immobilized and captured. Turn off current once fish are immobilized.
- Do not allow fish to come into contact with anode. Do not electrofish an area for an extended period of time. Remove fish immediately from water and handle as described below. Dark bands on the fish indicate injury, suggesting a reduction in voltage and pulse width and longer recovery time.

3) Fish Handling and Release

Fish must be handled with extreme care and kept in water the maximum extent possible during transfer procedures. A healthy environment for the stressed fish shall be provided—large buckets (five-gallon minimum to prevent overcrowding) and minimal handling of fish.

Place large fish in buckets separate from smaller prey-sized fish. Monitor water temperature in buckets and well-being of captured fish. As rapidly as possible (especially for temperature-sensitive bull trout), but after fish have recovered, release fish upstream of the isolated reach in a pool or area that provides cover and flow refuge. Document all fish injuries or mortalities and include in annual report.

4) Dewater the Construction Site

Upstream of the isolated construction area, divert flow around the construction site with a coffer dam (built with non-erosive materials) and an associated pump or a by-pass culvert. Diversions constructed with material mined from the streambed or floodplain is not permitted. Small amounts of instream material can be moved to help seal and secure diversion structures.

Pumps must have fish screens with 3/32 inch or smaller mesh. Dissipate flow energy at the bypass outflow to prevent damage to riparian vegetation or stream channel. If diversion allows for downstream fish passage (i.e., is not screened), place diversion outlet in a location to promote safe reentry of fish into the stream channel, preferably into pool habitat with cover.

When necessary, pump seepage water from the de-watered work area to a temporary storage and treatment site or into upland areas and allow water to filter through vegetation prior to reentering the stream channel.

5) Rewater the Construction Site

Upon project completion, slowly re-water the construction site to prevent loss of surface water downstream as the construction site streambed absorbs water and to prevent a sudden increase in stream turbidity. Monitor downstream during re-watering to prevent stranding of aquatic organisms below the construction site.

Pumping equipment must be staged away from the rivers; except for the pump hose, which may extend down to the edge of the rivers. Pump intakes must be screened with 3/32 inch or smaller mesh on the end of pump hose to filter-out aquatic organisms. This screen should be cleaned of debris periodically.

Place a spill containment enclosure around the pump and or generator to contain gas, oil or other fluids.

f. **Minimize Heavy Equipment Impacts to Aquatic and Riparian Habitats:** (Sources: USFWS 2007, WDFW and USFS 2005)

- Establish staging areas (used for construction equipment storage, vehicle storage, fueling, servicing, hazardous material storage, etc.) at least 150 feet away from streams in a location and manner that would preclude erosion into or contamination of streams or wetlands.
- All equipment used for instream work shall be cleaned and leaks repaired prior to entering the project area. Remove external oil and grease, along with dirt and mud prior to construction. Thereafter inspect equipment daily for leaks or accumulations of grease, and fix any identified problems before entering streams or areas that drain directly to streams or wetlands.
- Heavy equipment used for in-water work would use biodegradable hydraulic fluids.
- If the project includes excavation of the streambed or banks, those work areas shall be isolated from flowing waters to protect water quality and minimize turbidity.
- All equipment shall be cleaned of all dirt and weeds before entering the project area to prevent the spread of noxious weeds.
- Equipment used for instream or riparian work shall be fueled and serviced in an established staging area located at least 150 feet away from streams. When not in use, vehicles shall be stored in the staging area.
- Minimize the number and length of stream crossings and access routes through riparian areas. Stream crossings and access routes should be at right angles.
- Heavy equipment would follow planned routes of access, would travel across dry, un-wetted substrates to the extent possible, and would only cross wetted channels at designated locations.
- Existing roadways or travel paths would be used whenever reasonable. Minimize the number of new access paths to minimize impacts to riparian vegetation and functions.
- Project operations must cease under high flow conditions that inundate the project area, except for efforts to avoid or minimize resource damage.
- Initiate rehabilitation of all disturbed areas in a manner that results in similar or better than pre-work conditions through spreading of stockpiled materials, seeding, and/or planting with locally native seed mixes or plants. Planting shall be completed no later than fall planting season of the year following construction.

g. **Minimize Water-Quality Contamination from Concrete and Treated Wood:** (Sources: WDFW and USFS 2005)

- Fresh concrete, concrete by products, or other chemical contaminants shall not be allowed to enter water bodies. Structures containing concrete shall be sufficiently cured to prevent leaching prior to contact with the water body.
- Treated wood used for bridges or other structures shall meet or exceed the standards established in the most current edition of "*Best Management Practices For the Use of Treated Wood in Aquatic Environments*" developed by the Western Wood Preservers Institute.

h. Project Criteria for Culvert or Trail Bridge Placements: (Sources: USFWS 2007, WDFW and USFS 2005, WAC-220-110-070)

- Structure types may include closed-bottomed culverts, open-bottomed arch or box culverts, or bridges.
- The structure width shall never be less than the bankfull channel width. The stream width inside the culvert or between bridge footings shall be equal to or greater than the bankfull width.

- Culverts in fish-bearing streams shall be designed, installed, and maintained to provide passage for all fish species and all life stages that are likely to be encountered at the site.
- Stream crossing structures (culverts or bridges) must accommodate a 100-year flood flow while maintaining sediment continuity (similar particle size distribution) within the culvert as compared to the upstream and downstream reaches.
- Culvert removal or placement sites shall be dewatered or isolated from flowing waters to protect water quality and minimize turbidity.
- Culvert removal or replacement projects in fish-bearing streams would only occur during the approved inwater work season (July 16 – August 15).
- Structures containing concrete must be cured or dried before they come into contact with stream flow.
- Bridge abutments must be placed outside the bankfull channel width.
- Embedment – If a closed culvert is used, the bottom of the culvert shall be buried into the streambed not less than 20% and not more than 50% of the culvert height. For open-bottomed arches and bridges, the footings or foundation shall be designed to be stable at the largest anticipated scour depth. Substrate and habitat patterns within the culvert should mimic stream patterns that naturally occur above and below the culvert. Coarser material may be incorporated to create velocity breaks during high flows, thereby improving fish passage, and to provide substrate stability.
- Grade Control Structures – Grade control structures are permitted to prevent head-cutting above or below the culvert or bridge. Grade control typically consists of boulder structures that are keyed into the banks, span the channel, and are buried in the substrate. Grade-control structures must accommodate fish passage for all species and life stages of fish present.
- When removing woody debris from the road-crossing inlet, place the debris downstream of the road crossing.

i. **Project Criteria for Permanent Culvert or Bridge Removal (WAC-220-110-070):** (Sources: USFWS 2007, WDFW and USFS 2005, WAC-220-110-070)

- All fill material and man-made structures shall be removed from stream channels. The natural stream channel profile shall be restored. Bottom width opening of the fill removal at stream channel crossings shall be equal to, or greater than, the natural bankfull channel width.
- Streambanks shall be shaped to blend in to the existing natural banks upstream and downstream from the crossing removal.
- Streambed substrates shall mimic the natural streambed characteristics upstream and downstream of the crossing removal. Large woody material and/or large rocks may need to be placed within the crossing removal site to accomplish this objective.
- The toe of the excavation shall be stabilized with large wood, appropriately sized rock, and/or vegetation as necessary to prevent excessive erosion of the new streambanks.
- When removing culverts on fish-bearing streams, construction sites shall be dewatered or isolated from flowing waters to prevent generation of sediment and minimize turbidity.
- Dewatering is not required for culvert or ford removals on non-fish bearing streams unless substantial excavation of stream channel or culvert bedding materials would be required after the existing culvert or structure is removed.

j. Project Criteria for Inchannel Gravel Removal

Limited excavation of river gravels and cobbles for project fill is permitted. Gravel excavation is limited to dry gravel bars within the main Carbon River channel only. The following technical provisions apply to gravel removal projects (Source: WAC-110-140):

- Gravel removal from a watercourse shall be limited to removal from exposed bars and shall not result in a lowering, over time, of the average channel cross-section profile through the project area or downstream.
- Gravel removal from the Carbon River would only occur during the approved in water work season (July 9 – August 22).
- An "excavation line" shall be established. "Excavation line" means a line on the dry bed, at or parallel to the water's edge. The excavation line should be established at a distance that would avoid excavation disturbance within the wetted channel. The excavation line may change with water level fluctuations.
- An "excavation zone" shall be defined as the area between the "excavation line" and the bank or the center of the bar. The "excavation zone" shall be identified by boundary markers placed by the applicant and approved by the department prior to the commencement of gravel removal.
- Excavation shall begin at the excavation line and proceed toward the bank or the center of the bar, perpendicular to the alignment of the watercourse.
- Bed material shall not be removed from the water side of the excavation line.
- Equipment shall not enter or operate within the wetted perimeter of the watercourse.
- Gravel may be removed within the excavation zone from a point beginning at the excavation line and progressing upward toward the bank or the center of the bar on a minimum two percent gradient. It may be necessary to survey the excavation zone upon completion of the gravel removal operation to ensure the two percent gradient is maintained and that no depressions exist.
- The depth of gravel excavation from exposed bars is limited to the depth of the adjacent water level.
- No excavation of gravels from within wetted channels is allowed.
- At the end of each work day the excavation zone shall not contain pits, or potholes, or depressions that may trap fish as a result of fluctuation in water levels.
- The upstream end of the gravel bar shall be left undisturbed to maintain watercourse stability waterward of the ordinary high water line.
- Large woody material shall be retained waterward of the ordinary high water line and repositioned within the watercourse. Other debris shall be disposed of so as not to reenter the watercourse.
- Equipment shall be inspected, cleaned, and maintained to prevent loss of petroleum products waterward of the ordinary high water line.

k. <u>Project Criteria for Moving Inchannel Large Wood for use in Engineered Logjams</u>

- Only logs that are isolated on dry gravel bars in the Carbon River braided channel zone may be moved for use in logjams.
- No logs that are interacting with the wetted channel width may be moved, except within the construction footprint of a project site.

Equipment shall not enter or operate within the wetted perimeter of the watercourse, except at designated equipment crossing sites, and would only occur during the approved in water work season for the Carbon River (July 9 – August 22).

7. Ethnographic Resources Impacts

Alternative 1 Impacts

There would be no additional impacts to ethnographic resources. Although access to the Carbon River area is currently limited by the condition of the road and unimproved trail, there would be no changes to these characteristics in Alternative 1. Visitors, including tribal members would continue to park at the Carbon River Entrance and either walk or bicycle on the existing unimproved trail / road corridor. Slight beneficial impacts would be conferred by placement of two barbs and four logjams at the entrance that would protect existing facilities there. The facilities, however, would be removed over time, as called for by the GMP and the *Carbon River (Entrance and Ipsut Creek) Improvements Environmental Assessment / Finding of No Significant Impact* (NPS 1999).

Impacts from Elements Common to Alternatives 2-5
Potential impacts to ethnographic resources / tribal concerns could occur from implementation of agreements with partners to provide additional parking near the Carbon River Entrance or in boundary expansion areas. Additional parking access could be perceived as having an effect on access to and use of traditional hunting areas surrounding the Carbon River Entrance, a long-term minor adverse effect since parking already occurs informally in this area. This alternative would also improve access, somewhat, from construction of a turnaround at Milepost 1.2 (the Old Mine Trailhead). Because improved access for elders is desirable, there would be long-term beneficial impacts from construction of the turnaround, which would provide increased motor vehicle access to the old growth forest and to the proposed improved trail (Alternative 2), wilderness trail (Alternative 5) or road (Alternatives 3 and 4) beyond.

In addition, removal or improvement of fish passage culvert crossings on the improved trail (Alternative 2) or road (Alternatives 3-4) or from removal (Alternative 5) would have long-term localized beneficial impacts on fish habitat and potentially populations. At the same time, there would be minor to moderate adverse and beneficial effects from location of some erosion protection measures (Alternatives 1-5). Short-term adverse impacts would occur from placement of instream structures (such as logjams), while long-term beneficial effects would occur from bioengineering (associated with logjams and log cribs) and from use of large woody debris and other materials to create additional cover in logjams. As a result, there would likely be both beneficial and ongoing adverse effects on fisheries as an ethnographic resource.

Alternative 2 Impacts
Actions and impacts would be the same as in *Impacts from Elements Common to Alternatives 2-5*. In addition, there would be beneficial impacts on access from construction of an improved trail, which would also initially provide accessibility.

Alternative 3 Impacts
Actions and impacts would be the same as in *Impacts from Elements Common to Alternatives 2-5*. In addition, there would be long-term beneficial impacts from construction of a road that could be used by public vehicles, thereby improving access to area resources for tribal members.

Alternative 4 Impacts
Actions and impacts would be similar to Alternative 3, except that the improved access would be diminished because shuttle access would only be available in summer and on weekends and holidays. During other times of the year, this alternative would be similar to Alternative 2, with improved access for hiking and bicycling. Additional long-term beneficial effects would occur if there was off-site shuttle parking, such as in Wilkeson, which could diminish visitor parking near the Carbon River Entrance, where parking did not potentially impede access to / use of tribal resources.

Alternative 5 Impacts
Actions and impacts would be the same as in *Impacts from Elements Common to Alternatives 2-5*. Interim impacts would be the same as in Alternative 1. In addition, there would be minor to moderate adverse impacts on access because fewer people could and/or would use the wilderness trail.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts on ethnographic resources include:

- Additional consultations with affected Native American Indian tribes as plans for parking outside the Carbon River Entrance develop.

- If additional concerns or areas of use were later identified, consultation with the affected Native American tribe(s) and, as appropriate, the Washington State Office of Archeology and Historic Preservation, would occur to determine how to proceed.
- Fish and fish habitat mitigation measures are noted above in the Special Status Species section.

Cumulative Impacts: Establishment of the park in 1899 initiated a process of diminished Native American use of Mount Rainier – primarily by virtue of restricting, or banning traditional hunting and gathering practices. While, initially, these effects were relatively minor, changes to traditional use areas and the ability to use them later became moderate to major after 1917 when hunting activities were formally banned within the park boundary. In subsequent years, plant gathering activities, beyond levels accorded to all park visitors, were curtailed as well. Since the mid-1990s, increased cooperation with Native American Indian tribes has allowed some traditional uses to reemerge within the park landscape. Proposed actions in Alternative 1 would continue to contribute minor to moderate adverse effects which would be similar in Alternative 2 and during the interim condition of Alternative 5. Alternatives 3 and 4 would increase access to areas along the Carbon River Road and would provide easier access to high elevation subalpine areas.

Conclusion: There would be no change in access or fish habitat passage as a result of Alternative 1. Beneficial effects could occur from expanded parking. Alternatives 2-5 would have long-term minor beneficial impacts on ethnographic resources from improvement of fish habitat, and improvement of parking and access. Potential long-term minor adverse impacts would occur from expansion of parking outside the current Carbon River Entrance. Shuttle access under Alternative 4 could diminish some of this effect. Overall, the alternatives do not propose use where no use is currently occurring and compared to existing conditions, there would be minor changes that could affect Native American use of the area. There would be no adverse effect to and no impairment of known ethnographic resources from the implementation of Alternatives 1-5.

8. Prehistoric and Historic Archaeological Resources Impacts

Overview

Of the eight archeological sites documented by surveys in the Carbon River Road corridor since 1996: the following six could be affected by actions proposed in Alternatives 1-5:

- Washington Mining and Milling Company Mine Adit (a National Register eligible site),
- Carbon River Historic Levee #1 (National Register ineligible),
- Carbon River Historic Levee #2 (National Register ineligible),
- Carbon River Historic Levee #3 (National Register ineligible),
- Falls Creek Can Dump (National Register eligibility undetermined), and
- Ipsut Creek Campground (National Register eligibility undetermined).

One site that had previously been identified, a small tin can trash dump (dating to approximately 1915-1930) in the Falls Creek area was not relocated in 2008 surveys. Of these sites, the levees have been determined to be ineligible for the National Register of Historic Places. A National Register determination of eligibility has not been made for the tin can dump or Ipsut Creek Campground (Burtchard *et al.* 2009). The mine adit and associated features are considered eligible by the park for inclusion in the National Register. Other archeological resources in the area, including a cabin site, considered eligible by the park for inclusion in the National Register and an ineligible site consisting of an early NPS-constructed water system would not be affected.

Alternative 1 Impacts

There would be no effect on known archeological resources eligible for inclusion in the National Register of Historic Places from new actions proposed as part of Alternative 1, including reconstruction of the Ipsut Creek Patrol Cabin at the entrance, and installation of barbs and/or logjams at the entrance and maintenance area. Reconstruction of the cabin would expand the former footprint of the fee booth at the entrance, and could require archeological testing and/or monitoring. Construction of the logjams would be within and on the bed of the Carbon River near the entrance and maintenance area. Although excavation would be involved to anchor the jams, no known archeological resources are expected within the dynamic river bed.

Potential impacts could occur from ongoing actions, including use of the unmaintained Old Mine Trail and ongoing reconstruction of the unimproved trail through washout sections. Continued use of the Old Mine Trail could continue to have the potential for minor to moderate adverse effects because of the possibility that visitors could damage or remove associated artifacts. Gating of the mine adit, which is proposed for 2010 under a separate project, would have no adverse effect. It will not alter the historic fabric. Ongoing reconstruction and rerouting of the unimproved trail as continuing flood damage occurs from Carbon River, Falls Creek, Ipsut Creek or other tributary stream events will cause new ground disturbance in presumably more stable landscapes and could potentially affect previously unidentified archeological resources. Because of this potential, ongoing monitoring of trail construction would be needed as the trail is moved away from the Carbon River Road corridor (its existing alignment) over time.

Minimal maintenance of the existing trail and roadway could contribute to passive restoration of the former road and campground areas and could also result in ongoing damage to two sites with currently undetermined eligibility for the National Register – the can dump site at Falls Creek, Ipsut Creek Campground, and three ineligible levee sites; leading to potential minor to moderate adverse effects from loss of integrity at these sites. Because there would be no stabilization of the Falls Creek washout area, there could be additional indirect effects on the can dump site. Although it is unlikely that the three levee sites would be affected in the short-term, in the long-term, it is possible that ongoing movements of the river and flood-related impacts could cause additional damage to these sites. No specific mitigation measures would be implemented to prevent ongoing flood damage to the levee sites because they have been documented through archeological survey and cultural landscape inventory and because they are considered ineligible for the National Register. Specific mitigation measures, however, would be implemented associated with the can dump if it is re-identified. Analysis of its eligibility would occur.

In addition, National Register eligibility of Ipsut Creek Campground has not yet been determined; survey and/or testing would be needed where non-historic buildings or structures are removed. Such work would determine the extent to which previously unidentified archeological resources were obscured by the former location of Ipsut Creek Patrol Cabin and the Ranger Station. Testing would also be required if additional changes to other parts of Ipsut Creek Campground are proposed.

Impacts from Elements Common to Alternatives 2-5

As in Alternative 1, it is unlikely that there would be impacts to archeological resources from construction of the logjams at the entrance and maintenance area or from construction of a visitor contact station and arch (instead of the patrol cabin) in the location of the former fee booth. These actions and removal of the ranger station and replacement with parking or picnicking, however, would involve archeological monitoring and/or testing of excavation areas.

In addition to these impacts from Alternative 1, there would be potential additional impacts to previously unidentified archeological resources from:

- Reconstruction of the entrance arch,
- Construction of the turnaround at the Old Mine Trailhead,
- Removal of buildings and infrastructure from the entrance,
- Removal of buildings and infrastructure from the maintenance area (including removal of the historic CCC garage and its relocation to a currently identified site in the boundary expansion area and replacement with parking),
- Removal of the amphitheater storage building, chlorinator building, vault toilets and other infrastructure from Ipsut Creek Campground,

- Construction of backcountry toilets at Ipsut Creek,
- Construction of grade control structures for and removal of major culverts at Ranger Creek and an unnamed tributary near Chenuis, and from
- Removal (Alternatives 3-5) or potential removal (Alternative 2) of the Ipsut Creek Bridge.

Since some buildings and structures were constructed prior to the advent of formal archeological resources protection laws, no surveys were undertaken prior to their construction. As a result, archeological monitoring of these areas would occur during any ground disturbing activities. In addition, there would be analysis of the existing disturbed areas, including potential survey and testing following removal of the structures. Once a proposed new location was identified for the CCC garage in the boundary expansion area, that site would also undergo survey for archeological resources.

Because all action alternatives call for construction of a turnaround at the Old Mine Trailhead, near or potentially within the boundary of the Old Mine site, there would be additional testing to determine the site boundaries and if these were to be impacted by the action, avoidance and/or additional consultation would occur to ensure that there would be no adverse effect to the site.

Because all action alternatives call for some degree of restoration of a portion of Ipsut Creek Campground and the former Ipsut Creek Trailhead parking area, before actions are taken that would affect the currently undetermined eligibility of Ipsut Creek Campground for the National Register, a determination of eligibility would be completed. Because these restoration actions would involve removal of associated infrastructure and facilities and scarification of disturbed areas at the campground and along the road, where there is the potential to disturb previously unidentified archeological resources, monitoring and/or testing in the area of proposed actions would occur.

Alternative 2 Impacts

In addition to *Impacts from Elements Common to Alternatives 2-5*, there would be a greater potential to affect previously unidentified archeological resources from construction of a toll booth at the entrance and reconstruction of the patrol cabin in the campground parking area, from reconstruction of a formal (wider) trail to the south to bypass flood damaged areas (including moving the trail as flood damage continues to occur), from the implementation of a series of additional erosion protection measures, and from restoration of a portion of Ipsut Creek Campground as well as former parking areas along the road at Green Lake and Chenuis.

Potential impacts from construction of the toll booth at the entrance and from the reconstruction of the patrol cabin at the campground parking area would be similar to those from construction of the visitor contact station (including foundation excavation and grading). The entrance toll booth would require monitoring during construction. The reconstruction of the patrol cabin is within the boundary of the Ipsut Creek Campground site and would require testing prior to ground disturbing activities.

Construction of trail sections bypassing the washout areas and rehabilitation of trail sections along the road corridor, including approximately 11 trail bridges, a series of gabion mattress and turnpike trail sections would cause a variety of ground disturbance impacts, including excavation and fill for footings, removal of vegetation, including native rock, concrete or gabion mattresses. These actions would have the potential to affect previously unidentified archeological resources and the three ineligible levee sites and one undetermined archeological site (can dump) but could also help to retain these sites because of stabilization of erosion in the washout corridor. Long-term impacts could be minor to moderate and both adverse and beneficial. Monitoring during construction activities would be required when construction activities are located on a stable, undisturbed landform.

Additional erosion protection measures include approximately 20-24 road humps, approximately 29 span log drops in the Falls Creek Channel, potential grade control structures in the Falls Creek channel and approximately seven additional erosion protection structures (log crib and complex log crib walls, toe-roughened log cribs, and/or a buried groin). Constructing the humps would require excavation within the road surface and fill with logs or gravel to create areas resistant to future head-cutting erosion. The log crib walls and buried groin would also require excavation and fill, including from excavation of rock and placement of logs. Impacts could also occur from gathering of local materials for these.

Alternative 3 Impacts
In addition to *Impacts from Elements Common to Alternatives 2-5*, there would be a greater potential to affect previously unidentified archeological resources from reconstruction of a one lane road through the Falls Creek washout area and in flood damaged areas and from the implementation of a series of additional erosion protection measures. Impacts and actions associated with construction of the visitor contact station and toll booth and relocation of Ipsut Creek Patrol Cabin to the campground parking area would be the same as in Alternative 2.

Construction of the one lane road would require excavation and fill of a portion of the Falls Creek channel and tree removal adjacent to this area to construct the log crib (see below) and road. Although the channel has been previously disturbed from road construction and from reconstruction in 1996 and 2000, the adjacent intact area has not been disturbed. Therefore, there would be a higher potential for previously undiscovered archeological resources that would require monitoring during construction.

As in Alternative 2, there would be a potential for the same impacts to previously undiscovered archeological resources from construction of the span log drops in the Falls Creek channel and from six of the seven log crib and/or buried groin, except that no log crib would be constructed in Alternative 3 at Milepost 3.459. Instead, there would be much greater impacts from excavation and fill from construction of two additional log cribs and from construction of approximately eight engineered logjams. There would also be fewer impacts from constructing four road humps in Alternative 3, compared to the 20-24 in Alternative 2.

Alternative 4 Impacts
Impacts from Alternative 4 would be the same as in Alternative 3, however three fewer road humps would be constructed and one log crib could potentially also include an associated additional logjam. With two additional logjams and another log crib wall, there would be greater excavation and fill associated with reconstruction the road through an additional 0.8 miles and therefore additional potential to affect previously unidentified archeological resources.

Alternative 5 Impacts
Impacts would be the same as in Alternative 1 from continuing to maintain the unimproved trail until the wilderness reroute trail was constructed. Impacts would also be the same as in *Impacts from Elements Common to Alternatives 2-5*. In addition, there would be a substantially greater potential to affect previously unidentified archeological resources from construction of a new five mile long trail in wilderness through a previously undisturbed area, from implementation of some erosion protection measures, and from later reconstruction of the patrol cabin at a currently unidentified location in the boundary expansion area.

Construction of the new wilderness trail and 5-9 humps up to the Old Mine Trailhead plus the potential for additional humps along the section of road around the knob that would be maintained as a trail would have the potential to affect previously unidentified archeological resources from excavation and fill. Because this area has not been surveyed previously, new survey would be required to identify historic properties in the area of potential effects (requiring additional environmental analysis). In addition, because this alternative calls for eventual complete restoration of Ipsut Creek Campground and construction of a new backcountry campground, potential impacts from these actions would have a greater potential for impacts to archeological resources than in other alternatives. Because the eligibility of Ipsut Creek Campground has not been determined, and because a new location for a backcountry camp has not been identified, in addition to monitoring noted below, survey and additional environmental analysis would occur prior to implementation of these actions.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be included in the proposed project to minimize impacts on archaeological resources include:

- Before modifications were made to Ipsut Creek Campground or the Old Mine Trail, a determination of eligibility for the National Register of Historic Places would be undertaken (Alternatives 1-5).
- If the can dump was later relocated, a determination of eligibility for the National Register of Historic Places would be made and measures would be designed to limit adverse effects to it (Alternatives 1-5).
- Because of the potential for adverse effects to undetermined or unknown archeological resources to occur, archeological survey, monitoring (and/or testing as determined necessary) would be conducted associated with the following proposed actions (notify archeologist in advance of proposed work):
  - Reconstruction of the entrance arch (Alternatives 2-5)
  - Removal of ranger station (Alternatives 1-5) and removal of historic CCC garage and reconstruction in the boundary expansion area (Alternatives 2-5) and replacement with parking and picnicking at the entrance and maintenance areas (Alternatives 1-5),
  - Construction of a visitor contact station at the entrance (Alternatives 2-5).
  - Reconstruction of the Ipsut Creek Patrol Cabin at the entrance (Alternative 1) or in the Ipsut Creek area (Alternatives 2-4) or later at the boundary expansion area (Alternative 5),
  - Construction of the turnaround (Alternatives 2-5),
  - Trail or road work in the Falls Creek area (Alternatives 1-5),
  - Removal (Alternatives 3-4) or potential removal (Alternatives 1-2, 5) of the Ipsut Creek Bridge,
  - Potential changes (ground disturbance) to Ipsut Creek Campground (Alternative 1), reduction and restoration of portions of Ipsut Creek Campground (Alternatives 2-5),
  - Construction of the proposed reroute trail (Alternative 5), and
  - Construction of the proposed backcountry camp (Alternative 5).
- Additional interpretation would be designed for the Old Mine Trail (Alternatives 1-5) and the trail would be maintained because of potential increased use (Alternatives 2, 4, and 5).
- The Old Mine adit would be gated as part of another project to place safety / bat gates at abandoned mine sites (Alternatives 1-5).
- Should unknown archaeological resources be uncovered during construction, work would be halted in the discovery area, the park archeologist contacted, the site secured, and the park would consult according to 36 CFR part 800.11 and, as appropriate, provisions of the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990. In compliance with NAGPRA, the National Park Service would also notify and consult concerned tribal representatives for the proper treatment of human remains, funerary, and sacred objects should these be discovered during the course of the project.
- If necessary or possible, relocation of work to a non-sensitive area would occur to enable site testing and documentation. Long-term actions could include reinitiating the project in the same area (upon effective data collection) or relocating the action (if possible). There would be an emphasis on taking actions that would avoid further disturbance to the site(s).

Cumulative Impacts: Overall, park development projects have had negligible to moderate, localized long-term cumulative adverse impacts (when archaeological resources have been uncovered during surveys for these projects and from the construction of facilities prior to the advent of archeological resources protection laws) and long-term beneficial impacts from additional opportunities to study archaeological resources. Alternative 1 would contribute a potential for minor, cumulative adverse impacts. Alternative 2 would contribute a potential for minor to moderate cumulative adverse impacts and would have beneficial impacts. Alternatives 3 and 4 would have a potential for minor to moderate cumulative adverse and beneficial impacts. Alternative 5 would have a potential for moderate adverse impacts both because the area for the reroute trail has not been surveyed and because of the amount of new area disturbed.

Conclusion: There would be no adverse effect on the Washington Mining and Milling Company Adit, which has been identified as eligible for listing on the National Register. Although there would initially be no adverse effect on archeological resources under Alternatives 1, 2 and 5, it is likely that the can dump, in the Falls Creek area, which was not relocated in 2009, would potentially be lost later due to limited stabilization (Alternative 2), or no stabilization (Alternatives 1 and 5) of this area.   In Alternatives 3 and 4, the area would be stabilized and the can dump, if still present would likely be retained (no adverse effect). Changes to Ipsut Creek Campground as proposed in Alternatives 2-5, if determined eligible for the National Register could have a potential adverse effect. Other potential impacts to archaeological resources would be avoided by additional survey and analysis. This could include realignment of the proposed trail in Alternative 5 to avoid archeological resources. Proposed actions under Alternatives 1-5 would not result in impairment.

9. Historic Structures / Cultural Landscapes Impacts

Alternative 1 Impacts

Alternative 1 would have an *adverse effect* on the Mount Rainier National Historic Landmark District, as defined by Section 106 of the National Historic Preservation Act. This adverse effect would be as a result of the decision to not maintain the Carbon River Road to the Secretary of the Interior's Standards for the Treatment of Historic Properties and from incompatible alterations to this portion of the NHLD. Not maintaining the road would continue to result in the loss of landscape characteristics (natural systems and features, spatial organization, land use, circulation, topography, vegetation, buildings and structures, and archeological sites) and the integrity associated with them (design, materials, workmanship, feeling and association of the road).

Alternative 1 would have major changes in the width, alignment, grade and use of the road. Under Alternative 1, there would be no repairs to the damaged sections of the Carbon River Road, except as necessary to allow for an unimproved trail to persist. Discontinuing the road's traditional use in its capacity as a motor vehicle road, open to the visiting public and providing primary access to the Ipsut Creek Campground, would represent a substantial departure from the use the NPS has perpetuated since the 1920s. Without road repairs and ongoing maintenance, the historic integrity of the road would continue to be compromised as a consequence of ongoing erosion of the washout area, the inevitability of future flood damage, and the likelihood of rapid vegetative recovery in the road corridor due to frequent inundation of some of it by the river. Although portions of the road would likely remain for some time, until flood damage occurred, more than one mile of the road has already lost its character-defining features. Over time, as deterioration continued from lack of maintenance of the road surface, crown, side ditches and vegetation, even in intact areas, the road would narrow to a footpath.

Although there would be no active rehabilitation of the Carbon River Road corridor, the inability to get needed equipment into the area to maintain the remaining portions of the road would result in benign neglect, an adverse effect, wherein the remaining characteristics with integrity would diminish over time from lack of maintenance.

Additionally, although at the time of the flood, the landscape characteristics of the road associated with its significance, conveyed historic design patterns and intentions of the NPS landscape architects from the period of significance, some of these have since been lost and some would continue to be adversely affected or lost as part of the implementation of this alternative. There would be adverse effects on the following landscape characteristics: natural systems and features, spatial organization, land use, circulation, vegetation, buildings and structures, views and vistas and archeological sites. The factors contributing to the integrity of these characteristics would also be adversely affected.

Natural Systems and Features: Moderate adverse effects on natural systems and features would continue to result from the primary goal of the road (access to the lowest glacier in the continental United States – Carbon Glacier) being limited by the length of time it would take for visitors to get there. Whereas a large percentage of visitors to the area used to reach the Carbon Glacier on a day hike (7 miles) out of Ipsut Creek, a much smaller percentage of visitors would be able to achieve this goal because of the now 17 mile hike.

Spatial Organization: Minor adverse effects on spatial organization would result from ongoing loss of the nodes of development linked by the Carbon River Road, including parking, picnicking and camping along the road as over time, these areas deteriorated and evidence of these was removed. Most visitors would not have the stamina to reach the end of the road. Although day hikes could continue to be made to the Old Mine (0.5 miles round trip from Old Mine Trailhead, 2.9 miles round trip from the entrance), and day hikers and bicyclists could continue to reach the Chenuis Falls Trailhead (7.2 miles round trip) and Green Lake Trailhead, visitors might not actually reach the trailhead destinations, which would require even longer hikes (Green Lake – 6.0 miles round trip from the entrance and Chenuis Falls – 7.6 miles round trip from the entrance). And, as noted above, fewer still would reach the Carbon Glacier on a day hike.

Land Use: Moderate to major adverse effects on land use would result from ongoing use of the former road as a trail rather than as a public vehicle road. The former recreational and transportation opportunities provided by the road would continue to be unavailable to most visitors.

Circulation: Moderate adverse effects on circulation would result from the loss of the road as a public vehicle transportation corridor with access to picnicking, camping and pleasure driving in the northwest corner of the park. There would continue to be adverse effects from narrowing of the road corridor in some areas to bypass washout sections and from benign neglect of the roadway with loss of additional intact sections, including the road and parking areas from lack of maintenance over time.

Vegetation: Adverse effects on vegetation would result from ongoing loss attributed to erosion in areas affected by flood damage along the road / unimproved trail. Large old growth trees identified, marked and saved by the narrow construction limits of the road's construction would continue to be lost where the river inundates the road, including in the Falls Creek and Ipsut Creek washout areas and bite sections.

Buildings and Structures: Moderate to major adverse effects on buildings and structures, including the location and setting of Ipsut Creek Patrol Cabin resulted from its deconstruction and removal from its historic setting and its placement in storage. Although good records were kept of its deconstruction, the longer time that passes before it is reconstructed may result in changes in personnel and wood dimensions that would make it more difficult to reconstruct. Under Alternative 1, its reconstruction at the Carbon River Entrance as a visitor contact facility would continue to result in an adverse effect to these characteristics. Use of the patrol cabin as a visitor contact station would allow for preservation of the structure, though not in its original setting and only with part of its original function (visitor information and ranger overnight use), a long-term moderate to major adverse effect.

Eventual moving of the historic CCC garage would also allow the building to be adaptively reused, however as with the patrol cabin, there would be long-term moderate to major adverse effects from the loss of its historic location and setting from deconstruction of the garage and its removal to storage before later reconstruction in an undetermined location on the boundary expansion lands. This action would also conform to the GMP intent (removal of non-historic maintenance functions and employee housing) (NPS 2002:84).

Views and Vistas: Minor adverse effects on views and vistas would continue to result from the different type of visitor experience provided by walking or bicycling the road vs. driving the road. Due to the reroutes through forested areas and the need to look out for uneven and inconsistent (sandy) terrain, hikers and bicyclists would be focused more on the path ahead than on views and vistas provided by the curvilinear alignment of the road.

Archeological Resources: Minor to moderate adverse effects on archeological resources are noted in the previous section, but could include additional loss of non-contributing and potentially eligible resources.

Additional Effects on NHLD: The Carbon River Road corridor, to the extent that it remains discernible under Alternative 1, could continue to convey a part of the historic master plan (road access corridors linked by the circumnavigating Wonderland Trail) and contribute to the significance of the NHLD as a narrowed, poorly defined trail access corridor, rather than as a road access corridor. Primary impacts would be related to circulation and land use (from permanent redefinition of the road as a trail), on spatial organization (from changes to access in the northwest corner of the park), and on buildings and structures (from changes affecting the Carbon River Entrance and Ipsut Creek Campground).

As a result, selection of Alternative 1 would require the preparation of a Memorandum of Agreement (MOA) among the National Park Service, the Washington State Office of Archaeology and Historic Preservation, and the Advisory Council on Historic Preservation. The MOA would stipulate preservation measures that the NPS would take to adequately mitigate adverse effects on the contribution of the Carbon River Road to the Mount Rainier National Historic Landmark District. Because the Carbon River Road contributes to a NHLD with national significance, as a near fully-implemented master plan in the national park system, and is a nationally significant resource itself as a rare example of an early national park scenic highway, impacts from loss of this contributing feature to the NHLD would long-term, and moderate to major.

Alternative 2 Impacts

As in Alternative 1, under this Alternative, there would be no further consideration of reestablishing the road. Therefore, this alternative would have an adverse effect on the Mount Rainier NHLD by modifying the characteristics of the Carbon River Road that make it eligible for inclusion on the National Register of Historic Places. Although consultation on the Mount Rainier General Management Plan produced a letter documenting *no adverse effect* from conversion of the historic road to a hiking / bicycling trail, since then analysis of the proposed action, including additional consultation with the Washington State Historic Preservation Office, has found that this alternative would permanently alter the character-defining features of the road and these alterations would not be reversible and that there would, in fact, be an *adverse effect*.

As in Alternative 1, Alternative 2 would have major changes in the width, alignment, grade and use of the road. Under Alternative 2, repairs to the damaged sections of the Carbon River Road would occur only as necessary to allow for an improved trail to be constructed, using 10 feet of the once 20-foot wide road. As in Alternative 1, this alternative would not recreate the road's traditional use as a motor vehicle road, open to the visiting public and providing easy access to Ipsut Creek Campground. In addition, areas not used for the improved trail would be scarified and obliterated, including adjacent areas of roadway, parking areas and other features (ditches and culverts, etc.).

Although the log crib walls, logjams and buried groin and road humps would help to prevent deterioration of the remaining intact portions of the road and additional damage to the damaged portions of road, these actions would not be enough to preserve the character-defining features of the Carbon River Road. Over time, additional floods would likely continue to damage the intact portions of the Carbon River Road and the road would continue to lose historic integrity. This could occur following the next major flood or it could take many years. It is also likely that additional flooding would cause more trees to fall and that, over time, portions of the road corridor would appear less like a road corridor and continue to appear and function more like a river channel, which would periodically be used and abandoned by the river, similar to other side channel areas. Although a trail would be maintained for as long as possible within or adjacent to the historic road corridor, it is likely that over time the road corridor would become less and less visible. Therefore, as in Alternative 1, without road repairs and ongoing maintenance, the historic integrity of the road would continue to be compromised as a consequence of ongoing erosion of the washout area, the inevitability of future flood damage, and the likelihood of rapid vegetative recovery in the road corridor due to frequent inundation of some of it by the river. Although portions of the road would likely remain for some time, until flood damage occurred, approximately one mile of the road has already lost its character-defining features.

As in Alternative 1, there would be moderate adverse effects on natural systems and features, moderate adverse effects on circulation, minor adverse effects on vegetation, minor adverse effects on views and vistas and minor to moderate adverse effects on archeological sites. The factors contributing to the integrity of these characteristics would also be adversely affected.

Circulation: As in Alternative 1, there would be moderate adverse effects from changes in circulation. In Alternative 2, these effects would result from narrowing the historic road corridor from 20 feet to 10 feet wide (less in some areas) and scarification along the non-trail part of the road surface (generally on either side of the existing road crown or high point) to encourage natural revegetation. Surfacing, crown, side ditches and other road characteristics would also be lost over time. In addition, the alignment of the improved trail would change through both the Falls Creek section (0.49 miles) and between Milepost 4.4 and Ipsut Creek Campground (0.40 miles). Altogether 0.89 miles (or approximately 18 percent) of the road alignment would be modified.

Spatial Organization: Under Alternative 2, the visitor use nodes along the linear road corridor at Ranger Creek (parking for the Green Lake Trailhead), Chenuis (parking for the Chenuis Trailhead and picnicking), and Wonderland Trailhead would be scarified and obliterated, a long-term minor to moderate adverse effect on spatial organization. In addition, Ipsut Creek Campground would be reduced.

Buildings and Structures: There would be slightly fewer adverse impacts on buildings and structures in Alternative 2 compared to Alternative 1, with beneficial effects from reconstruction of the entrance arch, and moderate, rather than major adverse impacts, from reconstructing Ipsut Creek Patrol Cabin closer to its original location, along with beneficial effects from preserving the structure. Although the building would be preserved near its former location, its setting would be changed. It is likely, however, that unlike in Alternative 1, its historic uses could continue, including for visitor contacts and seasonal overnight use.

Land Use: Although there would also be fewer impacts to land use from retaining the first 1.2 miles of road for public vehicles, impacts to land use would remain moderate to major.

<u>Additional Effects on NHLD</u>: Similar to Alternative 1, the Carbon River Road corridor, to the extent that it remains discernible under Alternative 2, could continue to convey a part of the historic master plan (road access corridors linked by the circumnavigating Wonderland Trail) and contribute to the significance of the NHLD as a narrowed trail access corridor, rather than as a road access corridor. Primary impacts would be related to circulation and land use (from permanent redefinition of the road as a trail), on spatial organization (from changes to access in the northwest corner of the park), and on buildings and structures (from changes affecting the Carbon River Entrance and Ipsut Creek Campground).

As in Alternative 1, because of the *adverse effect* on the road as an eligible cultural landscape and as a contributing structure to the Mount Rainier NHLD, preparation of an MOA would be required and overall impacts on the NHLD would be considered moderate to major.

Alternative 3 Impacts
Although Alternative 3 would reestablish 3.6 miles of drivable Carbon River Road, that road would be a one-lane road with turnouts through Falls Creek and other future washout sections. In addition, the portion of road through the Falls Creek washout would be constructed not within, but adjacent to the historic road corridor to allow for construction of a log-crib retaining wall and to allow for ongoing flow to occur in some part of the former road corridor, which has become a river side channel that concentrates flow from the Carbon River during flooding and from Falls Creek.

As in Alternative 2, the portion of the road from Milepost 4.4 to Ipsut Creek Bridge would also be rerouted outside of the existing washout channel and would also change the alignment of the road. In addition, there would be changes to the parking area at Chenuis to create a vehicle turnaround and additional parking at that location, a long-term minor to moderate adverse effect. Between Milepost 3.6 and 5.0, the former Carbon River Road would become a narrowed trail corridor, with part of it traversing alongside the former roadway and part of it in the former roadway, a long-term moderate to major adverse effect. Together, these changes, although they would preserve the most drivable road for public vehicles, would have an *adverse effect* on the contribution of the Carbon River Road to the Mount Rainier NHLD.

As in Alternative 2, although the log crib walls, logjams and buried groin and road humps would help to prevent deterioration of the remaining intact portions of the road and additional damage to the damaged portions of road, these actions would not be enough to preserve the character-defining features of the Carbon River Road.

As in Alternative 1, there would be moderate adverse effects on natural systems and features and minor adverse effects on vegetation. There would also be minor adverse effects on views and vistas, but these would primarily be as a result of the closure of the road above Milepost 3.6 and would not affect the length of the road as in Alternative 1 or most of the road as in Alternative 2. The factors contributing to the integrity of these characteristics would also be adversely affected.

Circulation: There would be minor to moderate adverse effects from changes in circulation. In Alternative 3, these effects would result from reconstructing a one lane road with turnouts through the Falls Creek and future washout sections and from restoring the Wonderland Trailhead parking area. Surfacing, crown, side ditches and other road characteristics would be maintained over the first 3.6 miles but due to ongoing flooding could continue to be lost. In addition, the alignment of the road would change through both the Falls Creek section (0.49 miles) and the alignment of the improved trail would change between Milepost 4.4 and Ipsut Creek Campground (0.40 miles). Altogether 0.89 miles (or approximately 18 percent) of the road alignment would be modified. There would also be modifications at Chenuis to construct additional parking and a vehicle turnaround.

Spatial Organization: Under Alternative 3, the visitor use nodes along the linear road corridor at Ranger Creek (parking for the Green Lake Trailhead), Chenuis (parking for the Chenuis Trailhead and picnicking) would be retained, and part of Ipsut Creek Campground, and Wonderland Trailhead parking would be scarified and obliterated, a long-term minor to moderate adverse effect on spatial organization.

Buildings and Structures: Impacts associated with reconstruction of the Ipsut Creek Patrol Cabin (moderate adverse and beneficial), the CCC garage (moderate to major adverse) and reconstruction of the entrance arch (beneficial) would be the same as in Alternative 2.

Land Use: Although there would also be fewer impacts to land use from retaining the first 3.6 miles of road for public vehicles, impacts to land use would be moderate from changes to the remaining section and to other areas, such as the campground.

Archeological Sites: Archeological site preservation could benefit somewhat from retention of a road through the Falls Creek washout section, with rebuilding potentially increasing preservation of the non-contributing levees and the can dump (with unknown eligibility).

<u>Additional Effects on NHLD</u>: As in Alternatives 1 and 2, the Carbon River Road could continue to convey a part of the historic master plan (road access corridors linked by the circumnavigating Wonderland Trail) and contribute to the significance of the NHLD as a narrowed road and trail access corridor. Because more of it would be a road, there would be fewer overall impacts. Primary impacts would be related to circulation and land use (from permanent closure of the section from Milepost 3.6 to Ipsut Creek Campground), on spatial organization (from changes to access in the northwest corner of the

park), and on buildings and structures (from changes affecting the Carbon River Entrance and Ipsut Creek Campground).

There would be an *adverse effect* on the road as an eligible cultural landscape and as a contributing structure to the Mount Rainier NHLD, and as in Alternatives 1 and 2, preparation of an MOA would be required, however overall impacts would be moderate.

Alternative 4 Impacts

Although Alternative 4 would reestablish 4.4 miles of drivable Carbon River Road, that road would be a one-lane road through Falls Creek, the bite areas and other future washout sections that would be used not by private vehicles, but by shuttles on weekends, holidays and in summer. Still, this alternative would preserve the greatest extent of intact Carbon River Road. As in Alternative 3, however, the portion of road through the Falls Creek washout would be constructed not within, but adjacent to the historic road corridor to allow for construction of a log-crib retaining wall and to allow for ongoing flow to occur in some part of the former road corridor, which has become a river side channel that concentrates flow from the Carbon River during flooding and from Falls Creek. Similarly the road could be moved slightly south/southeast at some of the bite sections to allow for construction of log crib walls.

As in Alternatives 2 and 3, the portion of the road from Milepost 4.4 to Ipsut Creek Bridge would be rerouted outside of the existing washout channel and would also change the alignment of the road. In addition, there would be changes to the area around Milepost 4.4 to create a small shuttle turnaround, a long-term minor adverse effect. Between Milepost 4.4 and 5.0, the former Carbon River Road would become a narrowed trail corridor, traversing alongside the former roadway, a long-term moderate to major adverse effect. Together, these changes, although they would preserve the most drivable road for public vehicles, would have an *adverse effect* on the contribution of the Carbon River Road to the Mount Rainier NHLD.

As in Alternatives 2 and 3, although the log crib walls, logjams and buried groin and road humps would help to prevent deterioration of the remaining intact portions of the road and additional damage to the damaged portions of road, these actions would not be enough to preserve the character-defining features of the Carbon River Road. It is likely that ongoing damage would continue to occur and other sections, because they would not be rebuilt, would lose integrity.

As in Alternative 1, there would be moderate adverse effects on natural systems and features and minor adverse effects on vegetation. As in Alternative 3, there would also be minor adverse effects on views and vistas, but these would primarily be as a result of the closure of the road above Milepost 4.4. The factors contributing to the integrity of these characteristics would also be adversely affected.

Circulation: There would be minor to moderate adverse effects from changes in circulation. In Alternative 4, these effects would result from reconstructing a one lane road through the Falls Creek washout, bite sections and future washout sections and from restoring the Wonderland Trailhead parking area. Surfacing, crown, side ditches and other road characteristics would be maintained over the first 4.4 miles but due to ongoing flooding could continue to be lost. In addition, the alignment of the road would change through both the Falls Creek section (0.49 miles) and the alignment of the improved trail would change between Milepost 4.4 and Ipsut Creek Campground (0.40 miles). Altogether 0.89 miles (or approximately 18 percent) of the historic road alignment would be modified.

Spatial Organization: Under Alternative 4, the visitor use nodes along the linear road corridor at Ranger Creek (parking for the Green Lake Trailhead), Chenuis (parking for the Chenuis Trailhead and picnicking), part of Ipsut Creek Campground, and Wonderland Trailhead parking would be scarified and obliterated, a long-term minor to moderate adverse effect on spatial organization.

Buildings and Structures: Impacts associated with reconstruction of the Ipsut Creek Patrol Cabin (moderate adverse and beneficial), the CCC garage (moderate to major adverse) and reconstruction of the entrance arch (beneficial) would be the same as in Alternative 2.

Land Use: There would be moderate adverse impacts to land use from no longer allowing public vehicles on the reconstructed road, while also retaining the first 4.4 miles of road open to administrative vehicles. Other impacts to land use would be moderate from changes to the section beyond Milepost 4.4 and other areas, such as the campground.

Archeological Sites: As in Alternative 3, archeological site preservation could benefit somewhat from retention of a road through the Falls Creek washout section, with rebuilding potentially increasing preservation of the non-contributing levees and the can dump (with unknown eligibility).

Additional Effects on NHLD: As in Alternatives 1-3, the Carbon River Road could continue to convey a part of the historic master plan (road access corridors linked by the circumnavigating Wonderland Trail) and contribute to the significance of the NHLD as a narrowed road and trail access corridor. Because more of it would be a road, there would be fewer overall impacts. Primary impacts would be related to circulation and land use (from permanent to public vehicles past Milepost 1.2 and from permanent conversion of the section from Milepost 4.4 to Ipsut Creek Campground to a trail), on spatial organization (from changes to access in the northwest corner of the park), and on buildings and structures (from changes affecting the Carbon River Entrance and Ipsut Creek Campground).

There would be an *adverse effect* on the road as an eligible cultural landscape and as a contributing structure to the Mount Rainier NHLD, and as in Alternatives 1-3, preparation of an MOA would be required, however, as in Alternative 3, overall impacts would be moderate.

Alternative 5 Impacts

Retention of the unimproved trail and construction of a wilderness reroute trail in this alternative would have a long-term major adverse effect on the Carbon River Road as an eligible cultural landscape and as a contributing structure to the Mount Rainier NHLD. Most impacts would be similar to Alternative 1, with additional adverse impacts from complete closure of the corridor access pathway following construction of the new wilderness reroute trail.

Because there would only be the logjams at the entrance and maintenance area and a few humps constructed as erosion protection measures for a short-section of roadway converted to a trail around the knob below Chenuis, this alternative would likely result in the fastest deterioration of the historic road corridor as additional flooding occurred. As in Alternatives 1 and 2, a 1.2 mile section of the road would be preserved up to the Old Mine Trailhead turnaround.

Impacts associated with the landscape characteristics of the Carbon River Road would initially be the same as in Alternative 1 for natural systems and features, spatial organization, land use, circulation, vegetation, buildings and structures, views and vistas and archeological sites. Later impacts, from loss of the whole historic landscape would be greater. The factors contributing to the integrity of these characteristics would also be adversely affected.

Natural Systems and Features: Major adverse impacts would result from eventual loss of the Carbon River Road corridor and its replacement with a wilderness reroute trail. Although the distance to the Carbon Glacier would be similar to Alternative 1 and 2 at an estimated 5.2 miles to the trailhead, there would be no opportunity to shorten this hike through the use of bicycles. Therefore, it would be unlikely that visitors would undertake the Carbon Glacier hike (over 17 miles) via the wilderness trail as a day hike and because overnight hikes are more difficult to plan and carry out, fewer people would likely experience the Carbon Glacier.

Spatial Organization: There would eventually be major adverse effects on spatial organization from ongoing loss of the nodes of development linked by the Carbon River Road, including parking, picnicking and camping along the road as over time, these areas deteriorated and evidence of was removed. Other impacts regarding day hiking opportunities to former nodes at the Old Mine, Chenuis Falls and Green Lake would be similar to Alternative 1, but would require longer hikes. As noted above, fewer still would reach the Carbon Glacier.

Land Use: Major adverse effects on land use would result from eventual loss of the former road corridor. The former recreational and transportation opportunities provided by the road would be unavailable to most visitors. There would also be slight changes in land use from the opportunity to hike new loop trails formerly unavailable, such as to the Old Mine on a reroute trail and back on the road corridor.

Circulation: Major adverse effects on circulation would result from the loss of the road as a transportation corridor with access to picnicking, camping and pleasure driving in the northwest corner of the park. This circulation would be replaced by the wilderness trail. Although picnicking and camping could continue to occur, the need for facilities to support them would greatly diminish.

Vegetation: Impacts to vegetation would be the same as in Alternative 1.

Buildings and Structures: There would be major adverse impacts on buildings and structures associated with reconstruction of the Ipsut Creek Patrol Cabin at an undetermined location in the boundary expansion area. Although this action would afford preservation of the building, it would be disassociated from its historic location and setting, a long-term major adverse effect. Impacts from relocating the CCC garage to the boundary expansion area would be the same as in Alternatives 2-4, long-term and moderate to major, as would impacts from reconstructing the entrance arch (minor adverse and beneficial).

Views and Vistas: Moderate to major adverse effects on views and vistas would result from removing the visitor experience from along the river trail corridor to an elevated side hill trail through a different type of old growth forest. Except where connections are made to parts of the former road corridor, there would be few opportunities for views of the Carbon River. As in Alternative 1, views would become more localized and associated with retaining a firm footing on the trail.

Archeological Resources: As in Alternative 1, there would be minor to moderate adverse effects on archeological resources as noted in the previous section, but could include additional loss of non-contributing and potentially eligible resources.

Impact Avoidance, Minimization or Mitigation Measures

Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts on historic structures and districts include:

- Ongoing consultation with the State Historic Preservation Office regarding preparation of a Memorandum of Agreement.
- Detailed deconstruction notes and photographs would be used to reconstruct Ipsut Creek Patrol Cabin.
- CCC garage deconstruction would entail the preparation of detailed deconstruction notes and photographs to enable its later reconstruction.
- There would be periodic woody plant removal (trees and large shrubs) to preserve some of the character of the Carbon River Road corridor, however low growing shrubs and forbs would remain.
- There would be preservation maintenance of the first 1.2 miles of the road, including periodic gravel replacement and culvert cleaning.
- There would be preservation maintenance of the relocated Ipsut Creek Patrol Cabin and the CCC Garage.

- There would be interpretation of the history of the Carbon River corridor to park visitors, to include the prehistoric use of the valley, post-contact mining use, early park development guided by NPS Director S. Mather, and Civilian Conservation Corps period constructed works.

Cumulative Impacts: Mount Rainier National Park has undertaken two previous Memoranda of Agreement with the State Historic Preservation Officer and the Advisory Council. One was related to the reconstruction of historic rock walls along Highway 410, the other was related to the proposed demolition of the Sunrise Lodge. Both were prior to the designation of the Mount Rainier NHLD and the current GMP. The first resulted in construction of rock-faced reinforced concrete guard walls, a compromise to the reconstruction of historic rock walls along the Mather Memorial Parkway. The second expired during ongoing follow-up consultation on the GMP. Since that time, additional planning has taken place regarding the Sunrise Lodge and it is likely that the building will be retained.

Although the closure of the Westside Road to public vehicles also preceded both the GMP and the designation of the Mount Rainier NHLD, impacts from that closure have also had an impact on access to the park related to the implementation of the historic master plan. Alternatives 1 and 2 would contribute moderate cumulative adverse effects. Alternatives 3 and 4 would contribute minor to moderate cumulative adverse effects, and Alternative 5 would eventually contribute major cumulative adverse effects from the loss of one spoke from the wheel of access corridors as embodied in master planning for the park and commemorated as the Mount Rainier NHLD.

Conclusion: Alternatives 1-5 would have an *adverse effect* on the Mount Rainier NHLD and would require development of a Memorandum of Agreement with the State Historic Preservation Officer (SHPO) and Advisory Council for Historic Preservation (ACHP). There would be no impairment of historic structures or cultural landscapes from the implementation of Alternatives 1-5.

10. Visitor Experience Impacts

Alternative 1 Impacts
Visitor Use Access and Transportation: Alternative 1 would continue to have long-term moderate adverse impacts on the number and type of visitors that access the Carbon River area. Combined, the Mowich and Carbon River entrances typically accommodated approximately 25 percent of park visitors before the 1996 and 2006 floods and previous closures have resulted in a noted decrease in visitors. Although uninformed visitors would continue to arrive at the entrance, expecting additional facilities, including driving tour opportunities, these would likely diminish over time as better trip planning information was accessed. There would continue to be an ongoing change in the type of visitor that would access the Carbon River area, with more visitors desiring extended hiking and/or bicycling opportunities than visitors desiring touring or day-hiking opportunities.

Alternative 1 would continue to have the most reduced parking availability, with space for approximately 12 vehicles in the entrance parking area, 40 vehicles along the road up to the maintenance area, 20 in the former maintenance area, and informal, unsanctioned parking outside the entrance accommodating another approximately 50 vehicles, a long-term moderate adverse effect. Although it is unknown whether the lack of available parking during peak periods has caused park visitors to leave the area, a variety of ongoing problems associated with managing overflow parking have occurred since the 2006 flood. Very narrow road shoulders near the entrance, combined with little back-up room in the entrance parking area, and informal overflow parking outside the entrance have resulted in some visitor use conflicts and minor accidents.

Alternative 1 would continue to offer reduced access to individuals with limited mobility because of parking constraints and the inability to access other visitor use opportunities formerly available in this area, a long-term minor to moderate adverse effect. As a result, only parking at the entrance and a portion of the Carbon River Rainforest Loop Trail would provide universal access.

Access for other visitors could also be limited. During public scoping many individuals commented that numerous park visitors, such as families with young children or elderly and disabled individuals would be unable to experience features in this part of the park, either because of congestion and lack of parking at the closure point, lack of handicapped accessible surfacing and grades, lack of campgrounds and facilities, or excessive walking distances to desired trailheads and park features. At the same time, some visitors commented that it would be precisely these qualities that would improve their visitor experience, increasing the availability of a wilderness-like experience even in this non-wilderness area. As a result, there would be long-term major adverse effects on some visitors desiring ease of access and long-term beneficial effects on visitors desiring a wilderness-like visitor experience in this non-wilderness corridor.

Over time as additional flood damage occurred, the trail would be repaired and continued access provided on a similar unimproved trail. Over time, the improved trail could be moved further away from the former road corridor, as additional damage occurred. If the existing zone between the wilderness and the road was further narrowed by flooding, the trail could also become narrower to avoid impacts to wilderness but to retain it outside of wilderness to facilitate continued bicycle use. Under a worst case scenario, if future modifications to the trail impacted wilderness (needed to move more than 100 feet from the former centerline of the road, bicycle access could be reduced or eliminated, depending on where the damage occurred, a moderate to major long-term adverse effect on some visitors.

Visitor Use Opportunities: Day hiking on the former road bed / unimproved trail in Alternative 1 would continue to be a primitive experience and would continue to include potential conflicts with bicyclists due to the narrow trail, blind corners and uneven tread in the washout areas. Similarly bicycle access would continue to be on the same unimproved trail with the same potential user conflicts. Unlike bicycle access without road closure, which was coupled with public vehicle use, only administrative vehicles could initially be encountered beyond the maintenance area and only then up to the Old Mine Trailhead, except for administrative utility vehicle or all-terrain vehicle use for patrolling, maintenance and emergencies, which could continue to occur up to just before the Ipsut Creek Bridge, depending on the condition of the trail.

Day hiking opportunities would be limited in Alternative 1. In previous analysis, the cut-off mileage for day hikes has been identified as at approximately eight to ten miles (NPS 2002). Formerly, day hikes to Dick Creek, Carbon Glacier, Moraine Park, Seattle Park, Yellowstone Cliffs, Windy Gap, Moraine Meadows, Curtis Ridge, Mystic Lake and Elysian Fields were available at any time. Now, although bicycle use could allow day hiking availability for some of these, most would likely be overnight trips requiring advance planning and wilderness permits. Even with the availability of a combined bicycle hiking trip, many individuals commented during public scoping that they would likely not have the stamina to complete this type of day use trip. Instead, day hiking opportunities would continue to be available, but most would include longer hikes and because of these longer hikes, most visitors to the Carbon River area would experience old growth forest along a trail or road, rather than hiking to more distant subalpine areas as was mentioned during alternatives scoping. The Rainforest Loop Trail would be unaffected, but hikes on the Old Mine Trail, Chenuis Falls, and Green Lake (including mileage from existing parking at the entrance area) and other trails would increase. Combined these would be moderate to major adverse effects.

Access to extended wilderness overnight hiking opportunities as noted above would continue, with up to ten miles added to roundtrips. Caching supplies may be made more difficult with long-term modifications. While additional supplies could be provided at the Mowich Lake or Sunrise areas, trips may be more difficult if facilitation of this supply area was limited or eliminated.

Ongoing closure of the road past the maintenance area would continue to result in restricted access to camping, with the former five-mile drive now being a five-mile walk to access campsites at Ipsut Creek Campground. Although this alternative would retain the most campsites, use of these would likely continue to be reduced and it is likely that some facilities and sites could deteriorate over time, a long-term moderate adverse effect.

Picnicking opportunities would remain the same, with some located at the entrance, at the Chenuis Falls Trailhead and at Ipsut Creek Campground. Except for the entrance, opportunities to access these areas would continue to be via bicycle or on foot.

Visitors could continue to experience the wet Carbon River forest (on the Rainforest Loop Trail and up to the Old Mine Trailhead; old growth forest (along the unimproved trail to and at Ipsut Creek); historic cultural resources (to the extent that the historic road corridor continued to be visible); and the Carbon glacier (if a hiking or combined hiking/bicycling trip of approximately 17 miles was undertaken). Because the Carbon Glacier is the lowest in the continental U.S., the extremely long hike to reach it would likely continue to be undertaken by a hardy few, unlike the many who undertook it when it was seven miles (including classes of schoolchildren from the local area). Although many of these experiences would remain available, the loss of the Carbon glacier trip as a day hike would be a moderate long-term adverse effect.

Visitor Use Information and Interpretation: Initially, the Carbon River Entrance station would continue to be open to provide information and to facilitate parking, later, the patrol cabin would be reconstructed at the entrance and would provide similar functions. Limited additional interpretive information would continue to be available. Although the unmaintained Old Mine Trail has become more popular since the closure of the road, there is currently no information about this unmaintained trail on the park's website. Eventually, it is likely that additional interpretation, including waysides, would increase the availability of information.

Visitor Safety: Although the unimproved trail would continue to provide access, there would continue to be some hazards, including from the narrow width of the trail (causing potential conflicts with other user groups including among hikers, bicyclists and administrative vehicles); the lack of surfacing (causing an uneven surface and tread changes, such as sandy areas); ongoing potential for flood hazards and damage (primarily in fall and winter; and from potential delays in access to emergency services (because of the greater distance traveled on bicycle or foot, rather than by vehicle). Additional impacts would continue from informal visitor parking outside the entrance because there would continue to be no path along the road into the park. There would also continue to be ongoing exposure to existing geological hazards, such as debris flows due to the trail location in the bottom of the Carbon River Valley and due to the location of the Ipsut Creek Campground in a floodplain, between the Carbon River and Ipsut Creek. Combined these would be long-term minor to moderate adverse effects.

Alternative 2 Impacts

Visitor Use Access and Transportation: Impacts from Alternative 2 would be similar to Alternative 1, with potential moderate adverse impacts on the number and type of visitors accessing the Carbon River area from continued lack of motor vehicle access on the Carbon River Road. Although parking opportunities would improve with additional parking at the former maintenance area and could improve in this alternative via agreements with partners to provide a formal parking area outside the Carbon River Entrance, reduced parking would continue to limit access for some visitors. The turnaround at the Old Mine Trailhead, would offer a short driving experience to visitors with limited mobility and the formal improved trail would be constructed, as possible, to meet universal accessibility standards, including improvements in tread, width and grade, a long-term beneficial effect on accessibility. Although the trail would be improved, it is likely that difficulty in accessing facilities for numerous park visitors, such as families with young children and those with limited mobility would continue because of greater hiking and/or bicycling distances. For instance, access to the Carbon Glacier would likely continue to be unavailable to many people because of the ten-mile round trip increase in hiking/bicycling distance added to the seven mile round trip hike, although drop-off at the Old Mine turnaround could reduce this distance by 2.4 miles for some party members. As a result, there would continue to be long-term adverse effects on visitors desiring greater access combined with long-term beneficial effects on visitors looking for extended hiking/bicycling trips.

During construction of the improved trail, access in the Carbon River area could be limited, delayed or closed, a short-term minor to moderate adverse effect. Reduced access, delays or closures would limit the availability of the area for some visitors, including for local, regional and out-of-state visitors or those visiting from even further away.

Although it is likely that long-term access to the entrance and Old Mine turnaround would continue, the long-term prognosis for improved trail access would continue to be dependent on the effects of future flooding. Future flood damage could alter access to or along the trail. Damage could result in portions of the improved trail being converted to unimproved trail until additional staffing and funding could be dedicated to fixing the section(s). To some degree, the effects of future flood damage would be limited by erosion protection measures constructed to retain the trail. If reconstructing the improved trail would have unacceptable impacts, however, that trail section could be reconstructed as unimproved trail. As in Alternative 1, under a worst case scenario, future access by bicycles could be reduced or eliminated.

Visitor Use Opportunities: There would be improved day hiking and bicycling opportunities on the wider trail, with a consistent tread and grade. Because of the improved trail, it is likely that potential visitor use conflicts with other user groups would be reduced. Unlike in Alternative 1, motor vehicles could continue to be encountered along the road up to the Old Mine Trailhead turnaround. Thereafter, small administrative vehicles such as ATVs or UTVs used to transport supplies, for occasional patrolling and for emergencies could continue to be encountered but these encounters would be on a wider trail.

Day hiking opportunities and access and facilitation of extended hiking opportunities in Alternative 2 would be the similar to Alternative 1. Although passengers could be dropped off and/or picked up at the Old Mine Trailhead turnaround, effectively cutting off 1.2 to 2.4 miles of the additional round trip mileage, drivers would need to hike or bicycle this distance. For trips that formerly began at the Ipsut Creek Trailhead, an additional ten miles of round trip distance would be added to each hike. In Alternative 2, as in Alternative 1 this distance could be hiked or bicycled. Trailhead bicycle racks would facilitate this kind of trip.

Although Ipsut Creek Campground would continue to be available as a hike-in/bike-in camp, camping opportunities would be reduced from Alternative 1, with 15 fewer individual sites and two additional group sites. As in Alternative 1, these would be accessed via hiking or bicycling five-miles. Picnicking opportunities however would increase, with additional availability at the former maintenance area in combination with parking there.

As in Alternative 1, the key visitor use experiences in the Carbon River area would continue to be available. With passenger drop-off at the Old Mine Trailhead, the Carbon glacier trip would continue to be lengthy, but would be reduced by 2.4 miles to approximately 14.6 miles, still not a trip that most would undertake lightly. As a result, impacts on visitor experience would continue to be moderate, long-term and adverse.

Visitor Use Information and Interpretation: Alternative 2 would offer expanded visitor information and interpretation over Alternative 1. Wayside exhibits at the entrance and in combination with new parking/picnicking in the former maintenance area would describe impacts from flooding and changes in the Carbon River area. At the entrance, a small visitor contact station could have space for some exhibits, as well as a place for rangers to provide information. In addition, reconstruction of the Ipsut Creek Patrol Cabin in the Ipsut Creek area would allow functions formerly provided by this structure to continue (as a patrol stopover, intermittent housing and information station). There would also be additional information provided in each of these locations about trail length and difficulty including about the Old Mine Trail, which would become a maintained trail. Combined, these would be long-term beneficial effects.

Visitor Safety: Overall, visitor safety would be improved over Alternative 1 because of the wider constructed trail with better surfacing. It is likely therefore that potential conflicts between user groups now present in Alternative 1 would diminish. Although impacts from potential flood and geohazards would remain, overall information about these would improve and could influence decision-making by visitors about recreating and camping during inclement weather conditions, when hazards would potentially be greatest. Because of the lack of full-size motor vehicle access, there could be some ongoing impacts to visitors from potential delays in access to emergency services. As in Alternative 1, however, there would be no pathway available to accommodate visitors hiking or bicycling to the current Carbon River Entrance from distant parking, therefore visitors would continue to traverse along the edge of the road. There would be both long-term minor adverse and beneficial effects.

Alternative 3 Impacts
Visitor Access and Transportation: There would be beneficial impacts on visitor access from repair of the road up to Milepost 3.6. Repair of the washout area would allow visitors easier access to the campground, campground facilities, and unique features of the area and the park. Instead of adding ten miles to round trip hikes from the Ipsut Creek Trailhead, there would be 2.8 miles added. Other hikes beginning along the road, including the Old Mine Trail, the Green Lake Trail and the Chenuis Falls Trail would remain open and would include adjacent parking. The Carbon Glacier Trail would remain within the range of a long day hike of approximately 9.8 miles and could also be combined (as in Alternatives 1 and 2) with bicycling the 1.4 miles from the Chenuis turnaround to Ipsut Creek Trailhead.

Similarly, there would be improved access for all visitors, but especially those with very young children, and limited mobility. The turnaround at Chenuis Falls with its access to the Chenuis Falls trail would offer an extended driving tour combined with a short hike to visitors unable to undertake long hikes.

For those visitors who found the non-motorized trail from the entrance to Ipsut to be an improvement in the visitor experience because it reduced conflicts with motorized vehicles, reconstructing the road, even to Chenuis, would be a long-term minor to moderate adverse effect because some visitors would consider vehicular traffic as a negative impact on visitor experience and activities that have gained popularity since the road closure, such as bicycling and hiking on the former roadway.

Parking improvements would be the same as in Alternative 2, plus there would be additional parking at the Chenuis Falls turnaround and parking along the road at trailheads. Due to a limited number of spaces (approximately 30), however, the demand for access would likely exceed capacity and there could be unauthorized overflow parking or visitor use conflicts.

As in Alternative 2, the improved trail past the Chenuis turnaround would be constructed, as possible, to universal accessibility standards with a wide constructed surface suitable for hiking, bicycling and small administrative vehicles, a long-term beneficial effect.

As in Alternative 2, during reconstruction of the road and construction of the improved trail, access in the Carbon River area could be limited, delayed or closed, a short-term minor to moderate adverse effect.

Similarly, although it is likely that long-term access to the entrance and Old Mine turnaround would continue, the long-term prognosis for the reconstructed road / improved trail access would continue to be dependent on the effects of future flooding. As in Alternative 2, these effects would be limited by the construction of a variety of erosion protection structures that could serve to limit future flood damage to the road. Under a worst case scenario, however, future access by vehicles and bicycles could be reduced or eliminated.

Visitor Use Opportunities: As noted above under *Access and Transportation*, opportunities for visitors to drive the Carbon River Road up to the Chenuis Falls area would be available again. In addition, as in Alternative 2, there would be improved day hiking and bicycling opportunities on the wider trail, with a consistent tread and grade between the Chenuis Falls area and Ipsut Creek Trailhead. As in Alternative 2, the improved trail would likely reduce potential conflicts among user groups. With the improved road access, day hiking opportunities and access to and facilitation of Wonderland Trail extended hiking opportunities would increase. Only those day hiking opportunities beginning from the Ipsut Creek Trailhead would continue to be affected by changes in access along the Carbon River Road corridor. As in Alternatives 1 and 2, combining bicycling with hiking could reduce the amount of time needed for these trips and as in Alternative 2, trailhead bicycle racks would facilitate combined trips.

Camping opportunities at Ipsut Creek would be the same as in Alternative 2, with 15 individual sites and three group sites. Picnicking opportunities would also be the same as in Alternative 2. Both camping and picnicking at Ipsut would be facilitated by improved road access, with shorter hike-in or bike-in distances.

As in Alternatives 1 and 2, the key visitor use experiences in the Carbon River area would continue to be available. With travel to the Chenuis Falls area, the Carbon glacier trip would continue to be lengthy, but would be reduced by 7.2 miles to approximately 9.8 miles, which would bring it closer to a trip that more visitors could undertake. Nonetheless, because it exceeds the usual length of a day hike noted in previous visitor use surveys, visitor experience impacts would remain moderate, adverse and long-term.

Visitor Use Information and Interpretation: Impacts would be the same as in Alternative 2.

Visitor Safety: As in Alternative 2, overall visitor safety would be improved over Alternative 1. Impacts would generally be the same as in Alternative 2, except that there would be an increased potential for bicyclist-vehicle and vehicle-vehicle conflicts due to the increased drivable road and the one-lane sections. Erosion protection measures would also provide an added degree of safety from reduced potential for major loss or damage to some parts of the road, and there would be increased access to emergency services. As a result, there would be both long-term minor adverse and beneficial effects.

Alternative 4 Impacts

Visitor Access and Transportation: As in Alternative 3, there would be moderate to major improvements in visitor access from repair of the road. Repair of washout areas would allow shuttle access on the road up to Milepost 4.4 and visitors would have easier access to the campground, campground facilities, and unique features of the area and the park. As in Alternative 3, there would be fewer miles added to roundtrip hiking distances from the end of the road if the shuttle was available. Without the shuttle, distances would be the same as in Alternative 2. Other hikes beginning along the road, including the Old Mine Trail, the Green Lake Trail and the Chenuis Falls Trail would remain open would be available from shuttle stops along the road or from beginning hiking or bicycling trips at the Old Mine Trailhead. With the shuttle, the Carbon Glacier Trail would remain within the range of a day hike and would be approximately 8.2 miles long.

With shuttle drop-off, there would be improved access for all visitors, but especially those with very young children, and those of limited mobility. The ability to get within 0.6 miles of the Ipsut Creek Trailhead would increase the number of day hiking opportunities.

Because there would be only a small number of shuttles on the road at any given time, it is unlikely that access by hikers and bicyclists during the times the shuttle was operating would cause conflicts. In addition, because the shuttle would likely be operational only on weekends, holidays and in summer, there would be ample opportunity for visitors who wanted to avoid potential conflicts to use the improved trail / road at other times, a long-term beneficial effect.

Parking improvements would be the same as in Alternative 2. There would be an improved trail beyond the proposed shuttle road-end at Milepost 4.4. As in Alternatives 2 and 3, the trail would be constructed, as possible, to meet universal accessibility standards and would be suitable for hiking, bicycling and small administrative vehicles, a long-term beneficial effect.

As in Alternatives 2 and 3, during reconstruction of the road and construction of the improved trail, access in the Carbon River area could be limited, delayed or closed, a short-term minor to moderate adverse effect.

Similarly, although it is likely that long-term access to the entrance and Old Mine turnaround would continue, the long-term prognosis for the reconstructed road / improved trail access would continue to be dependent on the effects of future flooding. As in Alternatives 2 and 3, these effects would be limited by the construction of a variety of erosion protection structures that could serve to limit future flood damage to the road. Under a worst case scenario, however, future access by shuttles and bicycles could be reduced or eliminated.

Visitor Use Opportunities: There would be new opportunities for visitors to experience a part of the historic Carbon River Road via shuttle access. In addition, as in Alternative 2, there would be improved day hiking and bicycling opportunities on the shuttle access road / improved trail. As in Alternative 2, the improved trail would likely reduce potential conflicts among user groups. With the improved road access, day hiking opportunities and access to and facilitation of Wonderland Trail extended hiking opportunities would increase. As in Alternative 3, only those day hiking opportunities beginning from the Ipsut Creek Trailhead would continue to be affected by changes in access along the Carbon River Road corridor. Combining bicycling with hiking could reduce the amount of time needed for these trips.

Although camping opportunities would continue to be reduced over Alternative 1, they would be expanded compared to Alternatives 2 and 3, with 20 individual sites and three group sites. Picnicking opportunities would also be the same as in Alternative 2. Both camping and picnicking at Ipsut would be facilitated by shuttle access, when available, with shorter hike-in or bike-in distances, a long-term beneficial effect.

As in Alternatives 1-3, the key visitor use experiences in the Carbon River area would continue to be available. With travel to the Chenuis Falls area, the Carbon glacier trip would continue to be lengthy, but would be reduced by 8.8 miles to approximately 8.2 miles, which would bring it much closer to the trip length available when the road was open (7.0 miles), a trip that could potentially allow more visitors to experience the lowest glacier in the continental U.S., a long-term beneficial and minor adverse effect.

Visitor Use Information and Interpretation: Impacts would be the same as in Alternative 2.

Visitor Safety: As in Alternatives 2 and 3, overall visitor safety would be improved over Alternative 1, a long-term beneficial effect. Impacts would generally be the same as in Alternative 2, except that there would be a negligible increase in the potential for vehicle conflicts due to shuttle use. Erosion protection measures and more drivable road would also provide an added degree of safety from reduced potential for major loss or damage to some parts of the road and would provide increased access to emergency services. As a result, there would be both long-term beneficial and adverse effects.

Alternative 5 Impacts

Visitor Use Access and Transportation: Alternative 5 in both its interim and long-term condition would have long-term major adverse impacts on the number and type of visitors to the Carbon River area. Initially, bicycle use would continue to be available on the informal trail. Later no bicycle use would be available and the Carbon River entrance would essentially become a wilderness trailhead, providing access to a short-stretch (1.2 miles) of roadway up to a turnaround at the Old Mine Trailhead (the same as in Alternatives 2-4).

Parking availability would be the same as Alternative 2, with parking at the entrance, old maintenance area and in cooperation with partners at an undetermined location outside the entrance. As a result, impacts would be the same as Alternative 2.

There would be no additional accommodations made for accessibility in Alternative 2. Although visitors could park at the entrance and explore part of the Rainforest Loop Trail or drive to the Old Mine

Trailhead turnaround, there would be no opportunity for an extended experience, except associated with limited information available in the one-room visitor contact station at the entrance.

Access for other visitors would also be limited. Although visitors have become accustomed to being able to ride their bikes along the current unimproved trail, this activity would cease following construction of the wilderness reroute trail. Instead, visitors would need to hike to reach their intended destinations.

During public scoping many individuals commented that numerous park visitors, such as families with young children or elderly and disabled individuals would be unable to experience features in this part of the park, either because of congestion and lack of parking at the closure point, lack of handicapped accessible surfacing and grades, lack of campgrounds and facilities, or excessive walking distances to desired trailheads and park features. In Alternative 5, these access issues would be exacerbated, with an approximately 10.4 mile roundtrip hike to a much-reduced Ipsut Creek backcountry camp and no accessible trails beyond the entrance and lack of bicycle access. At the same time, access for visitors desiring few services or facilities would increase. Because some visitors desire ease of access and some visitors desire improved facilities, there would be both major adverse and beneficial effects.

Visitor Use Opportunities: Initially, impacts would be the same as Alternative 1, with primitive day hiking on the former road bed / unimproved trail. Similarly bicycle access would continue to be on the same unimproved trail with the same potential user conflicts. With construction of the wilderness trail, bicycle access would be discontinued and visitor use opportunities would become more suitable for experienced backcountry and wilderness visitors. Visitors who desired continued bicycle and/or vehicle access to the area would likely consider impacts a long-term moderate to major adverse effect.

Because some of the road would remain intact for some time, there would also be new opportunities for hiking some additional loop or spur trails once the reroute trail was constructed. Among these would include a loop trail via the reroute trail and old road bed to the Old Mine Trail and back to the entrance and a spur trail from the intersection of the Green Lake Trail that would lead to the Chenuis Falls area and down river.

Day hiking opportunities and extended overnight wilderness trips and impacts would be approximately the same as Alternative 1. The reroute trail is expected to be about 5.2 miles, compared to the five miles on the former road / unimproved trail.

Ongoing closure of the road past the maintenance area would continue to result in restricted access to camping, with the former five-mile drive now being a five-mile walk to access campsites there. This alternative would have the fewest camping opportunities, with Ipsut Creek Campground closure. In its place would be a backcountry camp with four individual sites and one group site and managed as part of the backcountry / wilderness permit system. Picnicking opportunities would also be reduced, with picnicking only available at the entrance and the former maintenance area.

Unlike other alternatives, existing experiences in the Carbon River area would be more limited, with the loss of views of Mount Rainier and the Carbon River, except from spur trails and the knob below Chenuis. As in other alternatives, experiencing the temperate rainforest and old growth forest would continue, however the very large trees typical of that experience now would generally not be found in the upland reroute section, instead trees and vistas would be more uniform than on the existing trail / road. The reroute trail would also result in the loss of the historic road corridor and any potential historic aspects of Ipsut Creek Campground. In addition, because Ipsut Creek Patrol Cabin would be constructed outside the current area, this would further diminish the experience of cultural resources in the Carbon River area. The Old Mine Trail would remain and would be maintained and there would likely be photographs of the former historic area in wayside exhibits at the entrance and maintenance area. As in Alternative 1, what had been a former popular day use trail to the lowest glacier in the continental U.S. would become a more than 17 mile hike that would likely be undertaken by comparatively few visitors.

Combined, there would be beneficial effects from retaining some of the Carbon River area unique experiences and long-term moderate adverse effects from the loss or difficulty associated with others.

Visitor Use Information and Interpretation: Compared to other action alternatives (2-4), there would be less visitor use information and interpretation because of reconstruction of the patrol cabin outside the area and fewer opportunities for visitors.

Visitor Safety: Initial impacts would be the same as Alternative 1. Later, there would be improved visitor safety on the reroute trail due to its new construction. Future maintenance would continue to be the same as for other wilderness trails, and would periodically include brushing and ditch clearing. The narrow width of the wilderness reroute trail would accommodate single and double file hikers and would be elevated above much of the existing debris flow hazard area. While the backcountry camp at Ipsut Creek would initially take advantage of existing campsites and disturbed areas within Ipsut Creek Campground and would be between the Carbon River and Ipsut Creek, later construction of a new backcountry camp would be at a higher elevation, outside of a potential floodplain.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts to visitor experience, including access and transportation, opportunities, interpretation and education, and visitor safety include:

- Avoiding evening, weekend and holiday work by requiring approval in advance. Longer construction delays or total road closures would also be approved in advance.
- Using a public information program to warn of construction related road closures, delays, and road hazards.
- Managing vehicle traffic and contractor hauling of materials, supplies, and equipment within the construction zone to minimize disruptions to visitors.
- Developing a safety plan prior to the initiation of construction to ensure the safety of visitors, workers, and park staff.

Cumulative Impacts: As a road, the Carbon River Road offered quick access to wilderness day hiking opportunities throughout the Carbon River Valley, including to the Green Lake Trailhead and Ipsut Creek Trailhead, where access to the Carbon Glacier via the Wonderland and/or Northern Loop trails was available. Over time, day hiking opportunities have been both lost and gained in the park. Prior to the current proposals in this environmental assessment, the greatest loss of day hiking opportunities occurred as a result of the closure of the Westside Road to private vehicles due to periodic glacial outburst flooding. As with the Carbon River Road, for many visitors, continuing popular loop trails as day hikes has recently been facilitated by bicycle use. Most day hiking in this area, however, has diminished, with possible displacement to Paradise or Sunrise where access to day hiking opportunities is much greater. As a result, Alternatives 1, 2 and 5 would contribute moderate adverse effects on visitor use opportunities from converting former day hikes to overnight trips, while Alternatives 3 and 4 would contribute minor adverse effects from increasing mileage for formerly shorter day hikes.

Over time, there have also been road closures, particularly on the west side of the park. While administrative access continues on much of the Westside Road, the portion above Klapatche Point has been closed for three decades. Nonetheless that portion of road continues to retain road characteristics and it is likely that even with scarification or restoration, some parts of the Carbon River Road would continue to retain road characteristics unless damaged by future flooding. Alternatives 1, 2 would contribute beneficial effects; Alternative 5 would contribute moderate beneficial effects; and Alternatives 3 and 4 would contribute beneficial effects.

Closure of Ipsut Creek Campground and conversion to a backcountry camp would contribute to interim loss of drive-in year-round camping in the Carbon River Valley (pending replacement in the boundary expansion area) and would add to the effects of the loss of year-round camping at Tahoma Creek (when the Westside Road was closed to private vehicles) and loss of year-round camping, when Sunshine Point was also severely damaged by flooding in 2006. Alternatives 1-5 would continue to contribute to long-term moderate adverse effects.

Despite increasing visitation over time, it is likely that all alternatives would accommodate fewer visitors than before the latest round of flooding began in the late 1990s. Alternative 5 would accommodate the fewest visitors and the narrowest demographic of visitors, while Alternatives 1 and 2 would be similar in their accommodation, with more facilities and likely a wider array of visitors in Alternative 2 than Alternative 1. Alternative 4 would accommodate the greatest array of visitors. Depending on how often shuttle transport was available, it is likely that Alternative 4 would also accommodate the greatest number of visitors, while Alternative 3 would accommodate fewer but would do so most of the year (except for road closures in winter or during heavy fall rains).

Conclusion: Alternatives 1 and 5 would continue to have long-term minor to moderate adverse effects and beneficial effects, with potential long-term moderate to major adverse effects on visitor access and transportation. Alternatives 1 and 5 would also have minor to major adverse effects on visitor use opportunities, but would also provide beneficial effects. There would be beneficial effects on visitor use information and interpretation; and ongoing minor to moderate adverse effects on visitor safety in Alternative 1 and negligible to minor impacts in Alternative 5.

Alternative 2 would have beneficial and minor to moderate, potentially major adverse effects on visitor access and transportation. Short-term minor adverse effects could occur during construction. As in Alternative 1, there would also be moderate to major adverse effects on visitor use opportunities but improvements would also contribute beneficial effects. Long-term impacts on visitor information and interpretation would be beneficial. Alternative 2 would also have long-term minor adverse and long-term beneficial effects on visitor safety.

Under Alternative 3, there would be beneficial impacts on visitor access and transportation combined with minor to moderate adverse effects and a potential for long-term moderate to major adverse effects. Short-term minor to moderate adverse effects could occur during construction. There would also be beneficial and minor adverse effects on visitor use opportunities. Impacts on visitor use information and interpretation would be the same as in Alternative 2. Impacts on visitor safety would include both minor adverse and beneficial effects.

Alternative 4 would have impacts similar to Alternatives 2 and 3, with beneficial and short-term minor to moderate adverse effects on visitor access and transportation and the same potential for moderate to major adverse effects from cessation of bicycle or road access. There would also be beneficial effects and minor adverse effects on visitor use opportunities. Impacts on visitor use and information and interpretation would be the same as in Alternatives 2 and 3, and impacts on visitor safety would be the same as in Alternative 3 (though slightly improved) – with beneficial and adverse effects.

11. Wilderness Impacts

Alternative 1 Impacts

There would be no additional impacts to wilderness from the implementation of this Alternative. Ongoing impacts would occur in the non-wilderness roaded multiuse zone. These ongoing impacts would continue to occur from periodic use of loud equipment or vehicles that could be heard 100 feet from the road. For the most part, however, wilderness visitors would not typically be in wilderness paralleling the road. Most visitors would continue to begin their wilderness experience at the Green Lake or Ipsut Creek trailheads. There would be no new activities occurring in wilderness. Wilderness in the Carbon River area would continue to remain untrammeled, natural and undeveloped, and there would continue to be outstanding opportunities for solitude and/or a primitive unconfined type of recreation (see definitions in Alternative 5 analysis).

Alternatives 2-4 Impacts
Initial impacts would be the same as Alternative 1. Later removal of the Ipsut Creek Bridge in Alternatives 3 and 4 (and potentially in Alternative 2) could result in short-term minor adverse impacts in wilderness from noisy equipment and helicopters used to remove the bridge components. In addition, helicopters would be used to remove the vault toilets, an additional minor adverse impact. Although the flight path and landing, if necessary, would likely be over the Carbon River Road corridor and Ipsut Creek Campground, in non-wilderness areas, noise impacts would occur and could disrupt the experience of wilderness visitors beyond the Ipsut Creek trailhead or in other areas nearby, such as across the river on the Northern Loop Trail. Because there would be no motor vehicle access in Alternative 2, and because access would be limited in Alternative 3 (to Chenuis) and Alternative 4 (to Milepost 4.4), there would likely also be additional short-term minor impacts to wilderness visitors from periodic use of helicopters for emergencies (potential transport of injured visitors and search and rescue operations).

There is a potential that in Alternatives 2-4 moving the trail away from damaged areas could eventually result in that trail needing to move into wilderness. If this occurred, sections of trail could be located closer to wilderness, instead of within or alongside the road corridor. If located in wilderness, these would require additional environmental analysis for impacts that would be similar to, but less than, Alternative 5, from constructing new trail segments in the *pristine* zone (see below).

Alternative 5 Impacts
The following characteristics of wilderness (as explained below) would be affected in Alternative 5: untrammeled, natural, undeveloped and opportunities for solitude and/or a primitive unconfined type of recreation.

- *Untrammeled* wilderness is essentially unhindered and free from modern human control or manipulation. As defined by Landres *et al.* (2005:11-12), untrammeled means that the "wilderness is essentially unhindered and free from modern human control or manipulation." Effects on the untrammeled quality of wilderness would include manipulation of biotic and abiotic components of ecosystems – including manipulation of fish and wildlife, manipulation of vegetation, manipulation of abiotic components of aquatic ecosystems and/or manipulation of soils and geologic features (Landres *et al.* 2005:23).
- *Natural* wilderness ecological systems are substantially free from the effects of modern civilization. As stated by Landres *et al.* 2005, "wilderness ecological systems are substantially free from the effects of modern civilization." Effects on the natural quality of wilderness would be those that would change the biotic or chemical composition of wilderness plant or wildlife or soils, such as from the application of pesticides.
- *Undeveloped* wilderness is essentially without permanent improvements or modern human occupation.
- *Outstanding opportunities for solitude or a primitive and unconfined type of recreation* includes the values of inspiration and physical and mental challenge (Landres *et al.* 2005:iii-iv).

In addition to impacts similar to Alternative 2 (including from potential removal of Ipsut Creek Bridge and use of helicopters to remove the vault toilets and for emergencies), Alternative 5 would have the following impacts minor to moderate localized adverse effects on the untrammeled quality of wilderness, minor adverse impacts on the natural quality of wilderness, moderate adverse effects on the undeveloped quality of wilderness and negligible to minor adverse impacts on opportunities for solitude and/or a primitive unconfined type of recreation.

Long-term effects on the untrammeled quality of wilderness would be associated with new trail construction and would include manipulation of living and non-living components (e.g. soils and vegetation) of wilderness along a 3-foot wide corridor just over five miles long (approximately 1.9 acres not including construction limits outside the 3-foot wide constructed trail which could encompass more than twice this area in some places where cuts or fills were needed). Similarly there would be long-term effects on the natural components of wilderness from the construction of trail bridges, turnpike and other formal trail features. Long-term effects on the undeveloped quality of wilderness would occur from the physical construction of the trail, including trail features, such as signs and bridges or culverts.

Both short- and long-term effects on opportunities for solitude and/or a primitive unconfined type of recreation would occur. Short-term effects would occur from noise and activity associated with construction, while long-term effects would occur from new use in an area that had been previously undisturbed by human activity, except from very limited off-trail use by visitors and resource survey staff.

Key to these effects would be recognizing that the existing wilderness management zone as defined by the Mount Rainier GMP, would change from pristine to primitive because it would no longer meet the GMP definition of *pristine* ("Very minimal signs of human use, no trails or designated campsites.") because there would be both a designated trail and a designated backcountry camp, nor would the route be primitive.

If this alternative was selected, a minimum requirements analysis followed by minimum tool analyses would be prepared. Implementation of this alternative would require the use of power tools, such as chainsaws, blasting, and other wilderness disturbance, a short-term moderate adverse effect.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts on wilderness include:

- No physical modifications initially proposed in Alternatives 1-4 would occur within wilderness (generally below Chenuis more than 100 feet from the centerline south of the road, above Chenuis more than 100 feet from the centerline of the road on either side).
- Potential physical impacts to wilderness from moving the trail away from the road corridor in Alternatives 2-4 would result in the need for additional environmental analysis.
- A minimum requirement / minimum tool analysis would be completed for selection of Alternative 5.

Cumulative Impacts: As pointed out during public scoping, Mount Rainier National Park offers superlative access to wilderness. The Carbon River Road formerly offered quick access to wilderness day hiking opportunities throughout the Carbon River Valley, including to the Green Lake Trailhead and Ipsut Creek Trailhead, where access to the Carbon Glacier via the Wonderland and/or Northern Loop trails was available. Alternatives 1, 2 and 5 would contribute long-term cumulative adverse effects by decreasing the availability of these day hiking opportunities in the Carbon River Valley from adding 10.0 to 10.4 miles to each round trip from the Ipsut Creek Trailhead and 6.2 miles (round trip) to reach the Green Lake Trailhead. Alternatives 3 and 4 would continue to allow for continued access to day hiking opportunities in wilderness, adding between 2.8 and 1.2 miles, respectively, to each trip.

Because no physical actions are proposed in wilderness, Alternatives 1-4 would contribute negligible cumulative adverse effects. Alternative 5 would contribute minor cumulative adverse impacts. Of the approximately 280 miles of trail in the park, approximately 250 are in wilderness. The addition of a trail in wilderness from the Carbon River Entrance to Ipsut Creek Trailhead would change a narrow corridor from *pristine* to *semi-primitive trail*.

Conclusion: Alternatives 1-4 would have short-term minor to moderate localized adverse effects on wilderness from temporary noise and disturbance, primarily associated with helicopter use to remove infrastructure and from potentially increased use associated with emergency operations. Alternative 5 would have both short-term minor to moderate localized adverse impacts, similar to Alternatives 1-4, but also from construction of a new trail in the pristine zone. Alternative 5 would also have long-term negligible to moderate adverse effects from location of a new trail in wilderness and from effectively changing existing zoning from *pristine* to *semi-primitive trail*. There would be no impairment of wilderness resources or values.

12. Wild and Scenic Rivers Impacts

Alternative 1 Impacts

Of the outstandingly remarkable values noted in the eligibility analysis, the scenic views of Mount Rainier and of old growth and temperate rainforest would not be affected by Alternative 1 and the recreational values, hiking, camping and nature viewing would continue to be available, although in the changed form that they have been since the 2006 flood (via hiking or bicycling rather than driving), a long-term minor adverse effect.

The analysis noted the presence of geologic and fish and wildlife values but identified these as "typical." And, it did not differentiate the values between segment 1 and 2 by mentioning the Carbon Glacier as the lowest glacier in the continental U.S. It is likely that if this analysis had been done following designation of a part of the area as critical habitat for bull trout and more informed knowledge of not only the presence of northern spotted owls, but also of detected marbled murrelet nesting behavior, that these fish and wildlife values would have been rated higher (3 or 4 instead of 2). Nonetheless, these values (the braided glacial stream and opportunity to see fish, northern spotted owls and other wildlife) would not be affected in the river corridor by the implementation of Alternative 1, except by continued loss of old growth trees during future flooding.

Because the Mount Rainier NHLD was not listed on the National Register until 1998, historical values did not mention it (the eligibility analysis was completed in 1990). Nonetheless, the analysis did identify access along an historic road and the abandoned copper mine (Old Mine) along it as historical values but rated them 2, rather than 3 or 4. If the analysis had been done after the designation of the Carbon River Road as part of the nationally significant Mount Rainier NHLD, it is likely that this rating would have been higher. It is difficult to qualify this value because of the incomplete eligibility report; however, ongoing inability to drive the road and eventual loss of the historic road corridor would likely have a long-term minor to moderate adverse effect on historical values.

Except to note in an introduction to the individual analyses of Pacific Northwest national park rivers that the rivers in Mount Rainier were all free flowing within the park, the characteristic of free flowing was not addressed in the eligibility analysis. The analysis, however did note the presence of flood protection structures at the entrance and between the entrance and Ipsut Creek. As a result, it is unlikely that adding to these structures by increasing one logjam and adding a series of two barbs that would later be logjams in Alternative 1 would affect the eligibility. This seems verified in the fact that different segments of the Stehekin River in Lake Chelan National Recreation Area were found eligible for their scenic and recreational characteristics, despite the presence of over 80 erosion protection structures on the river at the time of its evaluation for eligibility (NPS LCNRA 2010).

Neither the ongoing minor adverse effect on recreational values nor the minor to moderate adverse effect on historical values would result in loss of eligibility for Segment 2 to be designated as part of the wild and scenic rivers system. As a result, the Carbon River would continue to remain eligible for this designation under Alternative 1.

Alternative 2 Impacts

Impacts from Alternative 2 would be the same as in Alternative 1, except that there would be a series of additional erosion protection structures that would be constructed within the proposed quarter mile boundary usually associated with wild and scenic rivers. As in Alternative 1, these would not affect the eligibility of the Carbon River for designation as part of the wild and scenic rivers system.

Alternative 3-4 Impacts
Impacts from Alternatives 3 and 4 would be similar to Alternatives 1 and 2, except that there would be additional erosion protection measures constructed along the road / trail and a portion of the road (3.6 miles) would be available to private vehicles as in the past in Alternative 3 and to shuttles (4.4 miles) in Alternative 4, decreasing potential impacts to recreational values associated with the designation of the road to negligible in the open section and minor above that. There would also be a reduction in impacts to minor associated with historical values, with more preservation of the historic access road. There would be no effect on the eligibility of the Carbon River for designation as part of the wild and scenic rivers system.

Alternative 5 Impacts
Impacts from Alternative 5 would be similar to impacts from Alternatives 1 and 2. The primary difference in Alternative 5 would be from purposeful restoration of the road and its conversion to a wilderness trail. Because the first 1.2 miles of road would continue to pass through the inland rainforest at the entrance, there would be loss of this scenic characteristic only on the wilderness reroute trail which would be routed primarily above the valley floor through a different type of old-growth forest. Although the reroute trail would pass through a thickly forested area, rather than along the river as with the road / trail in other alternatives and would not offer views of Mount Rainier, one of the scenic resources values noted in the evaluation, these scenic views of Mount Rainier would continue to be available from the spur trails that would allow visitors to reach the former historic road corridor, such as from the river bar on the Chenuis Falls Trail. Therefore, there would be limited or minor adverse effects on the scenic resources values described in the eligibility report. There would be no effect on the eligibility of the Carbon River for designation as part of the wild and scenic rivers system.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts on wild and scenic rivers are noted in other sections:

Cumulative Impacts: Although no rivers within the park have yet been designated as part of the wild and scenic rivers system, in addition to the Carbon River, the West Fork, White River, Muddy Fork, Cowlitz River and Ohanapecosh River have also been found eligible for designation. There would be no cumulative adverse effects on wild and scenic rivers from the implementation of Alternatives 1-5. Although these alternatives would contribute negligible to minor adverse effects on some characteristics that make it eligible, none would have impacts that would affect the eligibility of the Carbon River for designation as part of the wild and scenic rivers system.

Conclusion: Although actions in Alternatives 1-5 would affect some values called out in the eligibility report, there would be no effect on the eligibility of the Carbon River for designation as part of the wild and scenic rivers system.

13. Park Operations Impacts

There would be a variety of impacts on park operations from implementation of the alternatives. These impacts would be associated with the resources required to construct and maintain the road or trail (including whether native or imported materials were used and overall costs of the alternative), effects associated with how far visitors could drive into the area, impacts on other park areas, staffing, effects dependent on what kind of visitor information would be provided, what facilities were provided, how difficult repairs following flooding would be to implement and how best the alternative implemented the different aspects of GMP direction. In addition, as a climate-friendly park, there is concern about how the alternative would meet goals of reducing the park's carbon footprint. Potential indirect and cumulative impacts would occur from reducing access to the Carbon River area.

Alternative 1 Impacts
Under Alternative 1, there would be short- and long-term minor to moderate adverse impacts on park operations. These would include ongoing impacts to staffing from reconstructing, perhaps annually, an unimproved trail through the washout sections. Without the use of heavy equipment, maintaining even an unimproved trail would continue to be extremely difficult because of the ongoing occurrence of and potential for head-cutting washouts and annual tree fall. Work on the trail in 2007 took approximately seven weeks of trail crew time plus additional modifications to sustain it. Since then it has taken approximately three weeks per year to maintain it. The trail, although currently used by hikers and bicyclists contains blind corners, poor clearance and an inconsistent trail width and tread. Due to future flooding impacts, it may be unlikely that the trail can be sustained within the historic road corridor as envisioned by the GMP and would have an *adverse effect* on the Mount Rainier NHLD. After closure of the upper 2.5 miles of the road, the park tried to maintain it as a trail for many years, but was eventually forced to abandon it and to reconstruct the trail on higher ground due to the amount of annual maintenance required to sustain it in the corridor. Except with respect to sections outside of the current floodplain, it is likely that this scenario would play out over time in the lower section of road.

While few imported materials would be used to maintain or reconstruct the trail, there would be time associated with gathering native materials to repair the trail when future washouts occurred. There would also continue to be impacts on staffing from facilitating the very limited visitor parking at the entrance, including the ongoing need for staff to direct parking on peak use days. Over time as additional buildings and structures were removed and parking expanded at the entrance and maintenance area these would be reduced but parking would remain difficult during peak use. As a result, it is likely that some visitors could be displaced to the nearby Mowich Lake area, which, depending on crowding there, could affect park facilities and staffing in that area.

Although the existing ranger station would be removed, with reconstruction of the Ipsut Creek Patrol Cabin at the entrance as a visitor contact station, park staff would continue to have the ability to provide visitor information, a long-term beneficial effect. Except for increased annual maintenance, Alternative 1 would also likely have the lowest cost because as a continuation of existing operations, it would have few initial costs and the fewest facilities, a long-term beneficial effect. In addition, because public and administrative vehicles would continue to be unable to drive the additional five miles to Ipsut Creek Campground, there would continue to be a reduction in exhaust emissions that would contribute to reducing the park's carbon footprint.

Alternative 2 Impacts
In Alternative 2, there would be short- and long-term minor to moderate adverse impacts on park operations. Many of the effects would be similar to or the same as those in Alternative 1, including effects associated with removing and reconstructing buildings, the provision of visitor use information, monitoring of parking, and potential displacement of visitors to the Mowich Lake area. Long-term beneficial effects would be similar to Alternative 1, with improvements in the park's carbon footprint, in conveying visitor use information with a similar but expanded visitor contact station and additional potential for visitor contact at the campground via the reconstructed patrol cabin. There would also be slight improvements in access from the 10-foot wide formal trail that could allow for some small administrative vehicles and construction equipment to access distant parts of the trail.

In addition, there would be initial impacts from reconstructing existing sections of the unimproved trail as improved trail in the same location or adjacent to it. As in Alternative 1, there would be no or limited use of heavy equipment to construct the trail and transporting materials would require many trips. Much of the rock would be gathered on site, while the logs would be gathered or imported. Once the trail was constructed, there would likely be less annual maintenance than in Alternative 1; however, annual maintenance would continue to be required. In addition, replacement of future washed out sections would take more time and, depending on their extent, could result in those sections remaining unimproved for some time until timing, funding and staffing were available for reconstruction.

Visitors could drive to Milepost 1.2 to drop off passengers but would have to return to park. Although there would be increased parking from removal of existing buildings and structures, there would continue to be impacts on park staff to monitor parking at the entrance and to ensure that no parking occurred at the turnaround, especially on peak use days.

Carbon River area resupply for extended wilderness hiking trips on the Wonderland Trail would continue to have minor adverse effects on park staff from conveying dropped supplies from the entrance to Ipsut Creek via ATV.

More buildings would be constructed, including reconstruction of the patrol cabin and construction of a small visitor contact station, as well as the entrance arch and backcountry toilets. As a result there would be additional impacts on park staff to construct or manage these projects. There would also be more erosion protection measures, including road humps, six log-crib walls and a buried groin that would take additional resources and personnel to construct or oversee.

This alternative would implement the GMP direction to replace the Carbon River Road with a hiking and bicycling trail and to convert Ipsut Creek Campground to a hike-in, bike-in facility after the next major washout. Some of the key tenets in the GMP associated with this approved action, however, are no longer valid. It has become clear, through alternative development and analysis that it is not possible to preserve the historic road corridor *in a manner consistent with the NHLD designation* with the closure of the road to public vehicles and its conversion to a hiking and bicycling trail. Therefore this and other alternatives would not meet this intent expressed in the GMP and would (as noted in *Historic Structures / Cultural Landscape Impacts* have an *adverse effect* on the Carbon River Road as an historic resource contributing to the significance of the Mount Rainier NHLD.

Among the key information not known when the GMP was developed / approved includes the extent to which the road corridor would need to be preserved to have *no adverse effect* on the Carbon River Road as an historic resource listed on the National Register and contributing to the Mount Rainier NHLD. Because the NHLD was designated during the GMP planning process, analysis and recognition of its key features was just beginning. At the time of the GMP, the Carbon River Road was considered the only road likely to experience catastrophic flooding impacts, but the effects of extremely heavy rainfall and widespread flooding in 2006 on other park roads affected not only this area, but also the Nisqually River and White River corridors, where extensive reconstruction has since taken place. In addition, there have been improvements in technology used to protect river floodplain values while preserving river corridor facilities.

Alternative 3 Impacts
Alternative 3 would have short- and long-term moderate adverse impacts on park operations. Although many impacts would be similar to Alternative 2, including the construction / reconstruction and removal of buildings and structures, many of the same erosion protection measures, and parking improvements, there would be additional impacts from reconstructing a road and allowing private vehicles on it, from constructing additional erosion protection measures and from managing vehicle congestion at the Chenuis turnaround due to very limited parking there. Long-term beneficial effects would be similar to Alternatives 1 and 2, though with fewer improvements in the park's carbon footprint, including conveying visitor use information from an expanded visitor contact station and additional potential for visitor contact at the campground via the reconstructed patrol cabin. The partially reopened road could allow easier administrative / emergency access.

Additional impacts would also include a need for increased staffing to manage parking during peak use periods, to improve visitor information about available facilities and parking and to construct and/or oversee a more robust road with more erosion protection features. Because this alternative would open the road to private vehicles, initial costs to construct the one-lane road with turnouts, approximately seven crib walls, a buried groin and eight flow deflection engineered logjams would be much greater and would have more effects on park staffing and operations.

Reconstructing the road would require use of rock, logs and fill to reconstruct the road and to construct the wide array of erosion protection measures. Because the road would be reconstructed, the use of heavy equipment and vehicles to transport materials and supplies, whether native or imported, would be easier.

This alternative would best fulfill the GMP intent of trying to keep the road open to private vehicles as long as possible that was expressed in the Record of Decision. It would also fulfill the intent of converting the road to a hiking and bicycling trail and the campground to a walk-in, bike-in facility after the next major washout since beyond Milepost 3.6, the road would be converted to a hiking and bicycling trail. As in Alternatives 1 and 2, despite reconstructing part of the road, implementation would also have an *adverse effect* on the Mount Rainier NHLD.

Alternative 4 Impacts
Alternative 4, similar to Alternative 3, would have short- and long-term moderate adverse impacts on park operations. Although most impacts would be the same, including construction of most of the same erosion protection measures, buildings and structures and a portion of the road, others could be both greater and fewer. Beneficial impacts would be the same as in Alternative 3, with more access for administrative / emergency operations.

Although the road would be longer, it would be narrower and would not need as many turnouts due to lower shuttle and administrative use. In addition, there would be fewer road humps, two more logjams and one additional crib wall that would require more native and imported resources to construct. Because the road would be open 0.8 miles further than in Alternative 3, access for construction and removal of facilities would be easier than in other alternatives. Combined, these would increase the initial cost and time needed for implementation of Alternative 4 over Alternative 3.

Reconstructing the road would require use of rock, logs and fill to reconstruct the road and to construct the wide array of erosion protection measures. As in Alternative 3, because the road would be reconstructed, the use of heavy equipment and vehicles to transport materials and supplies, whether native or imported, would be easier.

Because the road would not be open to private vehicles and would instead be available on weekends, holidays and during the peak summer season, the carbon footprint would decrease compared to Alternative 3, but would be greater than in other alternatives. There would also be increased impacts to park operations to run the shuttle, to facilitate parking and to provide visitor information about the opportunity, as well as to determine whether or how it should be linked to the Mowich Lake area.

This alternative would most closely implement the GMP proposal to close the Carbon River Road to private vehicles and to implement a shuttle system as described regarding changes made to the draft GMP in the final GMP and in the response to public comments in the final GMP.

Alternative 5 Impacts
Initial impacts of Alternative 5 would be the same as in Alternative 1. Overall, Alternative 5 would have short-term moderate and long-term minor adverse effects on park operations. Moderate adverse impacts would primarily be associated with construction of the trail over approximately five years, which would affects costs and staffing, while minor adverse impacts would be associated with maintaining it. Because of the extent of new trail construction but limited implementation of erosion protection measures, this alternative would be moderate in cost compared to Alternatives 3 and 4. Long-term beneficial effects would be the similar to Alternative 1, with improvements in visitor information from construction of a smaller visitor contact station at the entrance and continued reduction in the park's carbon footprint from fewer miles driven by visitors within the park. Although less information would be available at Ipsut Creek Campground, compared to Alternatives 2-4, fewer visitors would likely reach this area.

Alternative 5 would initially implement GMP direction to allow for hiking and bicycling in the Carbon River Road corridor. Eventually, however, it would not implement existing GMP direction because it would allow for trail construction in a pristine zone, would not allow for continued bicycling in the Carbon River Road corridor, would eventually close Ipsut Creek Campground to bike-in camping, and similar to Alternatives 1-4, would have an *adverse effect* on the Mount Rainier NHLD. This alternative would therefore amend current zoning in the GMP to *semi-primitive trail* along the new rerouted trail and would then be similar to other portions of existing Wonderland Trail zoned *semi-primitive trail* surrounded by *pristine* or *primitive* wilderness zones. Following rehabilitation of the Carbon River Road corridor unimproved trail, that area could remain *roaded multiuse* or could become *sensitive resource recreation*.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts on park operations include:

- Additional analysis of importing materials vs. gathering native materials would be made to determine which has fewer impacts and costs, particularly associated with Alternative 2.
- Analysis of potential displacement of park visitors to other areas would be made and, if appropriate, actions taken to improve communication about visitor use opportunities in this and other areas to limit its effects.
- Ongoing monitoring would occur in the Mowich Lake area to assess potential effects of increased visitor use in summer.

Cumulative Impacts: A FHWA hydraulics study in 1998 for the *Carbon River Road Reconstruction Environmental Assessment* estimated the average annual cost at approximately $30,000 per year to keep the road open. Since that time there have been four additional floods that have caused damage to the road, one just after it reopened in 1998 when damage was repaired fairly quickly using park staff, another in October 2000, one in 2006 and another in 2008. As a result, it is likely that these costs have increased somewhat. Nonetheless, since its construction in the 1920s, the road has reopened over nearly the past 90 years despite flooding despite ongoing impacts to park operations to repair and reconstruct sections of roadway. While it is possible that the lack of more robust repairs following the 1996 flooding contributed to damage from the washout that occurred immediately following that repair and to the more recent washouts, the Carbon River Road has been subject to flood damage since before it was completed. As a result, it is unlikely that any repair could prevent damage from future floods. Rather, ongoing flooding combined with the area's distance from other park operations has contributed to an ongoing systematic loss of infrastructure and operations from the area, including employee housing (removed due to presence in floodplain), interpretive programs, potable water, etc.

Regardless of the condition of the road or trail, the Carbon River area, situated as it is closest to the Seattle metropolitan area, will continue to draw visitors from the state, U.S. and from around the world, particularly because it also provides access to a unique inland temperate rainforest and to the lowest glacier in the continental U.S. Reducing access to the Carbon River area will not reduce the need for management of this area. As a result, park operations will continue to be important in this northwest corner of the park.

It is also possible that displacement of visitors from the Carbon River area to the Mowich Lake area is occurring or could change as a result of the implementation of the alternatives, a long-term minor to moderate adverse effect. Although it is also possible that visitors are being displaced to other areas during trip planning, it has not yet been possible to assess the effects of this possible displacement. Because the Carbon River area is at a lower elevation and is generally accessible year round and the Mowich Lake area is only accessible during the peak summer season, displacement to the Mowich Lake area would be most pronounced in summer. In addition, it would likely be most associated with visitors who arrive at the Carbon River area anticipating a scenic driving experience, rather than a wilderness hiking experience.

This displacement would most likely occur in Alternatives 1, 2 and 5, where only up to 1.2 miles of road access would be available and would be less likely to occur in summer associated with Alternatives 3 and 4 and during other times of year associated with Alternative 3.

Except for some slight improvements to retaining facilities at the entrance, to improving parking, from removing obsolete facilities, and from the need to maintain the unimproved trail, Alternative 1 would have few contributions to cumulative impacts on park operations. It would likely require the least short-term and a moderate long-term investment of resources, combined a minor cumulative impact on park operations. Alternative 2 would require a greater short-term investment of resources and fewer overall long-term impacts except associated with new impacts from flooding, contributing minor cumulative adverse impacts. Alternatives 3 and 4 would require both moderate short- and long-term investment of resources, particularly if new sections of roadway needed repair or were converted to hiking and bicycling trail. Alternative 5 would require a moderate short-term investment of resources and long-term minor investment, contributing minor cumulative adverse impacts.

Conclusion: Alternatives 1 and 2 would have short- and long-term minor to moderate adverse impacts on park operations. Alternatives 3 and 4 would have short- and long-term moderate adverse impacts. Alternative 5 would have short-term moderate and long-term minor adverse impacts on park operations.

14. Socioeconomics Impacts

Alternative 1 Impacts
Under Alternative 1, the Carbon River Road would be permanently closed. An unimproved trail for hiking and bicycling would continue to allow access to and through the area. To the extent that the trail could be reconstructed following future washouts in non-wilderness, bicycling would remain a viable activity. A new visitor contact station in the Ipsut Creek Patrol Cabin would provide information to visitors and there would continue to be walk-in, bike-in camping at Ipsut Creek Campground. Over time, infrastructure and facilities not essential to these operations would be removed as called for by the GMP. These visitor use opportunities would cost approximately $1.776 million to implement and would continue to draw visitors to the Carbon River area, a long-term beneficial effect.

At the same time, there would continue to be ongoing loss of revenue associated with reduced visitor use numbers from visitor perceptions that the road was closed and that therefore, fewer opportunities were available in the area. There would be periodic short-term beneficial impacts from construction spending to repair the trail following washouts. To the extent that materials and supplies or personnel were procured locally, there could be some beneficial impacts on local communities.

As noted in the 1998 EA for repair of 1996 flood damage on the Carbon River Road, permanent closure of the road would likely continue to result in a decrease in tourist-related revenues for Carbonado and Wilkeson. These long-term moderate adverse impacts would likely be greater on Wilkeson since this community relies to a larger extent on tourist-related revenues. It is also possible that permanent closure of the road would be beneficial to maintaining a rural character of the area, a potential beneficial effect, depending on town goals.

Alternative 2 Impacts
Impacts would be similar to Alternative 1, but with more beneficial effects. Instead of improving the trail over time as in Alternative 1, Alternative 2 would be implemented as a single project and would proceed through to completion, with facilities and infrastructure removal and facility and trail construction. As a result there would be greater (minor to moderate) short-term beneficial impacts as money was spent for supplies and materials and to hire personnel to implement the proposed actions. Because work would also avoid sensitive periods for special status species, implementation would likely occur incrementally, spreading the benefit over more than one season.

The trail itself would be more robust, with a wider area and erosion protection measures which would improve the visitor experience, perhaps drawing additional visitors to the Carbon River area, at first to experience the completed trail and later to enjoy a better experience hiking or bicycling. In addition, improved visitor information facilities, parking, and picnicking at the entrance would provide a draw. Alternative 2 would cost approximately $3.806 million to implement and would have short-term minor to moderate and long-term beneficial effects on the local economy, depending on the extent to which materials and supplies or personnel were hired from the area. The area would likely see slight beneficial growth in the construction industry economic sector.

Alternative 3 Impacts
As in Alternative 2, there would be beneficial effects from implementation of actions in a single project, as opposed to over time as in Alternative 1. Because Alternative 3 would cost more than Alternative 2 to implement, at approximately $10.968 million, there would be an increase in short-term beneficial effects from purchase of materials and supplies and hiring of personnel to implement the project. As in Alternative 2, because work would also avoid sensitive periods for special status species, implementation would likely occur incrementally, spreading the benefit over a longer period.

As in Alternative 2, there would be a more robust structure for visitors to use, in this case a road up to Milepost 3.6 and then a trail from Milepost 3.6 to Ipsut Creek Campground. Following completion, visitors would be able to drive most of the historic road. Therefore, Alternative 3 would draw a greater number of visitors to the area because of ease of access. It is unknown whether peak season use would rise to the level of former use of the road. Nonetheless, repair of damaged road sections would allow park visitors safe access to the Chenuis Falls area; from there they could continue hiking or bicycling the 1.4 miles to Ipsut Creek Campground and trailhead. As in Alternative 2, improved facilities at the entrance would also draw more visitors. Visitation to Carbon River, along with demand for tourist-related services, would be expected to increase over current levels and would likely result in an increase in tourist-related revenues for the communities of Carbonado and Wilkeson. Economic impacts to these communities would be long-term, and beneficial. Some short-term beneficial economic impacts could also occur from construction demand for meals, services, and construction materials.

Alternative 4 Impacts
Impacts associated with Alternative 4 would be similar to a combination of impacts from Alternative 2 and 3. Because Alternative 4 would allow for reconstruction of a more robust road, as in Alternative 3, but because that road would be used for shuttles during peak use periods, more visitors could be accommodated, but the timing associated with increases in visitors would occur only during weekends, holidays and in summer. During other times of the year, visitor accommodation would be the same as in Alternative 2. Alternative 4 would cost approximately $11.493 million to implement. Unlike other alternatives, shuttle operation would result in long-term beneficial impacts to the local population and economy from year-round weekend/holiday operations. In addition, there would be short-term beneficial impacts from initial reconstruction of the road up to Milepost 4.4 and the improved trail beyond that. In addition, because it is likely that Alternative 4 would attract additional visitors in summer, there would be a need to identify a shuttle staging parking area which could have some additional long-term beneficial effects. As in Alternatives 2 and 3, improved facilities at the entrance, including parking, picnicking and visitor information would also draw visitors.

Alternative 5 Impacts
While construction of a small visitor contact station, improved parking and picnicking could draw some additional visitors, similar to Alternatives 2-4, impacts of Alternative 5 would initially be similar to Alternative 1, and later would likely result in a change in the type and number of visitors to the Carbon River area, because area visitor use would change from hiking and bicycling to primarily wilderness hiking, mixed with the same opportunities for front-country hiking currently available to former destinations in the area. Visitors would enjoy longer trips, with little opportunity to decrease their length from bicycling part of the area (except up to the Old Mine Trailhead turnaround—1.2 miles). Nonetheless, there would likely be moderate-term beneficial impacts on local economies during trail

construction from implementation which would cost approximately $4.61million over approximately five years. In addition, there would be beneficial impacts from the same kinds of facility removal and construction activities in other alternatives and ongoing beneficial impacts from continued use of the area. Compared to ongoing operations in Alternative 1, there would likely also be long-term minor adverse effects.

Impact Avoidance, Minimization or Mitigation Measures
Measures that would be part of the proposed project (as appropriate to the alternative actions) to minimize impacts on socioeconomics include:

- Where possible, projects would be combined or phased to allow for cost-savings measures related to staging remaining in place, rather than setting up and taking down staging areas for sequential implementation activities.
- New buildings would be constructed to silver or greater LEED standards to minimize long-term operations costs.
- New buildings and facilities and other improvements would use native, and recycled or reused materials to minimize potential long-term adverse effects from consumption.
- Where removal of facilities occurred, these would be deconstructed to the extent possible, and materials used in other areas of the park or recycled.

Cumulative Impacts: The presence of the park would continue to generate long-term minor economic benefits to the local and regional economy from the presence of visitors, jobs and income. While Alternatives 1-5 would each contribute measurable economic benefits, most of these would be short-term, lasting only during construction. All alternatives, would also contribute long-term negligible to moderate economic benefits as well from provision for continued visitor use in the Carbon River area. Compared to a road fully open condition, these beneficial impacts would likely be smaller, but could increase over time due to population increases in local communities or overall and/or from other factors.

Conclusion: Alternatives 1 and 2 would have long-term minor adverse and short- and long-term beneficial effects. Alternatives 3 and 4 would have short- and long-term beneficial effects (more than in Alternatives 1 and 2). Alternative 5 would have long-term minor adverse and short- and long-term beneficial effects.

Table 34: Impact Comparison Chart

Impact Topic*	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Air Quality	Short-term negligible to minor adverse effects, long-term beneficial effects	Short-term minor adverse effects, long-term beneficial effects	Short-term minor and long-term moderate adverse effects, long-term beneficial effects	Short-term minor to moderate adverse effects, long-term beneficial effects	Negligible to minor adverse effects, long-term beneficial effects
Impacts would continue to occur from access to the area (Alternatives 1-5), and from both construction (Alternatives 2-4) and use of the area (Alternatives 3 and 4). There would be long-term beneficial effects from restoration in Alternatives 1, 2 and 5, and long-term beneficial effects in all alternatives from an overall reduction of vehicles on the roadway. Compared to existing conditions, these impacts would remain localized and would not be detectable over ambient conditions except in the vicinity of the roadway.					
Geology / Soils	Short- and long-term negligible to minor adverse effects, long-term beneficial effects	Short-term negligible to moderate adverse effects, long-term minor adverse effects, localized long-term beneficial effects	Same as Alternative 2 with more short-term moderate adverse effects and fewer beneficial effects	Same as Alternative 3	Same as Alternative 2
Short-term moderate and long-term minor adverse effects would be associated with construction of new facilities. Moderate adverse effects would be greatest in Alternatives 3 and 4 from the construction of erosion protection measures and reestablishment of the road and fewest in Alternatives 1 and 5. Beneficial effects would be greatest in Alternatives 5, 2 and 1, with fewer beneficial effects in Alternatives 3 and 4 from less overall restoration.					
Water Resources Hydrology	Short- and long-term negligible to minor with the potential for adverse effects, long-term beneficial effects	Same as Alternative 1 with additional short- and long-term minor to moderate adverse effects and additional beneficial effects	Same as Alternative 1 with additional short- and long-term minor to moderate adverse effects	Same as Alternative 3, with more moderate adverse and more beneficial effects	Same as Alternative 1, then long-term negligible to minor adverse effects, long-term beneficial effects
Water Resources Water Quality	Long-term negligible to minor adverse effects, short-term minor to moderate adverse effects, long-term beneficial effects	Long-term minor and short-term negligible to moderate adverse effects, long-term beneficial effects	Long-term minor to moderate adverse and short-term negligible to moderate adverse effects (more than Alternative 2), long-term beneficial effects	Same as Alternative 3, with more short-term moderate adverse effects and potentially more long-term beneficial effects	Short-term negligible to minor and long-term negligible adverse effects
Water Resources Floodplains	Short- and long-term minor to moderate adverse effects, long-term beneficial effects	Short-term minor to moderate and long-term moderate to major adverse effects, long-term beneficial effects	Short-term moderate and long-term major adverse effects, long-term beneficial effects	Same as Alternative 3 with fewer beneficial effects	Same as Alternative 1 with more long-term beneficial effects from discontinuing maintenance of the informal trail.
Water Resources Wetlands	Short- and long-term minor adverse effects on 0.5 acres plus minor long-term effects from informal trail. Long-term beneficial impacts on 0.5 acres.	Short- and long-term minor adverse effects on 0.5 acres plus minor long-term adverse effects on an additional 1.3 acres. Long-term beneficial effects on 1.8 acres.	Short-term minor and long-term moderate adverse effects on 1.24 acres, plus minor to moderate adverse effects on additional 1.31 acres, long-term beneficial effects	Short-term minor and long-term moderate adverse effects on 1.32 acres, plus minor to moderate adverse effects on additional 1.64 acres, long-term beneficial effects.	Short- and long-term minor adverse and beneficial effects on 0.5acres plus short-term minor adverse effects from constructing new drainage crossings
Vegetation	Long-term minor to moderate adverse effects, long-term beneficial effects	Long-term negligible to moderate adverse effects, localized beneficial effects	Similar to Alternative 2 with both more adverse and beneficial effects	Similar to Alternative 3, with fewer beneficial effects	Similar to Alternative 2, with more adverse effects
Beneficial effects would be greatest in Alternative 5, from greater area restoration of the road in the river corridor, followed by Alternatives 1, 2, 3 and 4, while adverse effects would also be greatest in Alternative 5 (from more physical modification of undisturbed vegetated landscape), followed by Alternatives 4, 3, 2 and 1.					

Impact Topic*	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Wildlife	Short-term negligible to minor and long-term minor to moderate adverse effects, some long-term beneficial effects	Short-term minor to moderate, long-term minor to moderate adverse effects, some long-term beneficial effects	Short- and long-term moderate adverse effects, with fewer beneficial effects	Similar to Alternative 3, with more beneficial effects	Short- and long-term minor to moderate adverse effects, long-term beneficial effects
Special Status Species (federally listed)	No effect: gray wolf, grizzly bear, lynx, fisher May affect, likely to adversely affect: • northern spotted owl • marbled murrelet • bull trout • bull trout critical habitat • steelhead, and • essential fish habitat for Chinook and coho salmon Although the effect determinations are the same, overall, there would be fewer adverse impacts in Alternatives 1, 2 and 5, compared to Alternatives 3 and 4.				
Ethnography	No change, some beneficial effects (no effect)	Long-term minor adverse, and long-term beneficial effects (no adverse effect)	Same as Alternative 2	Same as Alternative 2 with fewer beneficial effects from shuttle	Same as Alternative 2
Beneficial effects could occur from expanded parking. Alternatives 2-5 would have long-term minor beneficial impacts on ethnographic resources from improvement of fish habitat, and improvement of parking and access. Potential long-term minor adverse impacts would occur from expansion of parking outside the current Carbon River Entrance. Shuttle access under Alternative 4 could diminish some of this effect. Overall, the alternatives do not propose use where no use is currently occurring and compared to existing conditions, there would be minor changes that could affect Native American use of the area. There would be no adverse effect to known ethnographic resources.					
Prehistoric and Historic Archeological Resources	No adverse effect on Washington Mining and Milling Company Adit, potential adverse effect on can dump	Same as Alternative 1 plus: Potential adverse effect on Ipsut Creek Campground	No adverse effect on Washington Mining and Milling Company Adit and can dump, potential adverse effect on Ipsut Creek Campground	Same as Alternative 3	Same as Alternative 2
Other potential impacts to archaeological resources would be avoided by additional survey and analysis. This could include realignment of the proposed trail in Alternative 5 to avoid archeological resources.					
Historic Structures / Cultural Landscapes	Adverse effect on Mount Rainier National Historic Landmark District (NHLD) requiring a Memorandum of Agreement (MOA) with the State Historic Preservation Office (SHPO) and Advisory Council for Historic Preservation (ACHP).	Same as Alternative 1.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
The adverse effect would be as a result of the decision to not maintain the Carbon River Road to the Secretary of the Interior's Standards for the Treatment of Historic Properties and from incompatible alterations to this portion of the NHLD. The alternatives would change the characteristics of the Carbon River Road that make it eligible for inclusion on the National Register of Historic Places as part of the NHLD. Not maintaining the road would continue to result in the loss of landscape characteristics (natural systems and features, spatial organization, land use, circulation, topography, vegetation, buildings and structures, and archeological sites) and the integrity associated with them (design, materials, workmanship, feeling and association of the road).					
Visitor Experience Access and	Long-term minor to major adverse effects, long-term	Short-term minor adverse effects, long-term minor to	Short-term minor to moderate adverse effects,	Similar to Alternatives 2 and 3, with short-term minor to	

Impact Topic*	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Transportation	beneficial effects	major adverse effects, long-term beneficial effects	long-term minor to moderate adverse and beneficial effects	moderate adverse, effects long-term minor to major adverse and beneficial effects	
Visitor Experience Opportunities	Long-term minor to major adverse effects	Long-term moderate to major adverse effects, long-term beneficial effects	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
Visitor Experience Information and Education	Long-term beneficial effects	Similar to Alternative 1 with more interpretation	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
Visitor Experience Safety	Long-term minor to moderate adverse effects	Long-term minor adverse and long-term beneficial effects	Same as Alternative 2	Similar to Alternative 2 with additional improvements	Long-term negligible to minor adverse effects, long-term beneficial effects
Wilderness	Short-term minor to moderate adverse effects	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1 plus long-term minor to moderate adverse effects.
Wild and Scenic Rivers	Actions in Alternatives 1-5 would affect some values called out in the eligibility report, however there would be no effect on the eligibility of the Carbon River for designation as part of the wild and scenic rivers system.				
Park Operations	Short- and long-term minor to moderate adverse effects	Same as Alternative 1	Short- and long-term moderate adverse effects	Same as Alternative 3	Short-term moderate and long-term minor adverse effects
Socioeconomics	Long-term minor adverse, and short- and long-term beneficial effects	Same as Alternative 1	Similar to Alternatives 1 and 2, with more beneficial effects	Same as Alternative 3	Long-term minor adverse and long-term beneficial effects.

***There would be no impairment of any resource associated with the implementation of Alternatives 1-5.

Chapter VI: Consultation and Coordination

Internal and External Scoping

Mount Rainier National Park conducted internal scoping with appropriate NPS staff and external scoping with the public and interested and affected groups, agencies, and tribes to determine the range of issues to be discussed in this Environmental Assessment. This interdisciplinary process defined the purpose and need, identified potential actions to address the need, determined the likely issues and impact topics, and identified the relationship of the preferred alternative to other planning efforts in the park.

Media

A press release initiating the public scoping process and comment period was issued on June 23, 2008. It was published in numerous local and national news media, including the Tacoma News Tribune. Comments regarding the proposed project were incorporated into the proposed project. A series of public scoping meetings were held in June and July 2008 to present a preliminary range of alternatives, which were later modified into the current range of alternatives. A summary of public scoping is also found in Chapter II: *Purpose and Need*.

Agency and Tribal Consultation

Letters notifying agencies were distributed to the following agencies and tribes (among others) on the park's mailing list in June 2008: Washington State Historic Preservation Officer (SHPO), U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the six associated Native American Tribes. A representation of the Washington SHPO attended the Choosing by Advantages workshop held by the park in September 2009 to select the preferred alternative.

Native American Tribes

In addition to the letters sent to the following six associated Native American Indian Tribes (Muckleshoot Indian Tribe, Puyallup Tribe of Indians, Cowlitz Indian Tribe, Nisqually Indian Tribe and the Squaxin Island Tribe), follow-up consultation occurred with the Puyallup Tribe of Indians (July 21, 2008) and the Muckleshoot Indian Tribe (August 4, 2008).

U.S. Fish and Wildlife Service /National Marine Fisheries Service Consultation

In accordance with local implementing procedures for Section 7 of the Endangered Species Act, the NPS and USFWS consulted the websites for the USFWS and the NOAA-National Marine Fisheries Service to obtain a current list of federally-listed species in the project action area. There are currently 32 fish and wildlife species that are federally listed as threatened, endangered, proposed, or candidate species in western Washington. The NPS/USFWS reviewed species occurrence records maintained by the Park and the Washington Department of Fish and Wildlife. A list was developed of species known to occur or potentially occur in Mount Rainier National Park, and may occur in the project action area. Copies of the website species lists are in the project file for the Biological Assessment. A request for concurrence with the determinations of effect will be sent during the public review period for this Environmental Assessment.

Preparation of the Biological Assessment (Appendix 9) by the USFWS in cooperation with the park was concurrent with the latter part of preparation of the Environmental Assessment. It resulted in *No Effect* determinations for grizzly bear, gray wolf, Canada lynx and fisher; *May Affect, Not Likely to Adversely Affect* determination for Chinook salmon, and *May Affect, Likely to Adversely Affect* determinations for bull trout and bull trout critical habitat, steelhead, northern spotted owl, marbled murrelet, and essential fish habitat. These determinations apply to all alternatives, including no action. A request for formal consultation and concurrence with these determinations of effect was sent on July 28, 2010 and July 29, 2010 to both the National Marine Fisheries Service (NMFS) and the USFWS respectively.

Washington State Historic Preservation Office
Previous consultation with the SHPO occurred in 2000-2002 as a result of the General Management Plan (GMP) process associated with determining the future of the Carbon River Road. At that time the SHPO concurred with a determination of *No Adverse Effect*. A representative of SHPO, however, participated in the Choosing By Advantages workshop on July 21-23, 2009, to select the preferred alternative. As a result of that participation analysis of all of the alternatives has resulted in a determination of *Adverse Effect*. This determination applies to all alternatives, including no action. Ongoing consultation is continuing to initiate a Memorandum of Agreement.

Public Review
This Environmental Assessment is available for a **forty-five day** public review period. Refer to the park's website for posting of the document, more detailed information on the project and comment period located at http://www.nps.gov/mora and on the Planning, Environment and Public Comment (PEPC) website located at http://parkplanning.nps.gov/mora. A press release will be distributed to people and businesses who have expressed an interest in the road rehabilitation. The press release will also be mailed or emailed to a list of persons and agencies that have expressed interest in Mount Rainier National Park proposed actions and events. Included will be organizations such as The Wilderness Society, Wilderness Watch, The Mountaineers, Sierra Club, National Audubon Society, Mount Rainier National Park Associates, National Parks Conservation Association and Public Employees for Environmental Responsibility. In addition, organizations and individuals that have made a request will receive a digital copy of the Environmental Assessment. Others will be sent to those who request printed or digital copies during the review period.

Public meetings will be conducted in Buckley, Tacoma and Seattle, Washington. Refer to the park's two websites listed above for exact dates, times and locations.

Comments on this Environmental Assessment should be directed to:

Superintendent
Mount Rainier National Park
55210 238th Avenue East
Ashford, Washington 98304

Comments submitted via electronic mail may be addressed to MORA_Carbon_River_Comments @nps.gov or electronically via the Planning, Environment and Public Comment (PEPC) website http://parkplanning.nps.gov/mora.

If reviewers do not identify substantial environmental impacts, this Environmental Assessment will be used to prepare a Finding of No Significant Impact (FONSI), which will be sent to the National Park Service Pacific West Regional Director for signature.

During the public review period, additional consultation will occur with the Washington State Historic Preservation Office, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service. Notice of the concurrence with the determinations of effect for historical resources will be identified in the FONSI for this Environmental Assessment, if prepared (see above).

For more information concerning this Environmental Assessment please contact park Environmental Protection Specialist, Karen Thompson at (360) 569-2211, extension 3376. For a copy of this document, please call Mount Rainier National Park at (360) 569-2211, extension 2301.

Hard copies or CDs of the document have been mailed to the agencies, tribes and libraries listed below:

Washington State Office of Archaeology & Historic Preservation
Washington State Department of Fish and Wildlife

Washington Natural Heritage Program, Department Of Natural Resources
Washington State Department of Transportation
Washington State Parks & Recreation Commission
Washington State Dept. of Ecology
U.S. Environmental Protection Agency
U.S. Army Corps of Engineers
U.S. Fish & Wildlife Service, North Pacific Coast Ecoregion
NOAA Fisheries Service (National Marine Fisheries Service)
Federal Highway Administration, Western District Federal Division

Cowlitz Indian Tribe
Muckleshoot Indian Tribe
Nisqually Indian Tribe
Puyallup Tribe of Indians
Squaxin Island Indian Tribe
Yakama Indian Nation

Bonney Lake Library
Buckley Library
Eatonville Library
Enumclaw City Library
Graham Library
Orting Library
Packwood Timberland Library
Parkland-Spanaway Library
Puyallup Library
Seattle Central Library
South Hill Library
Summit Library (Tacoma)
Sumner Library
Tacoma Public Library
Tacoma Branch
Yakima Valley Regional Library

List of Persons and Agencies Consulted / Preparers

The following people and agencies were consulted during the preparation of this Environmental Assessment:

National Park Service, Pacific West Region (Oakland)
1111 Jackson Street, Suite 700, Oakland, California 94607

Alan Schmierer, Regional Environmental Coordinator

National Park Service, Pacific West Region (Seattle)
909 First Avenue, Seattle, Washington 98104

Bryan Bowden, Outdoor Recreation Planner
Susan Dolan, Historical Landscape Architect
Paul Kennard, Fluvial Geomorphologist
Keith Dunbar, Chief Planning and Environmental Compliance

c/o Craters of the Moon National Monument and Preserve, P.O. Box 29, Arco, Idaho 83213
Rose Rumball-Petre, Environmental Protection Specialist (preparer)

National Park Service, Mount Rainier National Park
55210 238th Avenue North, Ashford, Washington 98304

Dave Uberuaga, Superintendent
Randy King, Deputy Superintendent

Roger Andrascik, Chief Natural and Cultural Resources
Scott Beason, Geologist / Hydrologist (preparer)
Greg Burtchard Archaeologist / Native American Liaison (preparer)
Bryan Bowden, Outdoor Recreation Planner (preparer)
Tami DeGrosky, Chief of Maintenance
Benjamin Diaz, Archaeologist Technician (preparer)
Susan Dolan, Historical Landscape Architect (preparer)
Carl Fabiani, Trails Supervisor (preparer)
Ellen Gage, former Historical Architect
Julie Hover, Biotechnician (Restoration Specialist)
Jim Hull, Supervisory Visitor Use Assistant
Patricia Iolavera, former Environmental Protection Specialist
Steve Klump, former Wilderness District Ranger
Matt Knowles, former Park Ranger
Larry Miranda, former Environment Protection Assistant
Ellen Myers, Wildlife Biologist
Uwe Nehring, East District Ranger
Mason Reid, Wildlife Ecologist
Barbara Samora, Biologist (preparer)
Jim Schaberl, former Wildlife Ecologist
Darin Swinney, Geographic Information Systems Specialist
Lee Taylor, Chief Interpretation and Education
Karen Thompson, Environmental Protection Specialist
Daniel Van der Elst, Park Ranger
Eric Walkinshaw, Project Manager
Lou Whittaker, Plant Ecologist (preparer)
Ben Wright, Biological Technician
Chuck Young, Chief Ranger

NOAA National Marine Fisheries Service
Jody Walters, Consultation Biologist

U.S. Fish and Wildlife Service
Vince Harke, Fish and Wildlife Biologist (preparer)

Entrix, Inc.
Tim Abbe, Engineer

Geomax, Inc.
Don Reichmuth, GeoEngineer

Chapter VII: References

ABR 2009. Radar surveys for marbled murrelets in Mt. Rainier National Park, 2009. An unpublished report submitted to the National Park Service Mount Rainier National Park, Ashford WA. Prepared by ABR Inc., Forest Grove, OR. November 2009. 17 pp.

Almack, J.A., and S.H. Fitkin. 1998. Grizzly bear and gray wolf investigations in Washington State; 1994-1995, final progress report. Washington Department of Fish and Wildlife, Olympia, WA.

Anthony *et al*. 2004. Status and trends in demography of northern spotted owls. Report to the Interagency Regional Monitoring Program. 84 pp plus figures and tables.

Anthony, R.G., E.D. Forsman, A.B. Franklin and others. 2006. Status and trends in demography of northern spotted owls, 1985-2003. Wildlife Monographs 163:2-68.

Beason, Scott R., 2006. The environmental implications of aggradation in major braided rivers at Mount Rainier National Park, Washington. M.S. thesis, University of Northern Iowa, Cedar Falls, IA. 165 p.

Beason, S.R., 2007, The Environmental Implications of Aggradation on Major Braided Rivers at Mount Rainier National Park, Washington: M.S. Thesis, University of Northern Iowa, Cedar Falls, Iowa, 165 p.

Beechie, T., E. Buhlel, M.H. Ruckelshaus, A. Fullerton, and L. Holsinger. 2006. Hydrologic regime and the conservation of salmon life history diversity. Biological Conservation 130: 560-572.

Burger, A.E., I.A. Manley, M.P. Silvergieter, D.B. Lank, and others. Re-use of nest sites by marbled murrelets (Brachyramphus marmoratus) in British Columbia. Northwestern Naturalist 90:217-226.

Burtchard, Greg C. 1998. Environment, Prehistory and Archaeology of Mount Rainier National Park, Washington. Honolulu, Hawaii: International Archaeological Research Institute, Inc.

Burtchard, Greg C., S.C. Hamilton, and R.H. McClure. 1998. Environment, Prehistory and Archaeology of Mount Rainier National Park, Washington. Seattle, Washington.

Burtchard, Greg C. 2009. Holocene Subsistence and Settlement Patterns, Mount Rainier and the Montane Pacific Northwest. In *Archaeology in Washington*, Volume 13.

Cain, Cortney and Susan, Dolan. 2004. Cultural Landscape Inventory, Carbon River Road, Mount Rainier National Park Draft. Ashford, Washington: National Park Service.

Carey, A.B. 1995. Sciurids in Pacific Northwest managed and old-growth forests. Ecological Applications 5(3):648-661.

Carr, Ethan. 1998. Wilderness by Design: Landscape Architecture, and the National Park Service, Lincoln, Nebraska, University of Nebraska Press.

Catton, Theodore. 1996. Wonderland: An Administrative History of Mount Rainier National Park. National Park Service, Cultural Resources Program, Seattle, Washington.

Cavender, T.M. 1978. Taxonomy and Distribution of the Bull Trout, (*Salvelinus Confluentus*) (Suckley), From The American Northwest. California Fish and Game 64(3):139-174.

CDFG 1998. California salmonid stream habitat restoration manual. Third edition. Prepared by G. Flosi, S. Downe, J. Hopelain, and others. California Department of Fish and Game - Inland Fisheries Division. Sacramento, CA. 497 pp.

Clow, D.W., and Campbell, D.H., 2008, Atmospheric deposition and surface-water chemistry in Mount Rainierand North Cascades National Parks, U.S.A., water years 2000 and 2005–2006: U.S. Geological Survey Scientific Investigations Report 2008–5152, 37 p.

Crandell, Dwight R. 1969. Surficial geology of Mount Rainier National Park. U.S. Geological Survey Bulletin 1288. Washington, D.C.

Crandell, Dwight Raymond. 1971. Postglacial Lahars from Mount Rainier Volcano, Washington. U.S. Geological Survey Professional Paper 677.

Degerman, Traci. 2007. Special Status Plant Species with the Potential for Occurrence in the MORA Route 102 Project Area (Carbon River Road), September 17, 2007. Report on file, Mount Rainier National Park, Longmire, Washington.

Delaney, D.K., T.G. Grubb, P. Beier, L.L. Pater, and M.H. Reiser. 1999. Effects of helicopter noise on Mexican Spotted Owls. Journal of Wildlife Management 63:60-76.

Department of the Interior. 1995. The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings. National Park Service, Cultural Resource Stewardship and Partnerships, Heritage Preservation Services, Washington, D.C.

Deur, Douglas, and Nancy J. Turner. 2005. Keeping it Living; Traditions of Plant Use and Cultivating on the Northwest Coast of North America. University of Washington Press. Seattle.

Driedger, C.L. 1986.A Visitor's Guide to Mount Rainier Glacier. Pacific Northwest Parks and Forests Association, Longmire, WA.

Edwards, Ola M. 1977a. Final Report: Research on "Climbing Zone" Mount Rainier Vegetation Impact Study. Report on file Longmire Library, Mount Rainier National Park, Longmire, Washington.

Edwards, Ola M. 1985. Human Impact on the Alpine Ecosystem of Mount Rainier, Final Report Submitted to Mount Rainier National Park (Contract No. CX-9000-3-E060. Report on file, Longmire Library, Mount Rainier National Park, Longmire, Washington.

Entrix 2008. (Tim Abbe, Engineer)Topographic Survey, Hydraulic Modeling and Design Assessment of Proposed Carbon River Road Flood Damage Reduction Measures Final Draft Technical Memorandum, October 2008. ENTRIX Environmental Consultants, Seattle, Washington. Report on File, National Park Service, Mount Rainier National Park, Ashford, Washington.

Ewert, J.W., M. Guffanti, and T.L. Murray. 2005. An assessment of volcano threat and monitoring capabilities in the United States: Framework for a National Volcano Early Warning System: U.S. Geological Survey Open_File Report 2005-1164. 62 p.

Federal Highway Administration (FHWA). 1997. Hydraulics Report, Carbon River Road, Mount Rainier National Park. Western Federal Lands Highway Division, Seattle, Washington.

Formichella, Charlotte. 2009. Mount Rainier Acoustical Monitoring 2006-2007. Natural Resource Report NPS/NRPC/NRTR—2009/001. U.S. Department of the Interior National Park Service Natural Resource Program Center. Fort Collins, CO

Forsman, E.D., E.C. Meslow, and H.M. Wight. 1984. Distribution and biology of the spotted owl in Oregon. Wildlife Monographs 87:1-64.

Forsman, E.D. 1995. Spotted owl monitoring protocols for demographic studies. Unpublished Report. 10 pgs.

Forsman, E.D., R.G. Anthony, J.A. Reid, P.J. Loschl, S.G. Sovern, M. Taylor, B.L. Biswell, A. Ellingson, E.C. Meslow, G.S. Miller, K.A. Swindle, J.A. Thrailkill, F.F. Wagner, and D. E. Seaman. 2002. Natal and breeding dispersal of northern spotted owls. Wildlife Monographs 149:1-35.

Franklin, A.B., D. R. Anderson, E. D. Forsman, K. P. Burnham, and F. F. Wagner. 1996. Methods for Collecting and Analyzing Demographic Data on the Northern Spotted Owl. Studies in Avian Biology 17:12-20

Franklin, J.F., W.H. Moir, M.A. Hemstrom, S.A. Greene, and B.G. Smith. 1988. The Forest Communities of Mount Rainier National Park. Scientific Monograph Series No. 19. U.S. Department of the Interior, National Park Service. Washington, D.C.

Freeman, G. E., and J.C. Fischenich. 2000. Gabions for streambank erosion control. EMRRP Technical Notes Collection (ERDC TN-EMRRP-SR-22), U.S. Army Engineer Research and Development Center, Vicksburg, MS. www.wes.army.mil/el/emrrp.

Frest, Terrence J. and Edward J. Johannes. 2005. Baseline Mollusk Survey of Mount Rainier National Park. Technical Report NPS/MORA 04/01. Deixis Consultants and Mount Rainier National Park.

Geomax 2008. (Donald Reichmuth and Allan S. Potter, Engineers). Geomax: Geomorphology, Geomechanics and Geodesign, Spokane, Washington. January 30, 2008. Report on File, National Park Service, Mount Rainier National Park, Ashford, Washington.

Good, T.P., R.S. Waples, and P. Adams, editors. 2005. Updated status of Federally listed ESUs of west coast salmon and steelhead. U.S. Department of Commerce, National Marine Fisheries Service, Northwest Fisheries Science Center, NOAA Technical Memo. NMFS-NWFSC-66, Seattle, Washington. 598 p.

Gunther, Erna. 1973. Ethnobotany of Western Washington; The Knowledge and Use of Indigenous Plants by Native Americans. University of Washington Press. Seattle.

Hamer, T.E. and S.K. Nelson. 1995. Characteristics of Marbled Murrelet Nest Trees and Nesting Stands. Pp. 69-82 in Ecology and Conservation of the Marbled Murrelet (C.J. Ralph, F.L.Hunt, Jr., M.G. Raphael, and J.F. Piatt, eds.). USDA Forest Service General Technical Report. PSW-152, Albany, CA.

Hamer, T.E. 1995. Inland habitat associations of marbled murrelets in western Washington. Pages 163-175. in: C.J. Ralph, G.L. Hunt, M.G. Raphael, and J.F. Piatt (eds.). Ecology and conservation of the marbled murrelet. General Technical Report. PSW-GTW-152. Pacific Southwest Experimental Station, U.S. Forest Service, Albany, California. 420 pp.

Hamer, T.E., and S.K. Nelson. 1998. Effects of disturbance on nesting marbled murrelets: summary of preliminary results. An unpublished report prepared for U.S. Fish and Wildlife Service, Portland, OR. January 1998. Hamer Environmental, Mount Vernon, Washington and Oregon State University, Corvallis. 24 pp.

Hamer, T.E., S.K. Nelson, and T.I. Mohagen II. 2003. Nesting chronology of the marbled murrelet in North America. Hamer Environmental, Mount Vernon, WA.

Hard, J.J., J.M. Myers, M.J. Ford, and others. 2007. Status review of Puget Sound steelhead (Oncorhynchus mykiss). U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-81, 117 p.

Healey, M.C. 1991. Life history of Chinook salmon (Oncorhynchus tshawytscha). Pages 311-393 in C. Groot and L. Margolis, editors. Life History of Pacific Salmon. University of British Columbia Press, Vancouver, BC.

Hébert, P. N. and R.T. Golightly. 2006. Movements, nesting, and response to anthropogenic disturbance of Marbled Murrelets (Brachyramphus marmoratus) in Redwood National and State Parks, California. Unpublished report, Department of Wildlife, Humboldt State University, Arcata, California and California Department of Fish and Game Report 2006-02, Sacramento, California.

Herter, D., J. Schaberl and E. Myers. 2008. Rainier spotted owl demography study area – 2008 annual report. November 2008. Raedeke Associates, Inc. Seattle, Washington. 45 pp.

Herter, D., M. Reid and E. Myers. 2009. Rainier spotted owl demography study area – 2009 annual report. Raedeke Associates, Inc. Seattle, Washington. 48 pp.

Hoblitt, R.P., J.S. Walder, C.L. Driedger, K.M. Scott, P.T. Pringle, and J.W. Vallance. 1995. Volcano Hazards from Mount Rainier, Washington. U.S. Geological Survey Open-File Report 95-273.

Hoblitt, R.P., J.S. Walder, C.L. Driedger, K.M. Scott, P.T. Pringle, and J.W. Vallance. 1998. Volcano hazards from Mount Rainier, Washington, revised 1998: U.S. Geological Survey Report OF 98-0428. 11 p.

Hobson, F.D. 1976. Classification system for the Soils of Mount Rainier National Park. MS Thesis. Washington State University, Pullman, Washington.

ISPG 2003. Integrated streambank protection guidelines. Aquatic habitat guidelines: An integrated approach to marine, freshwater, and riparian habitat protection and restoration. Washington State Aquatic Habitat Guidelines Program. Washington Department of Fish and Wildlife, Washington Department of Transportation, and Washington Department of Ecology. April 2003. http://wdfw.wa.gov/hab/ahg/ispgdoc.htm

Johnson, Darryll R., Karen P. Foster and Katherine L. Kerr. 1990. Mount Rainier National Park 1990 Visitor Survey CA 9000-8-0007. National Park Service, Cooperative Park Studies Unit, College of Forest Resources, University of Washington, Seattle, Washington.

Landres, Peter, Steve Boutcher, Linda Merigliano, Chris Barns, Denis Davis, Troy Hall, Steve Henry, Brad Hunter, Patrice Janiga, Mark Laker, Al McPherson, Douglas S. Powell, Mike Rowan, Susan Sater. April 2005. Monitoring Selected Conditions Related to Wilderness Character: A National Framework. U.S.D.A, U.S. Forest Service, Rocky Mountain Research Station, General Technical Report. RMRS-GTR-15.

Lillie, R.J. and C.L. Driedger, 2001, Subduction, Volcanism and Natural Hazards: Geology Training Manual for Mount Rainier National Park: Unpublished Internal Document for Mount Rainier National Park. 68 p.

Long, L., and C.J. Ralph. 1998. Regulation and observation of human disturbance near nesting marbled murrelets. USDA Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, Arcata, California.

Marks, E.L., R.C. Ladley, B.E. Smith, and T.G. Sebastion. 2009. 2008-2009 Annual salmon, steelhead, and bull trout report: Puyallup/White River watershed water resource inventory area 10. Puyallup Tribal Fisheries, Puyallup, Washington.

Marzluff, J.M., and Neatherlin. 2006. Corvid response to human settlements and campgrounds: causes, consequences, and challenges for conservation. Biological Conservation 130(2006) 301-314.

McShane, C., T. Hamer, H. Carter, G. Swartsman, and others. 2004. Evaluation report for the 5-year status review of the marbled murrelet in Washington, Oregon, and California. Unpublished report. EDAW, Inc. Seattle, Washington. Prepared for the U.S. Fish and Wildlife Service, Region 1. Portland, Oregon.

Myers, E, and J. Schaberl. 2003. Mount Rainier National Park marbled murrelet 2002 progress report. NPS unpublished report. 23pp.

Myers, E. and J. Schaberl. 2003. Mount Rainier National Park Northern Spotted Owl Demographic and Compliance Program 2002 Progress Report. NPS Unpublished report. 25pp.

Myers, E. 2009. Mount Rainier National Park northern spotted owls demographic monitoring. 2008 progress report. March 2009. National Park Service Mount Rainier National Park. Ashford, WA. 19 pp.

National Marine Fisheries Service (NMFS). 1999. Endangered and Threatened Species; Threatened Status for Three Chinook Salmon Evolutionarily Significant Units (ESU's) in Washington and Oregon; and Endangered Status of One Chinook Salmon ESU in Washington. Federal Register. 64(56):14308-14328.

National Park Service (NPS). 1993b. Natural Resources Management Guideline (NPS-77), National Park Service, Washington, D.C.

NPS. 1998. NPS-28: Cultural Resources Management Guideline. U.S. Department of the Interior, National Park Service, Washington, D.C.

NPS, 1998. Director's Order #77-2. Floodplain Procedural Manual. Washington D.C.

NPS. 1999. Director's Order 41: Wilderness Preservation and Management. U.S. Department of the Interior, National Park Service, Washington, D.C.

NPS. 2002. Mount Rainier National Park General Management Plan and Environmental Impact Statement. National Park Service, Denver Service Center, Denver, Colorado.

NPS. 2003. Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making. U.S. Department of the Interior, National Park Service, Washington, D.C.

NPS. 2006. National Park Service Management Policies. U.S. Department of the Interior, Washington, D.C.

NPS. 2006a. Cultural Landscape Inventory: Carbon River Road, Mount Rainier National Park. National Park Service, Pacific West Regional Office, Seattle, Washington.

NPS, Lake Chelan National Recreation Area. 2010. Draft Stehekin River Corridor Implementation Plan, North Cascades National Park Service Complex, Sedro-Woolley, Washington.

NPS. Mount Rainier National Park. 2007. Carbon River Road Corridor Exotic Plant Summary (1/31/07). Report on file, Mount Rainier National Park, Longmire, Washington.

NPS, Mount Rainier National Park. 1989. Wilderness Management Plan Mount Rainier National Park. Report on File, Mount Rainier National Park, Longmire, Washington.

NPS, Mount Rainier National Park. 1995a. Birds: Mount Rainier National Park, A Checklist.

NPS, Mount Rainier National Park. 1999. Mount Rainier National Park Natural and Cultural Resources Management Plan. Report on file, Mount Rainier National Park, Longmire, Washington.

NPS, Mount Rainier National Park. 2003a. Carbon River Corridor Charette (in cooperation with the Mount Baker Snoqualmie National Forest (February and March 2003). Report on File, National Park Service, Mount Rainier National Park, Ashford, Washington.

NPS, Mount Rainier National Park. 2007. Hazard Tree Plan Environmental Assessment. Report on file, Mount Rainier National Park, Longmire, Washington.

NPS, Mount Rainier National Park. 2009. Mount Rainier National Park Marbled Murrelet 2009 Progress Report. Draft report prepared by J. Dhundale. August 2009. National Park Service Mount Rainier National Park, Ashford, WA. 23 pp.

NPS, Mount Rainier National Park. 2009. Carbon River Aquatic Resources Status Report. June through October 2009. Mount Rainier National Park. Unpublished draft field report, prepared by B. Samora and B. Wright. November 2009. National Park Service Mount Rainier National Park, Ashford, WA. 7 pp.

NPS and USFWS 2010. Mount Rainier National Park Carbon River Access Management Biological Assessment and Essential Fish Habitat Assessment. June 2010. Unpublished agency document prepared by the National Park Service, Mount Rainier National Park, Ashford, WA and U.S. Fish and Wildlife Service, Washington Fish and Wildlife Office, Lacey WA.

NPS, National Conference of State Historic Preservation Officers, and Advisory Council on Historic Preservation (NPS, SHPO, ACHP). 2008. Programmatic Agreement among the National Park Service, the National Conference of State Historic Preservation Officers, and the Advisory Council on Historic Preservation. U.S. Department of the Interior, National Park Service.

NPS, Pacific Northwest Region. 1990. Memo from Pacific Northwest Regional Director to Associate Director, Planning and Development, Washington Office regarding Special Directive 90 - 4, - Determination of Rivers on National Park System Lands Which Are Eligible for National Wild and Scenic Rivers System Designation. Unpublished Report on File, Mount Rainier National Park, Longmire, Washington. 95 pp.

National Research Council. 1994. Mount Rainier, Active Cascade Volcano: Research Strategies for Mitigating Risk from a High, Snow-Clad Volcano in a Populous Region. U.S. Geodynamics Committee, Board on Earth Sciences and Resources, Commission on Geosciences, Environment and Resources. National Academy Press, Washington, D.C. 85 pp.

Nelson, S.K., and T.E. Hamer. 1995a. Nesting biology and behavior of the marbled murrelet. Pages 57-67 in C.J. Ralph, G.L. Hunt, M.G. Raphael, and J.F. Piatt (eds.). Ecology and conservation of the marbled murrelet. General Technical Report. PSW-GTW-152. Pacific Southwest Experimental Station, U.S. Forest Service, Albany, California. 420 pp.

Nelson, S.K., and T.E. Hamer. 1995b. Nest success and the effects of predation on marbled murrelets. Pages 89-97 in C.J. Ralph, G.L. Hunt, M.G. Raphael, and J.F. Piatt (eds.). Ecology and conservation of the marbled murrelet. General Technical Report. PSW-GTW-152. Pacific Southwest Experimental Station, U.S. Forest Service, Albany, California. 420 pp.

Nelson, S.K. 1997. Marbled murrelet (Brachyramphus marmoratus). in: (A. Poole and F. Gill, eds.). Birds of North America, No. 276.. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists Union, Washington D.C.

Nylen, T.H. 2005. Spatial and temporal variations of glaciers on Mount Rainier between 1913 and 1994. M.S. Thesis, Portland State University, Portland, Oregon.

Nylen, Thomas H., 2001, Spatial and Temporal Variations of Glaciers (1913-1994) on Mount Rainier and the Relation with Climate: M.S. Geology Thesis, Portland State University, 114 p.

Pojar, Jim, and Andy MacKinnon. 1994. Plants of the Pacific Northwest Coast; Washington, Oregon, British Columbia & Alaska. Lone Pine Publishing. Vancouver, British Columbia.

Ralph, C. John; G.L Hunt, M.G. Raphael, J.F. Piatt, Technical Editors. 1995. Ecology and Conservation of the Marbled Murrelet. General Technical Report PSW-GTR-152. Albany, California, Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture: 420 pp.

Raphael, M.G., D. Evans-Mack, and B.A. Cooper. 2002. Landscape-scale relationships between abundance of marbled murrelets and distribution of nesting habitat. The Condor 104:331-342.

Raphael, M.G., G.M. Gelleher, M.H. Huff, S.L. Miller, S.K. Nelson, and R. Young. 2006. Spatially-explicit estimates of potential nesting habitat for the marbled murrelet. Chapter 5 in: Marbled Murrelet Effectiveness Monitoring Team; M. Huff, Tech. Coord. Northwest Forest Plan – The first 10 years (1994-2003): Status and trend of populations and nesting habitat for the marbled murrelet. Gen. Tech. Report. PNW-GTR-650. Portland, OR: USDA Forest Service, Pacific Northwest Research Station.

Reid, M., J. Petterson, and J. Schaberl. 2010. A Survey of Forest Carnivores in Mount Rainier National Park, Washington. Unpublished report. North Coast and Cascades Network, National Park Service, Mt. Rainier National Park, Washington.

Riedel, Jon L., 1997. Geologic Hazards And Floodplain Management, Mount Rainier General Management Plan: Unpublished internal document, National Park Service, 61 p.

Salvi, William, and Darryll R. Johnson. 1985. The 1985 Mount Rainier General Visitor Survey: Statistical Abstract. CA-9000-3-0004. Cooperative Park Studies Unit, College of Forest Resources, University of Washington, Seattle, Washington.

Scott, K.M. and J.W. Vallance, 1995, History of landslides and debris flows at Mount Rainier: United States Geological Survey Open File Report 93-111, 2 p.

SHRG 2004. Stream Habitat Restoration Guidelines: Final Draft. Saldi-Caromile, K., K. Bates, P. Skidmore, J. Barenti, D. Pineo. 2004. Co-published by the Washington Departments of Fish and Wildlife and Ecology and the U.S. Fish and Wildlife Service. Olympia, Washington. http://wdfw.wa.gov/hab/ahg/.

Simmons, Todd, Margaret Littlejohn, and Wade Morse. November 2001. Mount Rainier National Park Visitor Study Summer 2000. Visitor Services Project Report 124. CPSU University of Idaho.

Sisson, T.W., 1995, History and Hazards of Mount Rainier, Washington: United States Geological Survey Open File Report 95-642, 2 p.

Sisson, T.W., J.W. Vallance, and P.T. Pringle, 2001, Progress made in understanding Mount Rainier's hazards: EOS, Transactions of the American Geophysical Union, p. 113-120.

Scott, K.M., P.T. Pringle, J.W. Vallance. 1995. Sedimentology, Behavior and Hazards of Debris Flows at Mount Rainier, Washington. U.S. Geological Survey Professional Paper 1547. 56 pp.

Scott, K.M. and J.W. Vallance. August 1994. Volcano Hazards Public Awareness Information Sheet: History of Landslides and Debris Flows at Mount Rainier. U.S. Geological Survey, Cascades Volcano Observatory, Vancouver, Washington.

Smith, Allan H. 2006. Takhoma: Ethnography of Mount Rainier National Park. Pullman, Washington: Washington State University Press.

Smith, Marian W. 1940 Puyallup-Nisqually. Columbia University Contributions to Anthropology, Volume XXXII. Columbia University Press. New York.

Stewart, Hillary. 1984. Cedar: Tree of Life to the Northwest Coast Indians. Douglas & McIntyre. Vancouver, British Columbia.

Stinson, D. W., J. W. Watson, and K. R. McAllister. 2001. Washington State Status Report for the Bald Eagle. Washington Department of Fish and Wildlife, Olympia, Washington, USA.

Stinson, D. W. 2001. Washington State recovery plan for the lynx. Washington Department of Fish and Wildlife. Olympia, Washington. 86 pp + 5 maps.

Sullivan, Gregg. 1996. Carbon River Road Repair Project; Summary of Archeological Inventory Study. Mount Rainier National Park, Washington.

Swarthout, E.C.H., and R.J. Steidl. 2001. Flush responses of Mexican spotted owls to recreationists. Journal of Wildlife Management 65:312-317.

Taylor, W.P. and W.T. Shaw. 1927. Mammals and Birds of Mount Rainier National Park. Washington, D.C., U.S. Government Printing Office.

Thomas, J.W., E.D. Forsman, J.B. Lint, E.C. Meslow, B.R. Noon, and J. Verner. 1990. A conservation strategy for the northern spotted owl. Interagency Scientific Committee to address the conservation of the northern spotted owl. USDA Forest Service, USDI Bureau of Land Management, USDI Fish and Wildlife Service, and USDI National Park Service. Portland, Oregon. 458 pp.

Thompson, Erwin N. 1981. Mount Rainier National Park Washington Historic Resource Study. Denver, CO: Denver Service Center, Historic Preservation Branch Pacific Northwest/Western Team, National Park Service, United States Department of the Interior.

Toothman, Stephanie, S. Begley, and E. Carr. 1996. National Historic Landmark District Nomination, Mount Rainier National Park. National Park Service, Washington, D.C.

Town of Carbonado. 1995. Comprehensive Land Use Plan.

Town of Wilkeson. 1995. Comprehensive Land Use Plan.

U.S. Department of the Interior (USDI). 1910. Reports of the US Department of the Interior for the Fiscal Year Ended June 30, 1909 Vol. 1. Washington, D.C.: Government Printing Office.

U.S. Forest Service (USFS) 1998. Carbon River watershed analysis. Mt. Baker-Snoqualmie National Forest. White River Ranger District. USDA Forest Service Pacific Northwest Region. Mountlake Terrace, WA. September 1998.

United States Geological Survey (USGS) Stream Stats, 2010. Washington StreamStats basin characteristics report [Online]. Fetched June 22, 2010 from http://streamstats.usgs.gov. Last modified 03/14/2007.

U.S. Fish and Wildlife Service (USFWS). 1981. Bald eagle management guidelines, Oregon-Washington. US Fish and Wildlife Service Region 1 Office, Portland, Oregon, USA.

USFWS. 1986. Recovery plan for the Pacific bald eagle. U.S. Fish and Wildlife Service, Portland, Oregon, USA.

USFWS 1993. Summary of the grizzly bear recovery plan. U.S. Fish and Wildlife Reference Service, Bethesda, MD. U.S. Government Printing Office: 1993-777-490/85086. 21 pp.

USFWS. 1997. Recovery plan for the threatened marbled murrelet (Brachyramphus marmoratus) in Washington, Oregon, and California. U.S. Fish and Wildlife Service, Portland, Oregon. 203 pp

USFWS. 1998. Endangered Species Act Consultation Handbook. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.

USFWS 1999. Endangered and threatened wildlife and plants; determination of threatened status for bull trout in the coterminous United States. Federal Register / Vol. 64, No. 210 / Monday, November 1, 1999: 58910-58936.

USFWS 2003. Biological Opinion and letter of concurrence for effects to bald eagles, marbled murrelets, northern spotted owls, bull trout, and designated critical habitat for marbled murrelets and northern spotted owls from Olympic National Forest program of activities for August 5, 2003, to December 31, 2008. FWS Reference 1-3-03-F-0833. U.S. Fish and Wildlife Service, Lacey, Washington.

USFWS 2004. Draft recovery plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (Salvelinus confluentus). Volume I (of II). Puget Sound Management Unit. U.S. Fish and Wildlife Service, Portland, Oregon. 389 + xvii pp.

USFWS 2007. Biological Opinion and letter of concurrence USDA Forest Service, USDI Bureau of Land Management and the Coquille Indian Tribe for programmatic aquatic habitat restoration activities in Oregon and Washington that affect ESA-listed fish, wildlife, and plant species and their critical habitats. FWS Reference 13420-2007-F-0055. June 14, 2007. U.S. Fish and Wildlife Service, Portland, Oregon. 258 pp.

USFWS 2009. Endangered and threatened wildlife and plants; revised designation of critical habitat for the contiguous United States Distinct Population Segment of the Canada Lynx. Federal Register / Vol. 74, No. 36 / Wednesday, February 25, 2009. 8616-8702.

USFWS 2010. Endangered and threatened wildlife and plants; revised designation of critical habitat for bull trout in the coterminous United States; proposed rule. Federal Register / Vol. 75, No. 9 / Thursday, January 14, 2010: 2270-2431.

USFWS 2010. Endangered and threatened wildlife and plants; 12-month finding on a petition to remove the marbled murrelet (Brachyramphus marmoratus) from the list of endangered and threatened wildlife. Federal Register / Vol. 75, No. 13 / Thursday, January 21, 2010: 3424-3434.

Washington Department of Fish and Wildlife (WDFW) and USFS 2005. Memorandum of understanding between Washington Department of Fish and Wildlife and USDA Forest Service, Pacific Northwest Region regarding hydraulic projects conducted by USDA Forest Service, Pacific Northwest Region. January 2005.

WDFW. 2007. Washington Department of Fish and Wildlife. Heritage Database – Wildlife Occurrences in Washington State. Olympia, Washington. Note: these data are subject to WDFW and WDNR sensitive data policies.

WDFW 2009. Wolf conservation and management plan for Washington Draft Environmental Impact Statement (DEIS). October 5, 2009. Washington Department of Fish and Wildlife Wildlife Management Program. Olympia, WA. 343 pp. Available online at http://wdfw.wa.gov/hab/sepa/sepa.htm.

Vande Kamp, Mark E., Jane E. Swanson, and Darryll R. Johnson. 1999. A Survey of Wilderness Trail Users in Mount Rainier National Park. Technical Report NPS/CCSOUW/NRTR-2000-01, NPS D-339. Cascadia Field Station, USGS/BRD/FRESC, College of Forest Resources, University of Washington, Seattle, Washington.

WAC 220-110: Washington Administrative Code. Washington hydraulic code rules to provide protection for all fish life. http://apps.leg.wa.gov/wac/default.aspx?cite=220-110

Watson, J.W. and D. John Pierce. 1998. Migration, Diets, and Home Ranges of Breeding Bald Eagles Along Hood Canal and at Indian Island, Washington. Final Report. Washington Department of Fish and Wildlife, Olympia, Washington, USA.

Washington Department of Ecology (WDOE). 2006. Water quality standards for surface waters of the state of Washington, chapter 173-201A WAC. Available online: http://www.ecy.wa.gov/pubs/0610091.pdf. Accessed 2 February 2010.

Wikipedia.org (http://en.wikipedia.org/wiki/Wilkeson,_Washington) 2007. Accessed 7-12-07.

Wikipedia.org (http://en.wikipedia.org/wiki/Carbonado,_Washington) Accessed 7-12-07.

Winters, D. S., B. Bohn, D. J. Cooper, G. Eaglin, J. D. Hamerlinck, C. Hirsch, N. L. Poff, C. M. Quimby, F. J. Rahel, P. Rau, D. Scaife, D.M. Staley and M. Welker. 2004. Conceptual framework and protocols for conducting multiple scale aquatic, riparian, and wetland ecological assessments for the USDA Forest Service – Rocky Mountain Region. Available online: http://www.fs.fed.us/r2/projects/scp/arw/. Accessed 15 March 2006.

Young, S.P. 1944. The Wolves of North America. Part 1. Washington, D.C. American Wildlife Institute.

Appendix 1: Summary of Measures to Avoid, Minimize or Mitigate Environmental Impacts

Measures to Avoid, Minimize or Mitigate Impacts

Air Quality

- Chipping or mulching vegetation on site rather than disposing of it offsite or burning it.
- Spraying water over exposed soil, particularly during dry conditions to minimize fugitive dust.
- Covering trucks transporting cut or fill material along highways to reduce or eliminate particle release during transport.
- Encouraging contractor and NPS employees to travel in groups to and from the project site to the extent possible (rather than in multiple separate vehicles).
- Revegetating bare and staging areas as soon as possible (upon final grading or when staging area is no longer in use).
- Minimizing the extent of vegetation removal.
- Encouraging the use of local labor sources and large-volume material delivery where possible to minimize trip generation during construction activity.
- Using low VOC paints, solvents and other chemicals in building construction.
- Restricting idling of construction vehicles and equipment to no longer than 15 minutes when not in use.
- Using a biodiesel fuel mix rather than traditional diesel fuel.
- Minimizing use of administrative ATVs.

Geology / Soils

- Locating staging areas where they will minimize new disturbance of area soils and vegetation.
- Minimizing ground disturbance to the extent practicable.
- Using mats or plywood to minimize soil compaction impacts in sensitive fine-grained or other soils.
- Salvaging topsoil from excavated areas for use in re-covering source area or other project areas.
- Not leaving excavated soil at the base of trees, and providing tree protection if needed for specimen trees.
- Restoring project areas through scarifying, and/or native seeding or planting.
- Importing weed-free clean fill.
- Clearing and grubbing only those areas where construction would occur.
- Using vegetable oil in place of hydraulic fluid in heavy equipment.
- Minimizing construction along water courses during periods of heavy precipitation.
- Minimizing driving over or compacting root-zones.

Water Resources (see also Endangered Species section)

- Army Corps of Engineers (ACOE) recommended Best Management Practices would be followed to minimize potential impacts to water quality.
- Environmental Protection Agency (EPA) *Permanent Culvert Installation, Replacement and Removal Provisions* would be followed to reduce sedimentation impacts from construction activities.
- Locating staging and stockpiling areas located away from the Carbon River.
- Delineating staging areas to prevent incremental expansion of the staging area.

- Covering stockpiled fine-grained soil and rock near surface water and if overwintered with a breathable, water repellent fabric, such as silt fence, anchored around the perimeter.
- Using temporary sediment control devices such as filter fabric fences, sediment traps, or check dams as needed during culvert removal / replacement.
- Identifying the area to be cleared to define extent and clearing only those areas necessary for construction.
- Minimizing the amount of disturbed earth area and the duration of soil exposure to rainfall.
- Using bioengineering to stabilize riverbanks where erosion protection measures are employed.
- Minimizing soil disturbance and re-seeding or revegetating disturbed areas as soon as practical.
- Retaining silt fencing in disturbed areas until stabilization (by reseeding or revegetation).
- Using native duff and topsoil to cover exposed soil as soon as practical.
- Installing protective construction fencing around, adjacent to, or near wetland and/or riparian areas that are to be protected or other erosion control measures to protect water resources in the project area.
- Avoiding machinery use below the wetted perimeter of water bodies (work would be done from the bank) where possible. If not possible, dewatering of the channel would occur according to measures specified in the threatened and endangered species section.
- Using vegetable based hydraulic fluid in heavy equipment.
- Limiting the duration of the in-stream work as much as possible.
- Timing in-stream work to occur at lower flow periods (i.e., work would not occur during heavy river flows).
- Using a Storm Water Pollution Prevention Plan (SWPPP) for construction activities to control surface run-off, reduce erosion, and prevent sedimentation from entering water bodies during construction.
- Developing and implementing a comprehensive spill prevention/response plan that complies with federal and state regulations and addresses all aspects of spill prevention, notification, emergency spill response strategies for spills occurring on land and water, reporting requirements, monitoring requirements, personnel responsibilities, response equipment type and location, and drills and training requirements. Using an oil and hazardous materials spill prevention, control, and countermeasure plan to address hazardous materials storage, spill prevention, and responses.
- Conducting daily inspections of equipment used in the proposed project for fuel, oil, hydraulic fluid and other potential leaks.
- Additional consideration would be given to closing Ipsut Creek Campground during fall rain-on-snow periods.

Vegetation

- Minimizing construction limits and areas to be cleared, where possible.
- Clearly identifying the construction limits, to prevent expansion of construction operations into undisturbed areas.
- Retaining specimen trees (as identified by park staff) where possible adjacent to erosion protection sites (Alternatives 1-5) and along the wilderness reroute trail (Alternative 5).
- Salvaging plant material, prior to construction, from areas to be disturbed.
- Restoring staging and other temporarily impacted areas following construction.
- Minimize vegetation disturbance during project operations by staging on road and/or shoulder or other disturbed areas.
- Minimize the threat of exotic plant infestations by not gathering native materials from existing infested areas.
- Only importing freshly exposed subsurface materials.
- Covering trucks when transporting materials outside the project area to reduce or eliminate particle release during transport.

- Washing all vehicles having contact with soil or materials that may contain noxious weed seed prior to working in weed free areas or transporting weed free materials.
- Separating contaminated soil from weed free soil and using it for subsurface fill.
- Conducting annual monitoring for potential weed infestation.
- Identifying and controlling exotic plant species infestations prior to construction.

Wildlife

- Scheduling construction activities with seasonal consideration of wildlife lifecycles to minimize impacts during sensitive periods (e.g., bird nesting and breeding seasons). The timing of the construction of rock barbs and other channel or bank stabilization measures, as well as extraction of large woody debris, could be limited to avoid spawning and other sensitive periods for fish and aquatic wildlife.
- Minimizing the degree of habitat removal (vegetation clearing) by delineating construction limits.
- The park biologist would be notified of the presence of fish or amphibians in the vicinity of project work.
- Instream excavation and use of heavy equipment would be limited to the minimum amount needed.
- Limiting the effects of noise on wildlife habitat through controls on construction equipment and timing of construction activities, such as limiting construction to daylight hours.
- Using spill prevention measures to prevent inadvertent spills of fuel, oil, hydraulic fluid, antifreeze, and other toxic chemicals that could affect wildlife.
- Maintaining proper food storage, disposing of all food waste and food-related waste promptly, in a bear-resistant receptacle and removing all garbage off-site at the end of each working day.
- Placing the rock barbs or logjams from the bank and/or outside the wetted channel.

Threatened and Endangered Species (and Water Quality)

1. **Minimize Disturbance to Nesting Marbled Murrelets:** (Source: USFWS 2007)

- Felling of large trees in suitable nesting habitat for marbled murrelets would not occur during the marbled murrelet nesting season (April 1 – September 15). Tree felling would not be permitted from April 1 through September 15 to protect nesting murrelets, eggs, and young in stands that are identified as suitable murrelet nesting habitat. Large trees are defined as conifers with a dbh of 16 inches or greater.
- All project activities located would only occur 2 hours afterer official sunrise, and would cease 2 hours prior to official sunset during the murrelet nesting season (April 1 to September 15). This restriction avoids potential disruption to murrelets during their daily peak activity periods for feeding and incubation exchanges.

- Blasting activities would not occur between April 1 and August 5. This restriction avoids potential disruption of murrelets during their early nesting season which includes incubation and brooding of hatchlings.
- All food items would be stored inside vehicles, trailers, or trash dumpsters except during actual use to prevent unnatural attractants to crows, jays, and other wildlife which have been identified as predators of murrelet eggs and young.

Exceptions:
Project activities that require in water work (e.g., culvert removal) may occur during the murrelet nesting season to comply with seasonal restrictions for in water work (July 16 to August 15).

[1]A typical conservation measure is to avoid all construction activities located within the defined disruption distances during the murrelet early nesting season (1 April to 5 August). This measure has not been included here because the park has determined that compliance with this measure is not feasible.

m. **Minimize Disturbance to Nesting Spotted Owls:** (Source: USFWS 2007)

- Felling of large trees in suitable nesting habitat for spotted owls would not occur during the spotted owl nesting season (March 15 – September 30). Tree felling would not be permitted during the nesting season to protect nesting spotted owl, eggs, and young in stands that are identified as suitable nesting habitat. Large trees are defined as conifers with a dbh of 16 inches or greater.
- Blasting activities would not occur between March 15 and July 30. This restriction avoids potential disruption of spotted owls during their early nesting season which includes incubation and brooding of hatchlings.

Exceptions:
Seasonal restrictions may be waived if current spotted owl surveys indicate no spotted owls are nesting within the defined disruption distances from the project construction area.

Project activities that require inwater work may occur during the spotted owl nesting season to comply with seasonal restrictions to protect fish for inwater work (July 16 to August 15).

n. **Minimize Impacts to Bull Trout:** (Sources: USFWS 2007, WDFW and USFS 2005)

Follow the appropriate Washington Department of Fish and Wildlife (WDFW) guidelines for the timing of in-water work. These guidelines are intended to avoid in-water work during periods when salmonid eggs and fry incubate within stream gravels.

- In-water work is restricted to the period of **July 16 to August 15** for all Carbon River tributaries streams such as Ranger Creek (WAC-110-206).
- The extended in-water work season for the mainstem Carbon River is **July 9 to August 22.** This applies to work associated with placement of engineered logjams or other bank protections structures along the Carbon River.
- Fish within construction sites that would be dewatered or isolated from the main water body shall be captured and safely moved from the job site. Fish capture and transportation equipment shall be available on the job site during all in-water activities.
- Any pump used for diverting water from a fish bearing water body shall be equipped with a fish guard to prevent passage of fish into the pump. The pump intake shall be screened with 3/32 inch or smaller mesh. Screen maintenance shall be adequate to prevent injury or entrapment to juvenile fish and shall remain in place whenever water is withdrawn from the water body through the pump intake.

Exceptions:
In-channel work below the ordinary high-water line may occur outside the specified in-water work period in areas that are dry during the proposed work period. Many side-channels and other fish-bearing streams within the Carbon River floodplain are seasonally dry from mid-summer into fall.

o. **Fish Passage Criteria for Instream Structures:** (Sources: WDFW 2004 – *Stream Habitat Restoration Guidelines* and WAC-110-070)

Hydraulic drop is the difference in elevation between the water surface upstream and downstream of the structure. To maintain fish passage for juvenile salmonids, the following hydraulic drop criteria apply:

Drop structures or grade-control structures: The maximum hydraulic drop for instream structures is 0.7 feet (8 inches). This drop height can be achieved by placing notches in structures, or by setting the structure at an angle such that the desired drop height is achieved. The maximum hydraulic drop criteria must be satisfied at all flows between the low and high flow design criteria.

p. **Fish Removal and Dewatering Protocol:** (Source: USFWS 2007)

The following procedures would be used to isolate and dewater sites which require in-water work with heavy equipment. All fish capture, removal, and handling activities shall be conducted by an experienced fisheries biologist or technician.

6) Isolate the Construction Site and Remove Fish

Install block nets at up and downstream locations and leave in a secured position to exclude fish from entering the project area. Leave nets secured to the stream channel bed and banks until fish capture and transport activities are complete. If block nets or traps remain in place more than one day, monitor the nets and or traps at least on a daily basis to ensure they are secured to the banks and free of organic accumulation and to minimize fish predation in the trap.

7) Fish Capture Alternatives

- Collect fish by hand or dip nets, as the area is slowly dewatered.
- Seining – Use seine with mesh of such a size to ensure entrapment of the residing fish.
- Minnow traps – Traps would be left in place overnight and used in conjunction with seining.
- Electrofishing – Prior to dewatering, use electrofishing only where other means of fish capture may not be feasible or effective.

The protocol for electrofishing includes the following:

- If fish are observed spawning during the in-water work period, electrofishing shall not be conducted in the vicinity of spawning adult fish or active redds.
- Only Direct Current (DC) or Pulsed Direct Current (PDC) shall be used.
- Conductivity <100: use voltage ranges from 900 to 1100. Conductivity from 100 to 300: use voltage ranges from 500 to 800. Conductivity greater than 300: use voltage to 400.
- Begin electrofishing with minimum pulse width and recommended voltage and then gradually increase to the point where fish are immobilized and captured. Turn off current once fish are immobilized.
- Do not allow fish to come into contact with anode. Do not electrofish an area for an extended period of time. Remove fish immediately from water and handle as described below. Dark bands on the fish indicate injury, suggesting a reduction in voltage and pulse width and longer recovery time.

8) Fish Handling and Release

Fish must be handled with extreme care and kept in water the maximum extent possible during transfer procedures. A healthy environment for the stressed fish shall be provided—large buckets (five-gallon minimum to prevent overcrowding) and minimal handling of fish.

Place large fish in buckets separate from smaller prey-sized fish. Monitor water temperature in buckets and well-being of captured fish. As rapidly as possible (especially for temperature-sensitive bull trout), but after fish have recovered, release fish upstream of the isolated reach in a pool or area that provides cover and flow refuge. Document all fish injuries or mortalities and include in annual report.

9) Dewater the Construction Site

Upstream of the isolated construction area, divert flow around the construction site with a coffer dam (built with non-erosive materials) and an associated pump or a by-pass culvert. Diversions constructed with material mined from the streambed or floodplain is not permitted. Small amounts of instream material can be moved to help seal and secure diversion structures.

Pumps must have fish screens with 3/32 inch or smaller mesh. Dissipate flow energy at the bypass outflow to prevent damage to riparian vegetation or stream channel. If diversion allows for downstream fish passage (i.e., is not screened), place diversion outlet in a location to promote safe reentry of fish into the stream channel, preferably into pool habitat with cover.

When necessary, pump seepage water from the de-watered work area to a temporary storage and treatment site or into upland areas and allow water to filter through vegetation prior to reentering the stream channel.

10) Rewater the Construction Site

Upon project completion, slowly re-water the construction site to prevent loss of surface water downstream as the construction site streambed absorbs water and to prevent a sudden increase in stream turbidity. Monitor downstream during re-watering to prevent stranding of aquatic organisms below the construction site.

Pumping equipment must be staged away from the rivers; except for the pump hose, which may extend down to the edge of the rivers. Pump intakes must be screened with 3/32 inch or smaller mesh on the end of pump hose to filter-out aquatic organisms. This screen should be cleaned of debris periodically.

Place a spill containment enclosure around the pump and or generator to contain gas, oil or other fluids.

q. **Minimize Heavy Equipment Impacts to Aquatic and Riparian Habitats:** (Sources: USFWS 2007, WDFW and USFS 2005)

- Establish staging areas (used for construction equipment storage, vehicle storage, fueling, servicing, hazardous material storage, etc.) at least 150 feet away from streams in a location and manner that would preclude erosion into or contamination of streams or wetlands.
- All equipment used for instream work shall be cleaned and leaks repaired prior to entering the project area. Remove external oil and grease, along with dirt and mud prior to construction. Thereafter inspect equipment daily for leaks or accumulations of grease, and fix any identified problems before entering streams or areas that drain directly to streams or wetlands.
- Heavy equipment used for in-water work would use biodegradable hydraulic fluids.
- If the project includes excavation of the streambed or banks, those work areas shall be isolated from flowing waters to protect water quality and minimize turbidity.
- All equipment shall be cleaned of all dirt and weeds before entering the project area to prevent the spread of noxious weeds.
- Equipment used for instream or riparian work shall be fueled and serviced in an established staging area located at least 150 feet away from streams. When not in use, vehicles shall be stored in the staging area.
- Minimize the number and length of stream crossings and access routes through riparian areas. Stream crossings and access routes should be at right angles.
- Heavy equipment would follow planned routes of access, would travel across dry, un-wetted substrates to the extent possible, and would only cross wetted channels at designated locations.
- Existing roadways or travel paths would be used whenever reasonable. Minimize the number of new access paths to minimize impacts to riparian vegetation and functions.
- Project operations must cease under high flow conditions that inundate the project area, except for efforts to avoid or minimize resource damage.
- Initiate rehabilitation of all disturbed areas in a manner that results in similar or better than pre-work conditions through spreading of stockpiled materials, seeding, and/or planting with locally native seed mixes or plants. Planting shall be completed no later than fall planting season of the year following construction.

r. **Minimize Water-Quality Contamination from Concrete and Treated Wood:** (Sources: WDFW and USFS 2005)

- Fresh concrete, concrete by products, or other chemical contaminants shall not be allowed to enter water bodies. Structures containing concrete shall be sufficiently cured to prevent leaching prior to contact with the water body.
- Treated wood used for bridges or other structures shall meet or exceed the standards established in the most current edition of "*Best Management Practices For the Use of Treated Wood in Aquatic Environments*" developed by the Western Wood Preservers Institute.

s. Project Criteria for Culvert or Trail Bridge Placements: (Sources: USFWS 2007, WDFW and USFS 2005, WAC-220-110-070)

- Structure types may include closed-bottomed culverts, open-bottomed arch or box culverts, or bridges.
- The structure width shall never be less than the bankfull channel width. The stream width inside the culvert or between bridge footings shall be equal to or greater than the bankfull width.
- Culverts in fish-bearing streams shall be designed, installed, and maintained to provide passage for all fish species and all life stages that are likely to be encountered at the site.
- Stream crossing structures (culverts or bridges) must accommodate a 100-year flood flow while maintaining sediment continuity (similar particle size distribution) within the culvert as compared to the upstream and downstream reaches.
- Culvert removal or placement sites shall be dewatered or isolated from flowing waters to protect water quality and minimize turbidity.
- Culvert removal or replacement projects in fish-bearing streams would only occur during the approved inwater work season (July 16 – August 15).
- Structures containing concrete must be cured or dried before they come into contact with stream flow.
- Bridge abutments must be placed outside the bankfull channel width.
- Embedment – If a closed culvert is used, the bottom of the culvert shall be buried into the streambed not less than 20% and not more than 50% of the culvert height. For open-bottomed arches and bridges, the footings or foundation shall be designed to be stable at the largest anticipated scour depth. Substrate and habitat patterns within the culvert should mimic stream patterns that naturally occur above and below the culvert. Coarser material may be incorporated to create velocity breaks during high flows, thereby improving fish passage, and to provide substrate stability.
- Grade Control Structures – Grade control structures are permitted to prevent head-cutting above or below the culvert or bridge. Grade control typically consists of boulder structures that are keyed into the banks, span the channel, and are buried in the substrate. Grade-control structures must accommodate fish passage for all species and life stages of fish present.
- When removing woody debris from the road-crossing inlet, place the debris downstream of the road crossing.

t. **Project Criteria for Permanent Culvert or Bridge Removal (WAC-220-110-070):** (Sources: USFWS 2007, WDFW and USFS 2005, WAC-220-110-070)

- All fill material and man-made structures shall be removed from stream channels. The natural stream channel profile shall be restored. Bottom width opening of the fill removal at stream channel crossings shall be equal to, or greater than, the natural bankfull channel width.
- Streambanks shall be shaped to blend in to the existing natural banks upstream and downstream from the crossing removal.
- Streambed substrates shall mimic the natural streambed characteristics upstream and downstream of the crossing removal. Large woody material and/or large rocks may need to be placed within the crossing removal site to accomplish this objective.

- The toe of the excavation shall be stabilized with large wood, appropriately sized rock, and/or vegetation as necessary to prevent excessive erosion of the new streambanks.
- When removing culverts on fish-bearing streams, construction sites shall be dewatered or isolated from flowing waters to prevent generation of sediment and minimize turbidity.
- Dewatering is not required for culvert or ford removals on non-fish bearing streams unless substantial excavation of stream channel or culvert bedding materials would be required after the existing culvert or structure is removed.

u. Project Criteria for Inchannel Gravel Removal

Limited excavation of river gravels and cobbles for project fill is permitted. Gravel excavation is limited to dry gravel bars within the main Carbon River channel only. The following technical provisions apply to gravel removal projects (Source: WAC-110-140):

- Gravel removal from a watercourse shall be limited to removal from exposed bars and shall not result in a lowering, over time, of the average channel cross-section profile through the project area or downstream.
- Gravel removal from the Carbon River would only occur during the approved in water work season (July 9 – August 22).
- An "excavation line" shall be established. "Excavation line" means a line on the dry bed, at or parallel to the water's edge. The excavation line should be established at a distance that would avoid excavation disturbance within the wetted channel. The excavation line may change with water level fluctuations.
- An "excavation zone" shall be defined as the area between the "excavation line" and the bank or the center of the bar. The "excavation zone" shall be identified by boundary markers placed by the applicant and approved by the department prior to the commencement of gravel removal.
- Excavation shall begin at the excavation line and proceed toward the bank or the center of the bar, perpendicular to the alignment of the watercourse.
- Bed material shall not be removed from the water side of the excavation line.
- Equipment shall not enter or operate within the wetted perimeter of the watercourse.
- Gravel may be removed within the excavation zone from a point beginning at the excavation line and progressing upward toward the bank or the center of the bar on a minimum two percent gradient. It may be necessary to survey the excavation zone upon completion of the gravel removal operation to ensure the two percent gradient is maintained and that no depressions exist.
- The depth of gravel excavation from exposed bars is limited to the depth of the adjacent water level.
- No excavation of gravels from within wetted channels is allowed.
- At the end of each work day the excavation zone shall not contain pits, or potholes, or depressions that may trap fish as a result of fluctuation in water levels.
- The upstream end of the gravel bar shall be left undisturbed to maintain watercourse stability waterward of the ordinary high water line.
- Large woody material shall be retained waterward of the ordinary high water line and repositioned within the watercourse. Other debris shall be disposed of so as not to reenter the watercourse.
- Equipment shall be inspected, cleaned, and maintained to prevent loss of petroleum products waterward of the ordinary high water line.

v. Project Criteria for Moving Inchannel Large Wood for use in Engineered Logjams

- Only logs that are isolated on dry gravel bars in the Carbon River braided channel zone may be moved for use in logjams.

- No logs that are interacting with the wetted channel width may be moved, except within the construction footprint of a project site.

Equipment shall not enter or operate within the wetted perimeter of the watercourse, except at designated equipment crossing sites, and would only occur during the approved in water work season for the Carbon River (July 9 – August 22).

Ethnographic Resources

- Additional consultations with affected Native American Indian tribes as plans for parking outside the Carbon River Entrance develop.
- If additional concerns or areas of use were later identified, consultation with the affected Native American tribe(s) and, as appropriate, the Washington State Office of Archeology and Historic Preservation, would occur to determine how to proceed.
- Fish and fish habitat mitigation measures are noted above in the Special Status Species section.

Archaeological Resources

- Before modifications were made to Ipsut Creek Campground or the Old Mine Trail, a determination of eligibility for the National Register of Historic Places would be undertaken (Alternatives 1-5).
- If the can dump was later relocated, a determination of eligibility for the National Register of Historic Places would be made and measures would be designed to limit adverse effects to it (Alternatives 1-5).
- Because of the potential for adverse effects to undetermined or unknown archeological resources to occur, archeological survey, monitoring (and/or testing as determined necessary) would be conducted associated with the following proposed actions (notify archeologist in advance of proposed work):
  - Reconstruction of the entrance arch (Alternatives 2-5)
  - Removal of ranger station (Alternatives 1-5) and removal of historic CCC garage and reconstruction in the boundary expansion area (Alternatives 2-5) and replacement with parking and picnicking at the entrance and maintenance areas (Alternatives 1-5),
  - Construction of a visitor contact station at the entrance (Alternatives 2-5).
  - Reconstruction of the Ipsut Creek Patrol Cabin at the entrance (Alternative 1) or in the Ipsut Creek area (Alternatives 2-4) or later at the boundary expansion area (Alternative 5),
  - Construction of the turnaround (Alternatives 2-5),
  - Trail or road work in the Falls Creek area (Alternatives 1-5),
  - Removal (Alternatives 3-4) or potential removal (Alternatives 1-2, 5) of the Ipsut Creek Bridge,
  - Potential changes (ground disturbance) to Ipsut Creek Campground (Alternative 1), reduction and restoration of portions of Ipsut Creek Campground (Alternatives 2-5),
  - Construction of the proposed reroute trail (Alternative 5), and
  - Construction of the proposed backcountry camp (Alternative 5).
- Additional interpretation would be designed for the Old Mine Trail (Alternatives 1-5) and the trail would be maintained because of potential increased use (Alternatives 2, 4, and 5).
- The Old Mine adit would be gated as part of another project to place safety / bat gates at abandoned mine sites (Alternatives 1-5).
- Should unknown archaeological resources be uncovered during construction, work would be halted in the discovery area, the park archeologist contacted, the site secured, and the park would consult according to 36 CFR part 800.11 and, as appropriate, provisions of the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990. In compliance with NAGPRA, the National Park Service would also notify and consult concerned tribal representatives for the proper treatment of human remains, funerary, and sacred objects should these be discovered during the course of the project.

- If necessary or possible, relocation of work to a non-sensitive area would occur to enable site testing and documentation. Long-term actions could include reinitiating the project in the same area (upon effective data collection) or relocating the action (if possible). There would be an emphasis on taking actions that would avoid further disturbance to the site(s).

Historic Structures and Districts

- Ongoing consultation with the State Historic Preservation Office regarding preparation of a Memorandum of Agreement.
- Detailed deconstruction notes and photographs would be used to reconstruct Ipsut Creek Patrol Cabin.
- CCC garage deconstruction would entail the preparation of detailed deconstruction notes and photographs to enable its later reconstruction.
- There would be periodic woody plant removal (trees and large shrubs) to preserve some of the character of the Carbon River Road corridor, however low growing shrubs and forbs would remain.
- There would be preservation maintenance of the first 1.2 miles of the road, including periodic gravel replacement and culvert cleaning.
- There would be preservation maintenance of the relocated Ipsut Creek Patrol Cabin and the CCC Garage.
- There would be interpretation of the history of the Carbon River corridor to park visitors, to include the prehistoric use of the valley, post-contact mining use, early park development guided by NPS Director S. Mather, and Civilian Conservation Corps period constructed works.

Visitor Experience

- Avoiding evening, weekend and holiday work by requiring approval in advance. Longer construction delays or total road closures would also be approved in advance.
- Using a public information program to warn of construction related road closures, delays, and road hazards.
- Managing vehicle traffic and contractor hauling of materials, supplies, and equipment within the construction zone to minimize disruptions to visitors.
- Developing a safety plan prior to the initiation of construction to ensure the safety of visitors, workers, and park staff.

Wilderness

- No physical modifications initially proposed in Alternatives 1-4 would occur within wilderness (generally below Chenuis more than 100 feet from the centerline south of the road, above Chenuis more than 100 feet from the centerline of the road on either side).
- Potential physical impacts to wilderness from moving the trail away from the road corridor in Alternatives 2-4 would result in the need for additional environmental analysis.
- A minimum requirement / minimum tool analysis would be completed for selection of Alternative 5.

Wild and Scenic Rivers

- These measures are listed in the sections above.

Park Operations

- Additional analysis of importing materials vs. gathering native materials would be made to determine which has fewer impacts and costs, particularly associated with Alternative 2.

- Analysis of potential displacement of park visitors to other areas would be made and, if appropriate, actions taken to improve communication about visitor use opportunities in this and other areas to limit its effects.
- Ongoing monitoring would occur in the Mowich Lake area to assess potential effects of increased visitor use in summer.

Socioeconomics

- Where possible, projects would be combined or phased to allow for cost-savings measures related to staging remaining in place, rather than setting up and taking down staging areas for sequential implementation activities.
- New buildings would be constructed to silver or greater LEED standards to minimize long-term operations costs.
- New buildings and facilities and other improvements would use native, and recycled or reused materials to minimize potential long-term adverse effects from consumption.
- Where removal of facilities occurred, these would be deconstructed to the extent possible, and materials used in other areas of the park or recycled.

Appendix 2: Memorandum of Agreement: National Park Service and Advisory Council on Historic Preservation for Ipsut Creek Patrol Cabin (detached)

This detachment is available on the park's website located at http://www.nps.gov/mora and on the Planning, Environment and Public Comment (PEPC) website located at http://parkplanning.nps.gov/mora.

Appendix 3: Geomax: Site Assessment and Design of Rock Barbs, Check Dams and Other Flood Damage Reduction Measures for Carbon River Road (January 2008) (detached)

This detachment is available on the park's website located at http://www.nps.gov/mora and on the Planning, Environment and Public Comment (PEPC) website located at http://parkplanning.nps.gov/mora.

Appendix 4: ENTRIX: Final Draft Technical Memorandum: Topographic Survey, Hydraulic Modeling and Design Assessment of Proposed Carbon River Road Flood Damage Reduction Measures (October 2008) (detached)

This detachment is available on the park's website located at http://www.nps.gov/mora and on the Planning, Environment and Public Comment (PEPC) website located at http://parkplanning.nps.gov/mora.

Appendix 5: Draft Cultural Landscape Inventory (CLI) (detached)

This detachment is available on the park's website located at http://www.nps.gov/mora and on the Planning, Environment and Public Comment (PEPC) website located at http://parkplanning.nps.gov/mora.

Appendix 6: Cumulative Impacts Project List

Carbon River Road Reconstruction Environmental Assessment (FONSI August 1998)
Under the proposed action in this Environmental Assessment, the National Park Service (NPS) repaired flood-related damage to the Carbon River Road in fall 1998. Restoration of the road was intended to provide vehicular access to Ipsut Creek Campground and to trailhead parking for backcountry hiking trails. Prior to the February 1996 flood, visitors had used the Carbon River Road to drive 4.9 miles from the park's entrance near the Carbon River Ranger Station to Ipsut Creek Campground. Here they could camp overnight in the campground or use the trailhead parking as a starting point to day hike to Mystic Lake and the Carbon Glacier or to take more extended hikes the along the Northern Loop and Wonderland trails. From February 1996 to November 1998, the Carbon River Road was closed at the Carbon River Ranger Station. Vehicles had to park near the ranger station and visitors hiked or biked along the road to reach the campground and the hiking trails beyond. Upon completion of the road repair in November 1998, vehicle traffic began again on the Carbon River Road. Flooding in December 1998 and January 1999 again closed the road. Subsequent minimal action repairs reopened the road in March 1999 to high clearance vehicles.

Carbon River Area (Ipsut Creek Campground and Carbon River Entrance) Rehabilitation Environmental Assessment (FONSI June 1999)
Under this Environmental Assessment, the Ipsut Creek Campground water system was replaced with three small hand pump wells equipped with disinfection systems. These were designed to blend with the National Historic Landmark District. The existing water system was removed and the iron pipe distribution system abandoned in place. Restrooms at the Campground were proposed for replacement and Carbon River Entrance restrooms were replaced. Minor improvements to the Campground, including repair of the amphitheater were also proposed.

Rehabilitate the Former Thompson Home Site to Replace the Carbon River Ranger Station to Serve as the Primary Visitor Contact Area and to Provide Staff Offices, Employee Housing and Maintenance Facilities (2010)
Under this project, the park is beginning to implement actions on one boundary expansion parcel.

Carbon River Wonderland Trail Environmental Assessment (FONSI 2008)
Under this EA a reroute to the Carbon River portion of the Wonderland Trail, washed out by flooding in November 2006, was approved.

Mount Rainier National Park Hazard Tree Management Plan (FONSI 2010)
Under this plan hazard trees in Ipsut Creek Campground and throughout the park would be removed.

Proposed Boundary Expansion Lands Facility Construction
Upon completion of acquisition of boundary expansion lands, the park would begin planning for reestablishment of frontcountry (drive-in) camping and administrative facilities outside the Carbon River Entrance, as called for by the GMP. Access to these facilities and the existing Carbon River area would be linked.

Appendix 7: Draft Floodplains Statement of Findings

Floodplains Statement of Findings

Carbon River Area Access Management Plan Environmental Assessment
Mount Rainier National Park, Washington

Recommended: ______________________________________ Date: ____________
Dave Uberuaga, Superintendent, Mount Rainier National Park

Concurred: ______________________________________ Date: ____________
Bill Jackson, Chief, Water Resources Division

Recommended: ______________________________________ Date: ____________
Regional Safety Officer

Approved: ______________________________________ Date: ____________
Christine S. Lehnertz, Regional Director, Pacific West Region

1. Introduction

This Statement of Findings (SOF) was prepared to support the Carbon River Area Access Management Environmental Assessment (EA). The Carbon River road corridor (FIGURE 1) was originally constructed in the early 1920s and has historically been an important cultural resource to the region, providing access to a unique wet temperate rainforest habitat on Mount Rainier National Park's northwest side. The road corridor has also been listed in the National Register of Historic Places as part of the Mount Rainier National Historic Landmark District (NHLD). Additionally, vast tracts of designated wilderness are accessible from the northwest side of the park along the roadway. The goal of the Carbon River Road Area Access Management plan is to preserve year-round public access to the northwest corner of the Carbon River Valley. Executive Order 11988 (Floodplain Management) requires the National Park Service (NPS) to evaluate likely impacts of actions in floodplains. NPS Directors Order #77-2 (Floodplain Management) provides policy and procedural guidance for complying with the Executive Order. This SOF documents compliance with these orders.

The Carbon River's headwaters are at the Carbon Glacier, the lowest elevation alpine glacier in the continental United States at approximately 3,500 feet (1,067 meters) above sea level (ASL). The Carbon River then flows north and west toward the park boundary at 1,750 feet (533 meters) ASL. The Carbon Glacier begins its downward movement from near the summit of Mount Rainier at Liberty Cap, approximately 14,112 feet (4,301 meters). Along the way, the glacier scrapes and scours the volcanically-formed andesite rock below and adjacent to the glacier. The glacier acts as a giant conveyor belt and carries this rock and debris downstream to the headwaters of the Carbon River, for the river to carry out as part of its bedload. The river flows as a braided stream through a wide glacially-formed valley, constantly changing its braids and bars as sediment and water discharge fluctuate. Over time and owing to the river's exceedingly large sediment source, the riverbed is rising, or aggrading, as more sediment is provided to the river than can be conveyed out of the system. The Carbon River has historically aggraded up to 0.559 feet/year (0.170 meters/year) in a period between 1915 and 1971; rising a total of 31.329 feet (9.549 meters) in 56 years (Beason, 2006). The Carbon River's 52.023 square mile (134.739 square kilometer) drainage basin at the park entrance receives 99.4 inches of rain and is covered with approximately 57.9% forest (TABLE 1).

In November 2006, almost 18 inches of rain fell park-wide and led to the longest closure to public use in the park's history (The Nisqually Entrance was closed for six months between November 6, 2006 and May 5, 2007.) The Carbon River Road currently remains closed to public vehicle traffic at the Carbon River Entrance. The Carbon River Valley was one of many areas in the park that received major infrastructure damage. Between November 5, 2006 at 2:00 P.M. and November 7, 2006 at 2:15 P.M., 8.76 inches (22.25 cm) of precipitation was recorded at the USGS stream gauge on the Carbon River near Fairfax, Washington (USGS Gauge #12094000). A flood stage of 13.5 feet (4.1 meters) was recorded at the gauge around noon on November 6th and the stream gauge reached its highest recorded height of 16.93 feet (5.16 meters) about six hours later. The flood caused major damage to the Carbon River Road, especially near Falls Creek (2,600 linear feet; 792 meters) and just before Ipsut Creek Campground (1,350 linear feet; 411 meters). In these locations, the road was washed away and replaced with a gully approximately 6-10 feet (2-3 meters) deep. In two other locations, one lane of the Carbon River Road was washed away and both lanes were removed in one location between the Green Lake Trailhead and just before the Ipsut Creek Campground. Low recurrence interval (approximately 15-year) floods since 2006 have caused more damage to both the roadway and park infrastructure, mainly the loss of a structure caused by nearly 60 feet of bank erosion at the Carbon River maintenance area.

ENTRIX (2008) has shown that there may be an increase in the frequency and intensity of flood events as recorded by United States Geological Survey (USGS) stream gauges near the park. For instance, on the Carbon River at Fairfax, Washington, the 100-year flood during the period of record from 1930-1977 now has a recurrence interval closer to 70 years when compared with the entire period of record (1930-2006) (FIGURE 2). Therefore, ENTRIX (2008) states that design conditions are changing and larger, more intense floods should be anticipated. On the Nisqually River, on the park's southwest side, there were no 10-year recurrence interval floods that occurred before 1970. Since then, there have been six, including two events with recurrence intervals greater than 50 years. The general trend for the Nisqually River and Carbon River is an increase in the size of annual peak flows since the period of record began in 1940 and 1930, respectively. According to research by the University of Washington Climate Impacts Group (UW CIG), it is anticipated that by 2080, average yearly temperatures in the Washington Cascades region will be approximately 5.9°F warmer with an overall increase in precipitation of about 1-5 percent. Most of the anticipated increases in temperature will be between October and January (Mote, personal communication, 2008). The trend is for dryer summers and wetter winters, which is important in that the largest and most destructive floods occur in the late fall during the period of record at both the Nisqually and Carbon Rivers.

The Carbon River Valley has had a long history of flooding since the establishment of the Carbon River Road. Large floods in 1990, 1996 and 2006 caused major damage to the roadway (the second, third and largest floods on record since 1930, respectively) (FIGURE 3). Following the 1996 flood, the park spent approximately $787,000 on a repair to the road. Two medium-size floods five weeks later destroyed the recently-repaired sections of roadway, washing out a 1,200 foot (366 meter) section of roadway to a depth of about 2-3 feet (0.6-1.0 meters). Even low recurrence interval floods have historically caused damage to the roadway and associated park infrastructure near the river (FIGURE 4)[1]. The General Management Plan (GMP) signed in 2002 stated that the park would no longer maintain the Carbon River Road after the next major washout. The GMP did not define what a "major washout" of the road would be but under the guidance of the GMP, the park is not considering repairing and reopening the entire road corridor in its previous condition as part of the current EA.

2. Alternatives

The Carbon River Area Access Management EA has five alternatives:

1) **Continue Current Management** (*no action alternative*) – Maintain a primitive trail within the historic road corridor. The Ipsut Campground would be retained with 24 individual and 2 group sites. Public vehicle access would end at the park entrance.
2) **Hike and Bike Trail** (*preferred alternative*) – Construct a formal hike/bike trial to Ipsut Creek trailhead. Retain the Ipsut Creek Campground with 15 individual and 3 group sites. Public vehicle access would end at the Old Mine trailhead, approximately Milepost 1.2 on the Carbon River Road.
3) **Public Vehicle Access** – Reconstruct a one-lane road open to public vehicle access to Milepost 3.6 (near Chenuis Picnic Area). Construct a formal hike/bike trail from there to the Ipsut Creek Trailhead. Retain Ipsut Creek Campground with 15 individual and 3 group sites.
4) **Shuttle Access** – Reconstruct a one-lane road to Milepost 4.4 for shuttles only. Construct a formal hike/bike trail from there to Ipsut Creek Trailhead. Retain the Ipsut Creek Campground with 20 individual and 3 group sites. Public vehicle access would end at the Old Mine trailhead, approximately Milepost 1.2.
5) **Wilderness Reroute Trail** – Construct a hiking-only trail in the wilderness area from the Entrance along the south valley wall to the Ipsut Creek Trailhead. Close Ipsut Creek Campground and create a new backcountry camp elsewhere. Public vehicle access would end at the Old Mine trailhead, approximately Milepost 1.2.

Proposed Actions in Preferred Alternative (Alternative 2)

Alternative 2, the preferred alternative, involves the following measures:

- Visitor parking would be available at the Carbon River entrance and former Carbon River maintenance area for approximately 68 cars.
- The historic Carbon River Road would be retained between the entrance and the former Old Mine trailhead, approximately 1.2 miles (1.9 kilometers). Public vehicles would be allowed to travel on this portion of the road.

---

[1] Chapter 1 section D of the Carbon River Area Access Management EA has a flood damage timeline that shows years and extents of flood damage.

- The Old Mine trailhead would become a vehicle turnaround area with some limited parking.
- Constructing or maintaining a 10-foot wide trail in the former road prism that can accommodate disabled visitor access, hiking, biking and occasional all-terrain vehicle (ATV) access in emergencies or for maintenance. When flood damage occurs to the roadway, a reroute trail would be constructed around the washout.
- *Carbon River Entrance*: Existing buildings except vault toilets at the Carbon River entrance would be removed and the footprints from these areas would be reconfigured and replaced with formal parking and picnicking. A one-room visitor contact station would be constructed on the south side of the road at the entrance. The Carbon River entrance arch would be reconstructed.
- *Carbon River Maintenance Area*: All buildings and structures (except the weather station and radio tower/shed) at the Carbon River maintenance area would be removed and replaced with formal parking and picnicking.
- *Ipsut Creek Campground*: Both vault toilets at the Ipsut Creek campground would be removed and replaced with backcountry toilets. All bumper-stops, buildings, some picnic tables and campsites and most signs would be removed. The former Chlorinator building and amphitheater storage shed would be removed. The campground would be reduced in size and configuration, to 15 individual and 3 group sites. Bear proof storage lockers would be added. The former Ipsut Creek Patrol Cabin would be reconstructed at the Ipsut Campground in one of the two former parking areas at the campground (exact location to be determined).
- *Erosion protection measures*:
    - Up to four flow-deflection engineered log jams (ELJ) would be constructed along the riverbank between the entrance and maintenance area.
    - As many as 24 rock-cored, log-cored, or gravel covered log road humps would be constructed to divert sheet flow on the roadway off and back to the river.
    - Toe-roughened gabion or toe-roughened log crib walls would be constructed at Milepost 3.463, 3.939 and 4.484, in areas that the river as significantly eroded the bank and road prism down to one or both lanes. These structures would be approximately 200-400 feet (61-122 meters) in length.
    - Additional log crib walls would be constructed at Milepost 4.658 and Milepost 4.802. These structures are much smaller (approximately 50 feet in length; 15 meters) and designed to protect rapidly bank-eroding areas that are not already exposed.
    - A "launchable" groin would be constructed at Milepost 4.621, at the end of the remaining road just before Ipsut Creek campground. This structure looks similar to a complex crib wall but is buried into the extant bank with the anticipation that floods will cause bank erosion up to the structure, exposing it rather than constructing it in the already-exposed riverbed.
    - In the Falls Creek area, spanning trees whose root wads are on the left (south) bank of the river would be cut, notched and pulled into the new Carbon River side channel/former road prism. The root wad would remain on the left bank. Large woody debris would be chocked on the left side of the channel behind the structure to encourage aggradation and bank protection of the left bank.
- *Grade control structures*: Where large culverts are going to be removed (e.g., at Ranger Creek and an unnamed tributary at the Chenuis Falls trailhead), a series of 3 log grade control structures will be constructed to prevent the release of stored sediment behind the culvert.
- Several culverts would be removed and replaced with trail bridges.

Potential Adverse Effects to Floodplain Values
Under the preferred alternative, the management actions that could negatively affect the Carbon River floodplain are as follows:

1. Erosion protection measures: Under Alternative 2, new erosion protection measures would be installed in a total of 11 sites along the river channel. Another, approximately 24 sites would include road humps built on and along the roadway to divert sheet flow across the roadway back into the river channel. The erosion protection sites would include a variety of technologies: ELJs, gabion baskets, crib walls, road humps and spanning trees. Impacts to the floodplain would be minor to major and include prevention of bank erosion within the river's channel migration zone. Many of the erosion protection measures are long term in design: ELJs are designed to be self-mitigating and self-sustaining, which means the structure is designed to stay as part of the landscape for the long-term. These would be the first major structures built in the Carbon River reach within the park boundary in the attempt to prevent short- and long-term infrastructure damage.

Bank erosion is a natural process in this and other major braided rivers at the park and is only a noted issue in this area due to the presence of the road and infrastructure near a river that is currently actively eroding its bank. In undeveloped areas, a natural balance is often developed between large trees that fall into the river channel and temporarily prevent the further bank erosion. Given that the entire valley bottom has little relief, over centuries, however, the channel migration zone *is* the valley bottom between the steep valley walls on either side of the active channel.

2. Farming of rock and cobble in the river for erosion protection structures: Many structures require not only large numbers of logs for their construction, but also ballast material in the form of gravels and cobbles from the riverbed. To avoid trucking in thousands of cubic yards of material, much of this material is proposed to be removed from the riverbed using heavy equipment. This is an impact that will not only disrupt the natural process of sediment deposition and transport, but could also negatively affect threatened and endangered species that live in the river and adjacent riparian areas. Some of the structures are so robust that they require large amounts of farmed material from the riverbed. It may not be feasible to collect an adequate amount of material for all of these structures while remaining outside of the bankfull high water mark.

3. Prevention of channel avulsion: This is primarily a concern in the Falls Creek area. The river in this reach is up to 16 feet higher than the road and is within 50-100 feet of the road itself. During the 2006 flood (as well as prior floods), a large portion of the Carbon River main stem flowed south through the roadway. Approximately 2,600 feet of roadway was eroded away. Looking at the area geomorphically, the former road prism is essentially a high-flow flood channel and there is a high likelihood that the area will catch a major main stem Carbon River avulsion here.

This issue is shown in sharp focus when using a method of map analysis called "Height Above Water Surface" (HAWS). HAWS is an analysis that uses survey data from 2008 (Light Detection and Ranging, LiDAR) and sets the cross section datum at the river elevation. The rest of the cross section is subtracted from the river elevation. This displays a map that shows the relative elevation along the cross section above and below the water surface. FIGURE 5 shows the HAWS map for the Falls Creek reach of the Carbon River. On the upstream end of the Falls Creek area, the Carbon River main stem is within 1-2 feet of overtopping the overbank area between the active channel boundary and the post-2006 channel. The floodplain mapping that is described later shows a large portion of the Carbon River flowing into this channel at as low as a 2-year recurrence interval flood (FIGURE 6). The active channel here is relatively perched above the surrounding overbank area to the south; the Carbon River Road happens to be in this overbank area. When the Carbon River flows into this side channel/former road prism, there is a chance the river could establish this as the new main stem; and thus, an avulsion could and likely will occur. Any protection measures that prevent this from happening encourage the river to build up higher than the land surrounding it.

4. Levee effects: The Carbon River is a naturally sediment-rich system, evidenced by its braided form and channel development. Many of the erosion protection measures attempt to prevent the river from flowing into overbank floodplain areas adjacent to the active channel. This may keep the river in the active channel in the short term but presents a problem when sediment is deposited into the active channel and not the overbank areas. Over time, unvegetated active channel may build up higher than the land around it at a faster rate than has been seen historically as the river is confined in its active channel. This increases the risk of a catastrophic channel avulsion into the floodplain.

Potential Beneficial Effects to Floodplain Values

Several actions in the plan would enhance floodplain values and mitigate some of the impacts of retaining the road in the floodplain. These include focusing NPS facilities and contact areas at the entrance and at boundary expansion lands rather than along and within the geomorphically active floodplain, and removal of infrastructure in the floodplain which would contribute to an overall more natural floodplain. Specific actions include:

1. Removal of the NPS maintenance facilities and most facilities at the park entrance: Alternative 2 calls for the removal of most facilities at both the former maintenance area and park entrance, with limited replacement of some facilities at the park entrance. As evidenced during a flood in 2008, the highly erodible bank and a small to moderate size flood led to more than 60 feet of bank erosion and collapse of a building in the maintenance area. The park entrance and maintenance area are both above the regulatory 100 and 500 year floodplain but not out of the potential channel migration zone of the Carbon River in its valley. Highly erodible banks and possible extreme floods can lead to rapid bank erosion that places structures built near the river at risk of undercutting and failure. Any removal of infrastructure from within the valley bottom within the potential channel migration zone of the Carbon River is a beneficial impact to the overall floodplain.

2. Removal of vault toilets and formal car camping facilities at Ipsut Creek Campground: Despite the fact that the Ipsut Creek campground is not within the regulatory 100 and 500 year floodplain, the campground itself is only situated less than 10 feet (3 meters) above the 100-year high water mark. This places the facility within the potential channel migration zone of the Carbon River within the valley floor. Additionally, due to a severe avulsion risk upstream of the campground, there is a possibility that at least some percentage of the main stem Carbon River could flow into a newly-formed channel along the west valley wall, which joins with Ipsut Creek. This, in essence, creates a possible “island” scenario for the Ipsut Creek campground, where, at high flow, the campground could potentially be surrounded on all sides by flood flows (see FIGURE 6).

The preferred alternative calls for the removal of facilities that support public car camping at Ipsut Campground. This would enhance floodplain values because it removes a potential source of pollutants from automobiles as well as making the continual formal maintenance of the Carbon River road not necessary within the park boundary. This would allow the river to reclaim portions of its floodplains that have been cut off over time and where human infrastructure has impinged on the floodplain. Removal of permanent structures, especially vault toilets that contain hazardous human waste, would allow the floodplain to return to a more rustic and natural setting and would allow the river to reclaim these areas as channel migration and avulsion occurs. The vault toilets would be replaced with backcountry toilets, similar to toilets in other remote areas of the park. These actions are overall a positive change for the floodplain environment.

3. Removal of 3.8 miles (6.1 kilometers) of roadway within the floodplain: Alternative 2 calls for the decommissioning of the roadway from Milepost 1.2 until the end of the roadway at the Ipsut Creek campground, approximately at Milepost 4.992; therefore decommissioning approximately 3.792 miles (6.103 kilometers) of former roadway within the river bottom. In its place would remain a 6- to 10-foot (2- to 3-meter) hike and bike path. Where the riverbank has eroded along the roadway and left a new riverbed in the former road area, a reroute trail would be constructed around the washout. The removal of the roadway would overall beneficial effects on floodplain values because its removal would decrease the risk of air and water pollution in the vicinity of the roadway from both park visitor and administrative traffic. Removal of the road would also allow the river to naturally move about its floodplain and channel migration zone without confining it in a set channel over time. Rerouting the hike and bike trail around future washouts is a slightly negative overall effect on the floodplain because it could mean removal of a few large trees in the riparian areas. The net effect of allowing hiking or biking on the remnant and newly-constructed portions of the trail, however, would improve the floodplain environment compared to the potential of allowing vehicle access to the Carbon River Road.

4. Removal of undersized culverts and stabilizing stored mobile sediment upstream of culverts: The preferred alternative calls for the removal of two large, undersized culverts at both Ranger Creek and an unnamed tributary in the vicinity of the Chenuis Falls trailhead. The unnamed tributary additionally has a hanging culvert of approximately 6 feet (2 meters) above the Carbon River main stem, which effectively cuts off fish passage for the tributary. The plan is to remove these two culverts and install a series of up to three grad control structures to stabilize sediment that has accumulated in the backwater area upstream of the culvert since its installation. The grade control structures would allow small drops over logs and other structures, which would support the highly-mobile stored sediment load and prevent head-cutting in the tributaries. The overall effect of this is that it would prevent a sudden surge of mobile sediment into the Carbon River, an overall beneficial effect.

There are also plans to remove many undersized and/or clogged culverts along the entire reach and replace them with larger, bottomless culverts or trail bridges. Any culvert that is removed and replaced with a bottomless culvert or bridge is a positive change for the floodplain because it would allow sediment load to pass through the culvert in a more efficient manner than has previously been allowed with the culvert. Culvert modifications also allow for much better fish passage, especially in areas with noted threatened and endangered species.

3. Site Description

The project area along the Carbon River Road includes approximately 5 miles of active river channel and associated riparian habitat, from the river corridor adjacent to and just upstream of Ipsut Creek campground downstream to the park boundary (FIGURE 1). The Carbon River Valley has designated wilderness beginning 100 feet south of the road centerline until the Green Lake trailhead, then 100 feet on both sides of the road until the Ipsut Creek Campground. The overall Carbon River watershed at the park boundary is 52.023 square miles (134.738 square kilometers), of which, 74.7% or 38.871 square miles (100.676 square kilometers) is within the park boundary. The remaining 13.152 square miles (34.062 square kilometers is within the Mount Baker-Snoqualmie National Forest, just north of the park.

3.1. Change in flood frequency and magnitude on the Carbon River

The Carbon River in the park is flood-prone because of the shape of its watershed, steep slopes within the watershed, its glacial source which can be prone to glacial outburst floods, and the location of the drainage basin relative to the Pacific Ocean. Mount Rainier is a large obstruction to the eastward movement of moisture. As the moisture is forced to rise up against the mountain, it cools, condenses and forms clouds. As it continues to rise, the moisture is squeezed out of the clouds in the form of rain or snow.

The Carbon River is also flood-prone because it can flood at least two times each year. Heavy, warm November and December rainfall trigger rapid snowmelt and flooding within the reach and within the park as a whole. The entire watershed receives most of its precipitation in the winter as snow, and warm spring temperatures and rain can trigger rapid snowmelt and flooding. Unlike fall flood peaks, which typically pass within a few days, spring floods are smaller, but last for several weeks between May and June.

In 2008, ENTRIX Environmental Consultants produced a hydraulic study on the Carbon River that showed there may be an increase in the frequency and intensity of flood events as recorded by United States Geological Survey (USGS) stream gauges near the park. On the Carbon River at Fairfax, WA, the 100-year flood during the period of record from 1930-1977 now has a recurrence interval closer to 70 years when compared with the entire period of record (1930-2006) (FIGURE 2). Therefore, ENTRIX (2008) states that design conditions are changing and larger, more intense floods should be anticipated. On the Nisqually River, on the park's southwest side, there were no 10-year recurrence interval floods that occurred before 1970. Since then, there have been 6, including two events with recurrence intervals greater than 50 years; this trend is also noted on the Carbon River and, to a lesser extent, the Puyallup and White Rivers. There is also a regional trend that is similar in nature to what has been observed in Mount Rainier's rivers. The general trend for the Nisqually River and Carbon River is an increase in the size of annual peak flows since the period of record began in 1940 and 1930, respectively. According to research by the University of Washington Climate Impacts Group (UW CIG), it is anticipated that by 2080, average yearly temperatures in the Washington Cascades region will be approximately 5.9°F warmer with an overall increase in precipitation of about 1-5%. Most of the anticipated increases in temperature will be between October and January (Mote, personal communication, 2008). The trend is for dryer summers and wetter winters, which is significant in that the largest and most destructive floods occur in the late fall during the period of record at both the Nisqually and Carbon Rivers.

In the past 20 years, the Carbon River has had the three largest floods on record (TABLE 2). The November 2006 flood event (14,500 cfs at Fairfax, WA) was believed to have a 100-year recurrence interval, a trend that matches streams park-wide from that flood. The 1996 and 1990 floods had recurrence intervals near 35 and 50 years, respectively. Not only do the largest floods cause damage. As shown in FIGURE 4, many smaller events with recurrence intervals near 1.5 to 2 years have historically caused damage to the road corridor. As larger events potentially become more common, the anticipated damage to park infrastructure in the river bed is greater risk.

Small, steep, straight tributaries to the Carbon River, especially those north of the park boundary from logged and clear-cut areas, can carry debris flows during large precipitation events. Debris flows can occur many times during the year along the entire stretch of the river, especially during periods of hot weather where stored water can surge out the glacier (glacial outburst floods). Additionally, as increased glacial recession occurs, steep-walled lateral moraines are prone to failure because the ice buttressing effect of the glacier is diminished. These walls of loose, unconsolidated glacial till can fail at anytime and provide large sources of sediment to the river.

3.2. Carbon River Valley floodplain and landforms

The Carbon River floodplain is located along the floor of the Carbon Valley in a deep glacially-formed canyon, with peaks rising more than 3,000 feet (914 meters) above the river. The valley floor contains a wide variety of sediment sizes from sand and silt to large cobbles and erratics, debris flow deposits from small, steep tributaries, alluvial fans from larger tributaries and the Carbon River and its floodplain. The terraces are composed of gravel, cobbles and boulders and are crossed by numerous old flood channels. Debris flow deposits and alluvial fans have slopes steeper than 10-15% and are covered with boulders, levees and deeply incised channels at junctions with the Carbon River floodplain.

Chenuis and Cayada Creeks have deposited large alluvial fans on the Carbon Valley floor. This is especially true for Cayada Creek, which has provided a large amount of sediment to the valley floor. The Carbon River main stem has moved south from the valley floor at the confluence of Cayada Creek, likely due to these debris deposits. Other major tributaries like Ipsut Creek, Ranger Creek and Falls Creek likely deposit large amounts of sediment as they reach the valley wall, but the active channel of the Carbon River is away from the alluvial fans that developed from the change in slope as the tributaries reached the valley bottom.

Areas of sediment storage in the lower valley are marked by channel instability and wide floodplains. Sediment transport is a major feature of the Carbon River as it flows from its glacial source downstream to the park boundary. Major channel alteration can occur as sediment waves move through the system, locally aggrading and/or incising large areas of the valley bottom. Large falling trees can also result in large-scale aggradation immediately upstream of the falling tree. Not only do large trees contribute to aggradation, but they also are an important "sediment source" in of themselves. Wood is a natural part of the floodplain and there are large accumulations of woody debris throughout the whole reach.

4. Justification for Use on the Floodplain

Most of the proposed actions under this alternative would seek to remove, modify or build infrastructure within the Carbon River floodplain and channel migration zone. Most of the road would be either converted to a hike or bike trail or would be decommissioned. Erosion protection measures and road humps would be built on and in the vicinity of the main stem in order to prevent further erosion of trail segments and areas of human infrastructure.

The Carbon River Road was constructed in the 1920s as a way for park visitors to have access to the relatively remote areas in the northwest corner of the park. As such, the road was constructed in the valley bottom rather than along the steep valley wall due to difficulties in building on the steep wall compared with the relatively flat areas near the rivers. Over time, the roadway itself became part of the historical character of the park, designated as part of the Mount Rainier National Historic Landmark District. Repeated repairs to the roadway have attempted to retain this historical character of the roadway, despite the relatively unsustainable nature of portions of the roadway where the river threatens it.

As rivers aggrade and move around in the Carbon River valley, the potential for more roadway damage over time increases, especially if the river is confined in one place for a long time. Moving the roadway out of the floodplain and/or from river conflicts would require Congress to change wilderness in the park. It would also require blasting and/or heavy excavation work across cliffs and unstable slopes, the removal of hundreds of large old growth trees, and would disturb threatened and endangered species, and/or cause major impacts to undisturbed wetlands.

There are recreation sites near the floodplain. Ipsut Creek campground was one of two year-round campgrounds in the park and is located in the channel migration zone, approximately 10 feet higher than the 100-year floodplain inundation level (both of the year-round campgrounds were affected by the same 2006 flood, with one of them eroded away). Ipsut Creek Campground is low relative to the river and has the possibility of becoming an "island" during large floods, surrounded on all sides by surging flood flows. NPS plans to remove vault toilets and replace them with composting or pit toilets in the campground, but the camp sites would remain in a potential channel migration zone. Flooding at the site occurs over a period of days or hours; flood conditions are summarized in Table 3.

5. Description of Site-Specific Flood Risk

5.1. Recurrence Interval of Flooding

Information on flood recurrence interval comes from USGS stream gauging data collected since the 1930s on the Carbon River near Fairfax, WA (USGS stream gauge #12094000) and a HEC-RAS model built for this study that incorporates interpolated peak flows using regional regression equations. The flows used for the study reach are based on USGS StreamStats software (USGS StreamStats, 2010). StreamStats uses regional regression equations, drainage basin size, precipitation and other statistical data to estimate 2, 10, 25, 50, 100 and 500 year flood flows. An analysis of the USGS StreamStats peak flows with observed flood recurrence intervals at USGS gauging stations near the park found that the StreamStats regional regression equations under estimated peak flows for smaller drainage basins in the park. Because of this finding, the modeled flows were increased by between 18-30% from the StreamStats flows, as defined by a statistical relationship to the flows. Given work by ENTRIX (2008) and others which is showing changing design conditions for the entire region, using slightly higher flows will adequately address future design conditions as warming and precipitation patterns change region-wide. The modeled flood flows are shown in Table 3 and the model results are shown in Table 4.

The "100 year flood," or, 1% chance of exceedance in a given year, in the reach varies between 6,560 to 13,444 cubic feet per second (cfs), depending on location in the reach (i.e., As the river flows downstream, it accumulates water from hill slope runoff and major tributaries; thus, flows upstream will be lower than flows downstream). The 500-year flood, or 0.2% chance of exceedance in a year, varies between 8,683 to 17,776 cfs.

5.2. Hydraulics of Flooding at the site (depths, velocities)

Information on flood flows and floodplain risk comes from studies done by ENTRIX (2008) and a 1-D HEC-RAS floodplain model constructed by the NPS. The regulatory 100- and 500-year floodplains (1% and 0.2% exceedance probability) were delineated using ArcGIS 9.3.1, HEC-GeoRAS 4.2.93 and HEC-RAS 4.1.0 as well as 1-meter LiDAR (Light Detection and Ranging) elevation survey of the Carbon River Valley as determined by aerial surveys in September, 2008. HEC-RAS is a one-dimensional steady-state open-channel-flow hydraulic modeling program which is used to route water through a drainage basin to determine a variety of flow characteristics. These include, but are not limited to: discharge, water surface elevations, flow area, channel velocities, shear stresses, and others.

Using the 2008 LiDAR for the Carbon River Valley, a series of river cross sections were digitized across the valley bottom. For this study, 228 cross sections were digitized from just south (upstream) of Ipsut Creek Campground to just west (downstream) of the Carbon River Entrance at the park. The stream center line was delineated by the LiDAR flow accumulation layer and river banks were delineated by analysis of the LiDAR hillshade and LiDAR Canopy Height layer. The stretch of drainage basin varies considerably between the most upstream and downstream locations. For instance, the upstream drainage basin size is 20.742 square miles (53.722 square kilometers), whereas the drainage basin size at the park boundary is 52.023 square miles (134.738 square kilometers). The difference between the two drainage basins is result of large tributaries which empty into the mainstream Carbon River. These tributaries include Ipsut Creek, Chenuis Creek, Ranger Creek, Cayada Creek and Falls Creek. The stream network used in HEC-RAS for this project takes into account the accumulation of progressively larger flows downstream as result of these tributaries adding flow to the main stem Carbon River.

With the exception of the Falls Creek area, the majority of the NPS road and visitor facilities lay outside of the regulatory 100 and 500 year floodplains (FIGURE 6). However, a portion of the roadway between the park entrance and maintenance area as well as a large portion of the roadway from the Chenuis Falls trailhead to Ipsut Creek campground has the main stem river flowing within 10-50 feet of the roadway. This is a risk because large rates of bank erosion can occur with moderate to large floods.

The Falls Creek area is a 2,600 foot (792 meter) stretch of roadway near milepost 9.75 that has had a history of flood damage. As mentioned previously, in 1996, this stretch was damaged by flood flows before and five weeks after repairs were completed. In 2006, a major portion of the roadway was effectively eroded and became a new side channel of the Carbon River. As the 2008 LiDAR topography shows now, the roadway is up to 16 feet below the adjacent main stem Carbon River (FIGURE 5). HEC-RAS flood-inundation modeling completed for this study show that even a 2-year recurrence interval flood would cause a significant portion of the main stem Carbon River to pour into this new channel. The side channel/former roadway here is much narrower, only approximately 20-30 feet wide compared to the 100-200 foot-wide main-stem. Therefore, any flows that would fall into the side channel would likely experience higher velocities and associated shear stresses.

TABLE 6 shows the general depths and associated velocities for the regulatory 100 and 500 year floods on the Carbon River from upstream of Ipsut Creek campground downstream to the Carbon River Entrance. In general, the higher velocities are at the upper extent of the reach, as expected with steeper slopes. The deepest flows are in the new Carbon River/Ipsut Creek side channel west of Ipsut Creek Campground.

5.3. Time Required for Flooding to Occur (Amount of Warning Time Possible)

The amount of time required for warning of possible flooding in the Carbon River floodplain ranges from a few hours to a few days, depending on the nature of the flood hazard. The largest floods have historically occurred within days of large, heavy rain events and the Carbon River can rise quickly. The flood crest generally passes quickly and most peaks occur between 6 pm and midnight. The National Weather Service has developed an “Advanced Hydrologic Prediction Service” (AHPS) system that predicts anticipated river peaks based on forecasts, snow packs, temperatures and other weather data. While the AHPS system does not have a station within the Carbon River valley in Mount Rainier National

Park, the downstream station at Fairfax, WA[2] can be interpolated for the upstream reach. This data can be accessed by anyone with a web browser on the internet.

Other natural phenomena also provide serious risks to visitors, staff and infrastructure in the Carbon River valley. These include glacial outburst floods, debris flows, lahars, volcanic eruptions, and volcanic edifice failure. A park-wide hazard analysis was undertaken as part of the GMP planning effort in 1996. Field analysis by Jon Riedel (NPS, 1997) determined the debris flow hazard in the Carbon River area to be a "Case III," with small debris flows affecting the area on the order of one every 100 years or less. Riedel also determined the rate of aggradation on the Carbon River to be approximately six inches per year. Riedel recommended the closure of the walk-in sites at the Ipsut Creek campground and the removal of housing at the Carbon River Entrance. These sites have since been closed or made into a day-use facility. Riedel also determined that the majority of the Ipsut Creek campground was outside of the regulatory 100- and 500-year floodplains but their proximity to the floodplain and relatively low elevation in relation to the main stem Carbon River was a high hazard.

Mount Rainier has had a history of producing lahars, or volcanic mudflows, whose spatial extent is extensive. Lahars are the most far reaching hazard from the volcano, and have travelled as far as the Enumclaw plain, with some events reaching the Puget Sound (Scott and Vallance, 1995). According to research by Sisson, Vallance and Pringle (2001), the northwest corner of the volcano, with its numerous dikes and vents, provides an abundance of hydrothermally altered volcanic andesite, which leads to the development of a clay-like material, prone to failure. Edifice failure, both due to and independent of volcanic eruption is a risk to low-lying areas near and far from the volcano.

6. Opportunity for Evacuation of the Site in the Event of Flooding

Evacuations for the Carbon River floodplain would involve the public, NPS personnel, and possibly outside agencies. Since vehicular access with the preferred alternative is limited to only the first 1.2 miles of the former road, in the event of a flooding event, the public traveling in motor vehicles would be evacuated west on the Carbon River Road until the intersection of State Route 165. The public would then travel northwest to the areas downstream of Carbonado, Washington. For foot and bicycle traffic between the entrance to the Ipsut Creek campground, a more complicated evacuation route would be necessary and would be dependent on the location of visitors in relation to trailheads and evacuation routes. In most cases, floods can be adequately predicted ahead of time and the public can be summarily notified of the anticipated flood risks. Floodplain and volcano evacuation routes are being developed to prevent injury or death to park visitors in cooperation with the counties and USGS. Depending on the location of the visitor, the following routes are being proposed:

- *Travel near the park entrance and former maintenance facilities:* The proposed evacuation route involves traveling south on the Rainforest Loop Trail until the intersection of the Boundary Trail. The evacuation route would continue on the Boundary Trail until a posted assembly area, approximately 200 feet above the elevation of the valley bottom.
- *Travel near the Old Mine trailhead:* The posted evacuation route involves traveling south on the non-maintained Old Mine trail until the end of the trail and a posted assembly area, approximately 200 feet above the elevation of the valley bottom.
- *Travel near the Green Lake trailhead:* The posted evacuation route involves traveling southwest on the Green Lake trail until a posted assembly area, approximately 200 feet above the elevation of the valley bottom.
- *Travel near the Chenuis Falls trailhead:* The evacuation route here is dependent on the location of the visitor in relation to the active channel. For visitors on the west side of the active channel, a proposed sign would notify visitors to not cross the log bridge spanning the Carbon River and

---

[2] National Weather Service Advanced Hydrologic Prediction Service forecast for the Carbon River at Fairfax, WA can be found at: http://water.weather.gov/ahps2/hydrograph.php?wfo=sew&gage=ffxw1&view=1,1,1,1,1,1,1,1

instead travel to the Green Lake trailhead. The sign would then notify visitors to follow the posted instructions at the Green Lake trailhead to safely evacuate. For visitors on the east side of the active channel, a sign would notify visitors to proceed east on the Chenuis Falls trail until a posted assembly area, approximately 200 feet above the valley bottom.

- *Travel near the Ipsut Creek campground:* The Ipsut Creek campground is one of the more unsafe locations for park visitors during flood events due to the "island" effect of the combined Carbon-Ipsut Creek on the west side of the campground and the main stem Carbon River on the east side of the campground. In essence, during a large flood, the entire campground is an island surrounded on all sides by water. However, a potential posted evacuation route would involve traveling south on the Wonderland trail spur from the Ipsut Creek trailhead to the junction of the Wonderland Trail. The evacuation route would continue west on the Wonderland Trail until a posted assembly area adjacent to Ipsut Creek, approximately 200 feet above the elevation of the valley bottom.

Additionally, it should be noted that most of the large floods that occur in the Carbon River valley are between September to May, during a time when park visitation is reduced. This does not imply that the area is vacant of visitors but only that the higher crowds occur during the warmer, drier summer months where flooding is relatively uncommon. With lower numbers of park visitors during the potential months for flooding, notification of flood hazards to the visiting public may be easier to accomplish with the limited fall and winter staff.

7. Geomorphic Considerations (Erosion, Sediment Deposition, Channel Adjustments)

The Carbon River is remarkable for the dramatic changes it undergoes in the wide alluvial valley. Throughout the entire reach from Ipsut Creek campground to the entrance, the river transports a large amount of sediment, including silt/sand, gravels, cobbles, boulders and occasional erratics. The river also moves large woody debris, frequently creating large jams of debris. Floods dramatically change the shape and braiding pattern of the river as well as the location of the main stem of the river within the active unvegetated channel.

Gradient in the active channel of the reach varies between approximately 1.3 to 3.5% in the reach, from downstream to upstream, respectively. Tributary channels are much steeper, exceeding 10 to 15% in some places. Many tributaries are relatively straight, steep reaches and are transport zones for sediment and large wood. Some tributaries, especially those on the downstream side of the reach, are from areas of clear-cut logging on US Forest Service property, part of the Mount Baker-Snoqualmie National Forest. While it is a study need, it is anticipated that these areas contribute large amounts of sediment, especially after they have been cleared.

The Carbon River also has a history of bank erosion, especially witnessed along the Carbon River Road. It is not uncommon for bank erosion rates in some areas along the road to exceed tens of feet per year. Almost all of the bank erosion occurs during floods, with some erosion occurring as lower flows travel along the newly formed and highly mobile banks. Locally, bank erosion can lead to channel incision and channel widening, but the overall trend, even with bank erosion, is net channel aggradation.

Exact rates of bed and suspended sediment transport are unknown for the reach, because of the extreme difficulty in calculating bed load transport in cobble-bedded rivers as well as difficulties in adjusting sediment transport equations to the braided river environment at the park. Because of the volcano and the erosion of the volcano by various forces of ice, wind and water, the rivers at Mount Rainier are constantly provided with an excess of sediment. Over time, the bed is highly mobile and frequent major channel changes occur. Year-to-year aerial photos prove that the Carbon River (among others in the park) is constantly in flux and adapting to the changing sediment loads.

8. Description and Explanation of Flood Mitigation Plans

This plan includes only a few limited measures to reduce hazards to human life and property. All action alternatives propose placing at least some infrastructure within regulatory floodplains in many areas, including the construction of bank protection or erosion protection structures, road humps, trail reconstruction, etc. in areas where floods inundate at 100- and 500-year events. Removal of the road from the Old Mine Trailhead to Ipsut Creek Campground, however, will be a net benefit to the floodplain as it provides for visitor and NPS safety in the event of a flood, as well as decreasing a possible non-point-source pollutant. NPS proposes to mitigate these hazards by placing interpretive and warning signs at selected pullouts. These signs will inform people about the nature of the hazards and what precautions to take during periods of heavy rainfall. These precautions would include signed evacuation routes for visitor and park staff.

These proposed signs would be located along the road and trails and have a negligible impact to the natural resources of the floodplain (and associated wilderness). Parts of the road, camps, and trails, however, would remain within the floodplain. Roads, trails, and campgrounds that remain in the floodplain would continue to be subject to periodic flooding.

9. Summary

This draft Floodplains Statement of Findings accompanies an Environmental Assessment (EA) for the Carbon River floodplain for actions designed in the Carbon River Area Access Management Plan.

Recent major floods and the resulting landscape changes on the upper Carbon River have intensified flood and erosion threats to National Park Service (NPS) facilities and natural resources within Mount Rainier National Park. The three largest floods on the Carbon River have occurred in the last 20 years; the last of which in 2006 altered the historic use of the Carbon River road corridor. The NPS has spent hundreds of thousands of dollars to protect access to the 5 miles of the Carbon River Road and one of two former year-round public car-camping locations in the park (the other of which was destroyed in the 2006 flood). The roadway was constructed in the valley bottom in the 1920s, providing a relatively easy construction compared to constructing a roadway along a steep valley wall. While this construction was easier, it did not address the problems of flooding, channel migration and channel avulsion. Now, recognizing the changing design conditions of flood frequency and magnitude, combined with the issues of excess sediment accumulation in the river (aggradation), the NPS proposes to use a more conservative approach of the channel migration zone to direct planning actions in the Carbon River valley.

The proposed action in the preferred alternative, Alternative 2, will reduce flood risk by removing NPS facilities and most of the Carbon River road from the floodplain. The primary negative impacts to the floodplain in this alternative are impacts from installing new bank erosion measures thereby limiting the channel migration and floodplain utilization of the Carbon River. Other negative impacts include reconstructing trails in the floodplain, prevention of channel avulsion, and the prevention of floodplain sedimentation that could lead to a “levee” situation that could lead to catastrophic flooding and channel movement. New recreational opportunities proposed would also be within the channel migration zone.

Impacts to floodplain values are offset by several proposed management actions. These include: (1) removal of the NPS maintenance facilities and most facilities at the park entrance; (2) removal of vault toilets and formal car camping facilities at Ipsut Creek campground; (3) removal of 3.8 miles (6.1 kilometers) of the roadway within the floodplain; and (4) removal of undersized culverts and stabilization of stored mobile sediment upstream of the culverts.

10. Conclusion

Floodplain values are moderately impacted by several actions of the preferred alternative in the proposed in the Carbon River Area Access Management Environmental Assessment, including placement of new erosion control structures, farming of rock and cobble in the active channel of the Carbon River for use in erosion protection structures, prevention of channel avulsion, and the prevention of channel overbank sedimentation that would lead to an increased threat of catastrophic flooding. For facilities that remain in floodplain, and with the exception of bank erosion, flood hazards are relatively minor (depth less than about 3.4 feet, velocity less than 4.3 ft/sec) and advance warning of hours to days is likely.

These impacts are mitigated, to some extent, by several actions that enhance floodplain values. These include removal of NPS maintenance facilities and most facilities at the park entrance, removal of vault toilets and formal car camping facilities at Ipsut Creek Campground, removal of 3.8 miles (6.1 kilometers) of roadway within the floodplain and removal of undersized culverts and stabilization of stored mobile sediment upstream of the culverts.

11. References

Beason, S.R., 2006. The environmental implications of aggradation in major braided rivers at Mount Rainier National Park, Washington. M.S. thesis, University of Northern Iowa, Cedar Falls, IA. 165 p.

ENTRIX, 2008. Topographic survey, hydraulic modeling and design assessment of the proposed Carbon River road flood damage reduction measures: Final draft technical memorandum. ENTRIX Environmental Consultants, Seattle, WA.

National Park Service, 1998. Director's Order #77-2. Floodplain procedural manual. Washington D.C.

Riedel, J.L., 1997. Geologic hazards and floodplain management, Mount Rainier General Management Plan: Unpublished internal document, National Park Service, 61 p.

Scott, K.M. and J.W. Vallance, 1995, History of landslides and debris flows at Mount Rainier: United States Geological Survey Open File Report 93-111, 2 p.

Sisson, T.W., J.W. Vallance, and P.T. Pringle, 2001, Progress made in understanding Mount Rainier's hazards: EOS, Transactions of the American Geophysical Union, p. 113-120.

United States Geological Survey (USGS) Stream Stats, 2010. Washington StreamStats basin characteristics report [Online]. Fetched June 22, 2010 from http://streamstats.usgs.gov. Last modified 03/14/2007.

FIGURE 1: Overview map of the Carbon River watershed at the park entrance and the analysis area covered by this SOF.

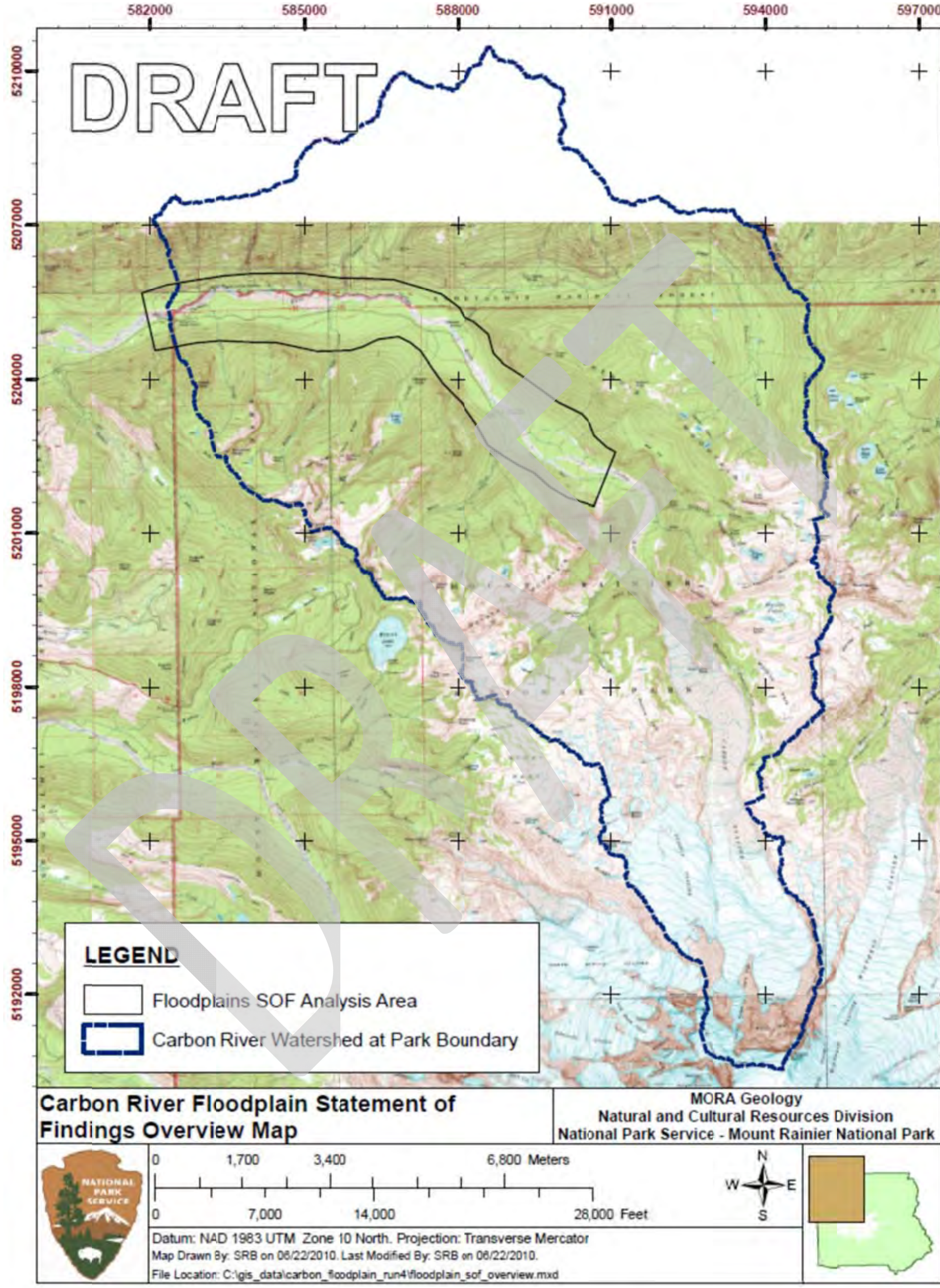


FIGURE 2: Comparison of flood recurrence intervals in the periods of 1930-1977 and 1930-2008 based on annual peak flows from the USGS stream gauging station #12094000 – Carbon River at Fairfax, WA (Modified from ENTRIX, 2008).

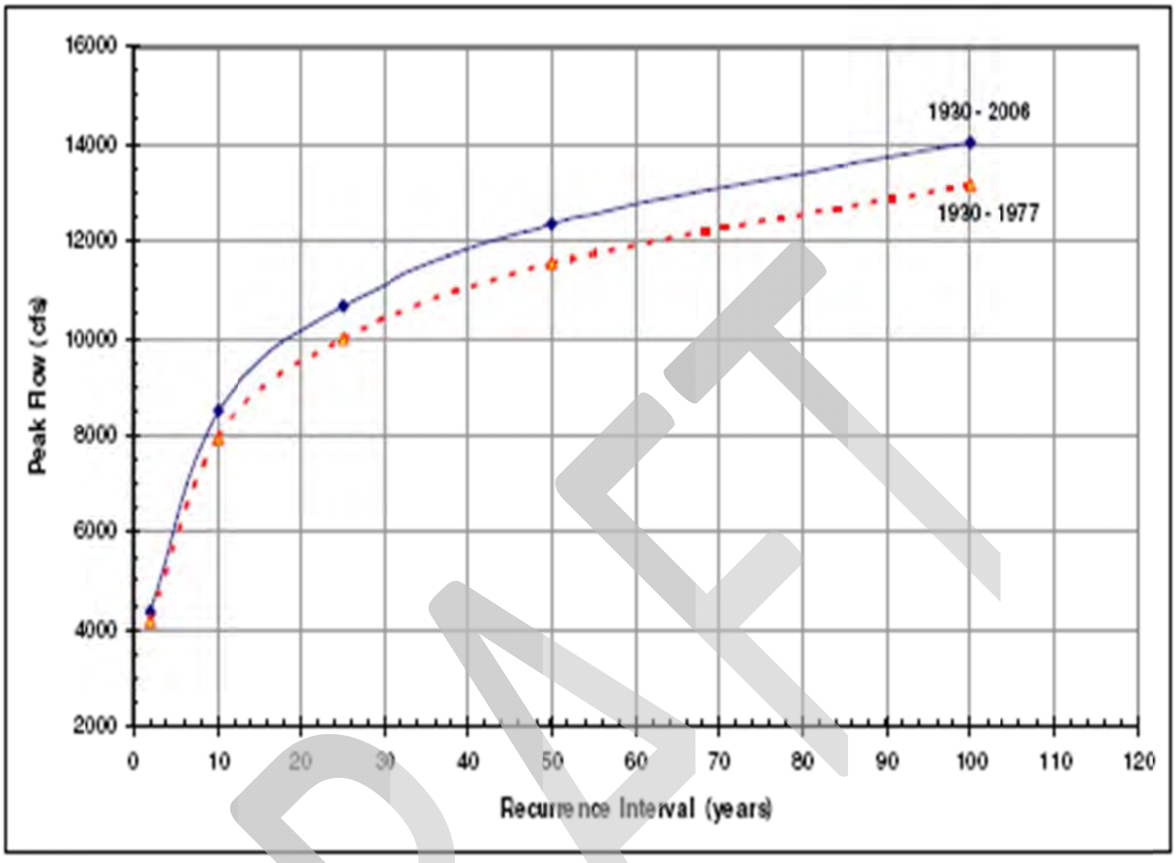


FIGURE 3: Annual peak flows at USGS stream gauging station #12094000 – Carbon River at Fairfax, WA from water years 1930-2008.

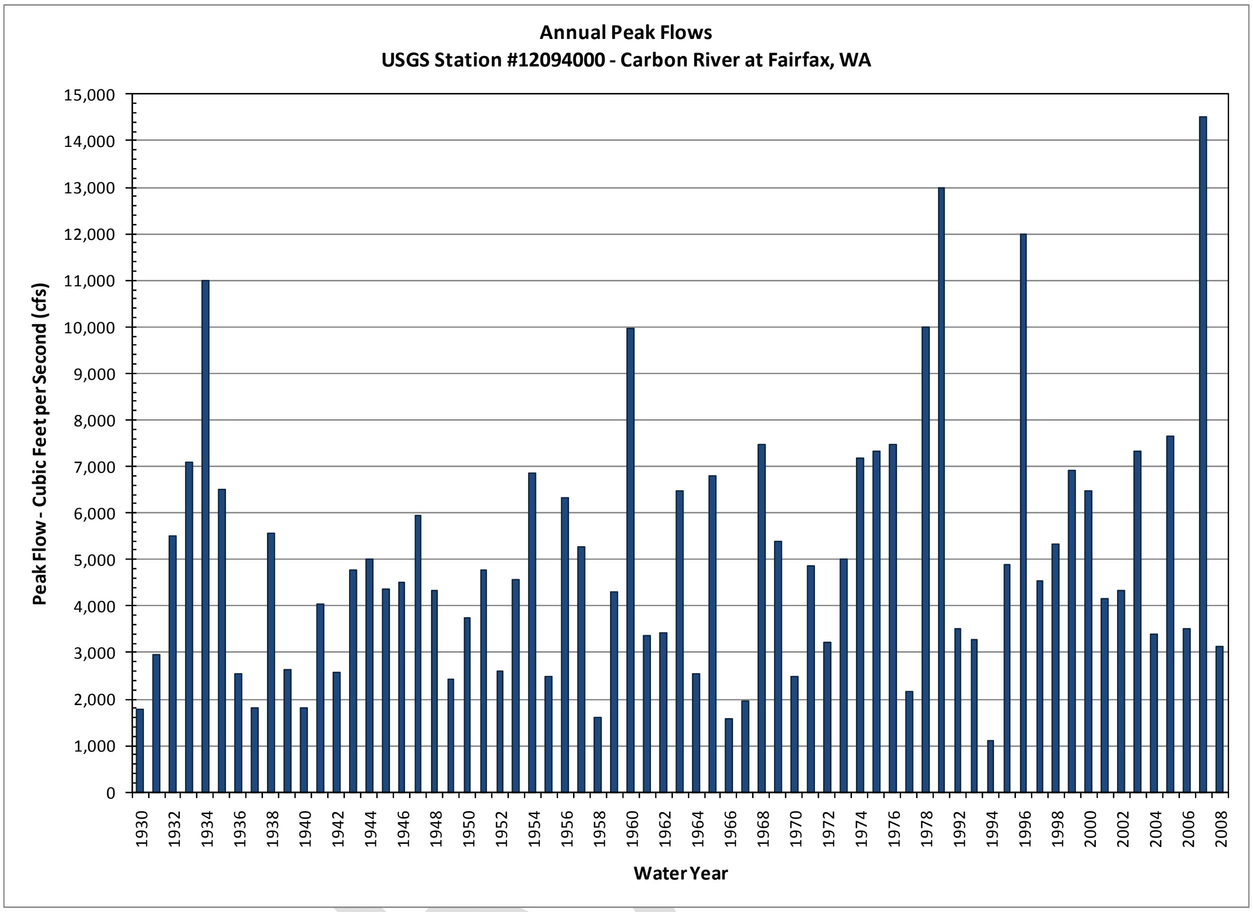


FIGURE 4: Comparison of mean daily flow of large floods that did and did not cause damage on the Carbon River Road. Based on data from the USGS stream gauge #12094000 – Carbon River at Fairfax, WA

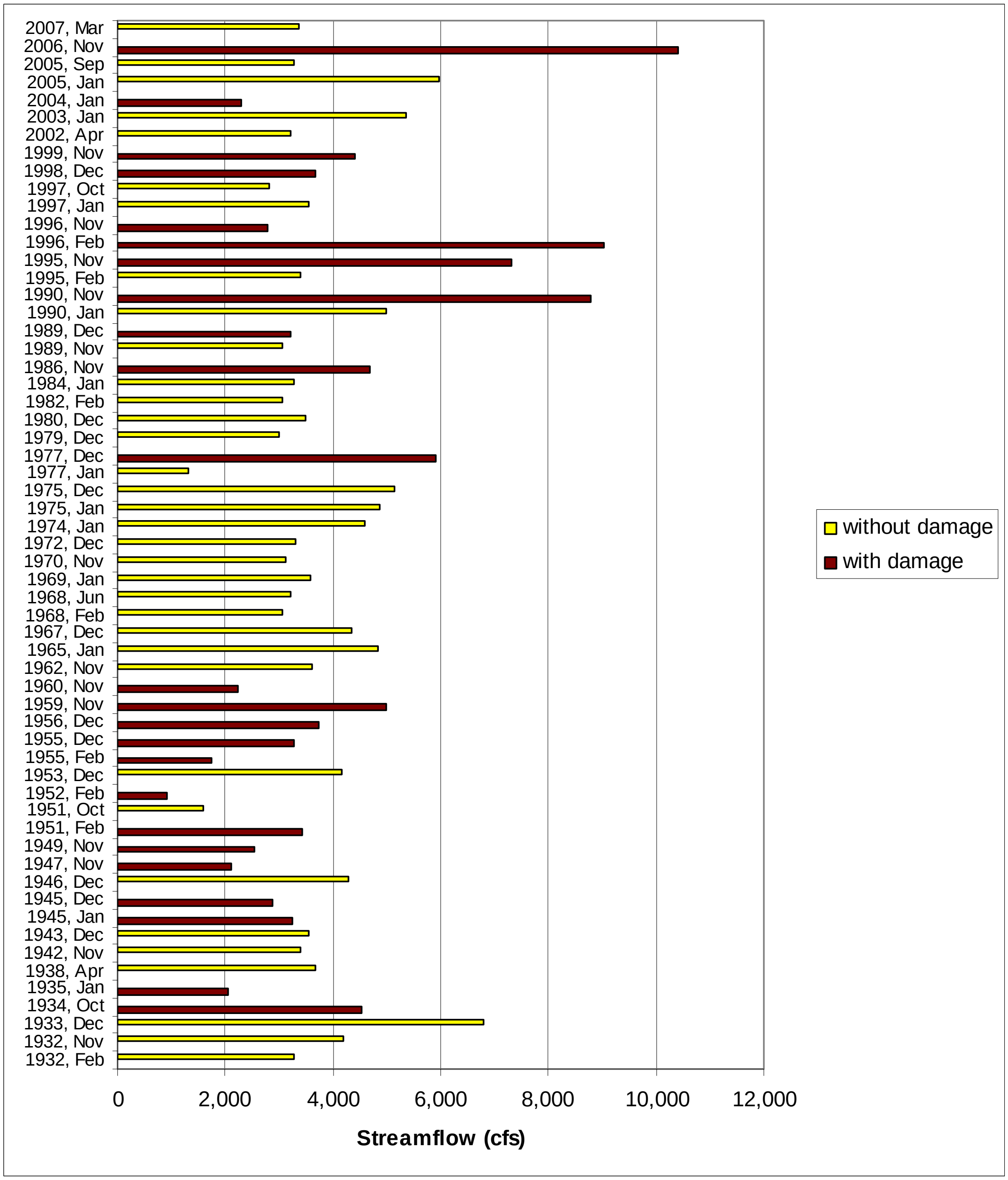


FIGURE 5: Height Above Water Surface (HAWS) map for the Falls Creek reach of the Carbon River.

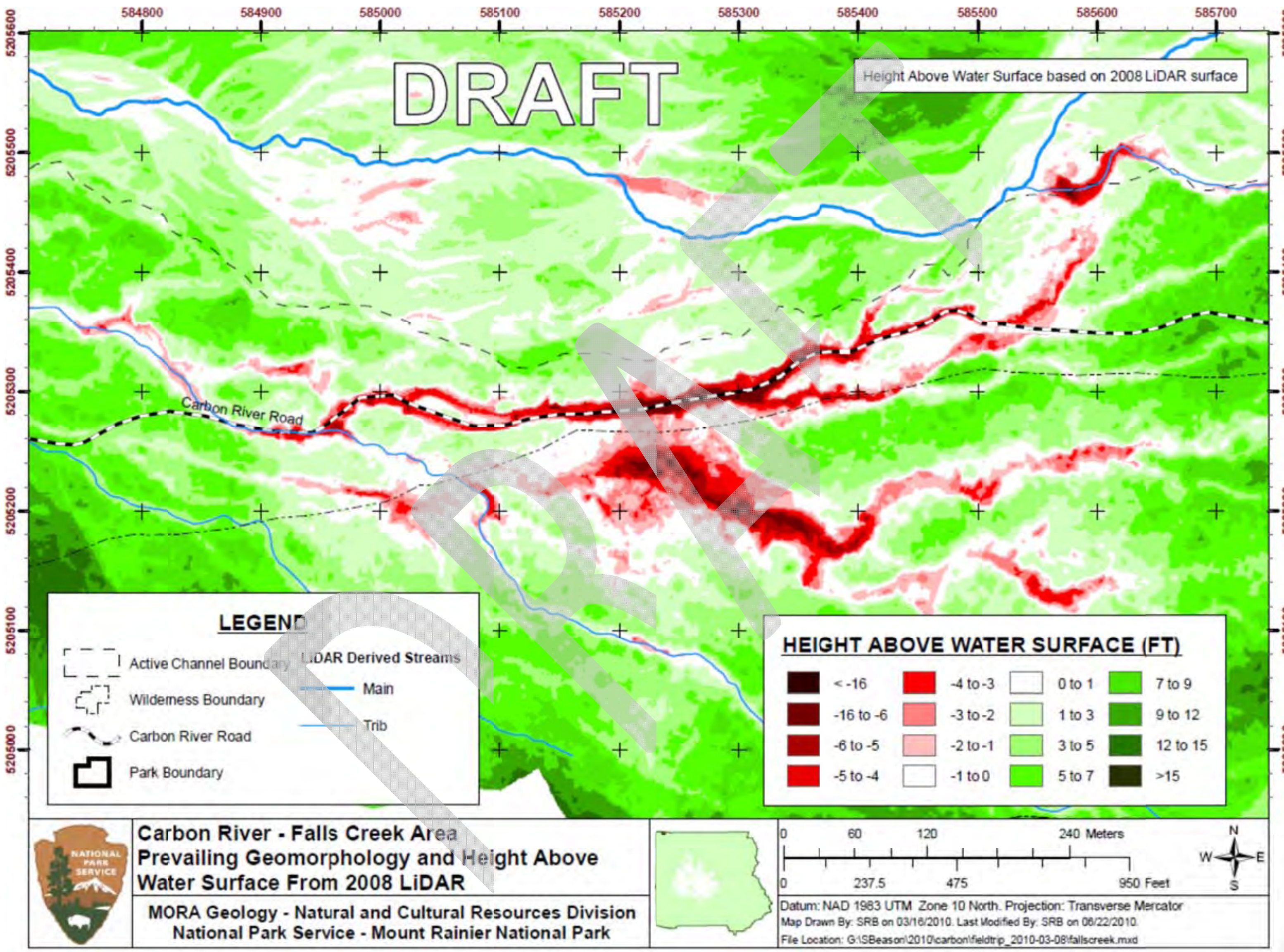


FIGURE 6: Carbon River 100- and 500-year floodplain inundation map based on 1-D HEC-RAS open channel flow models.

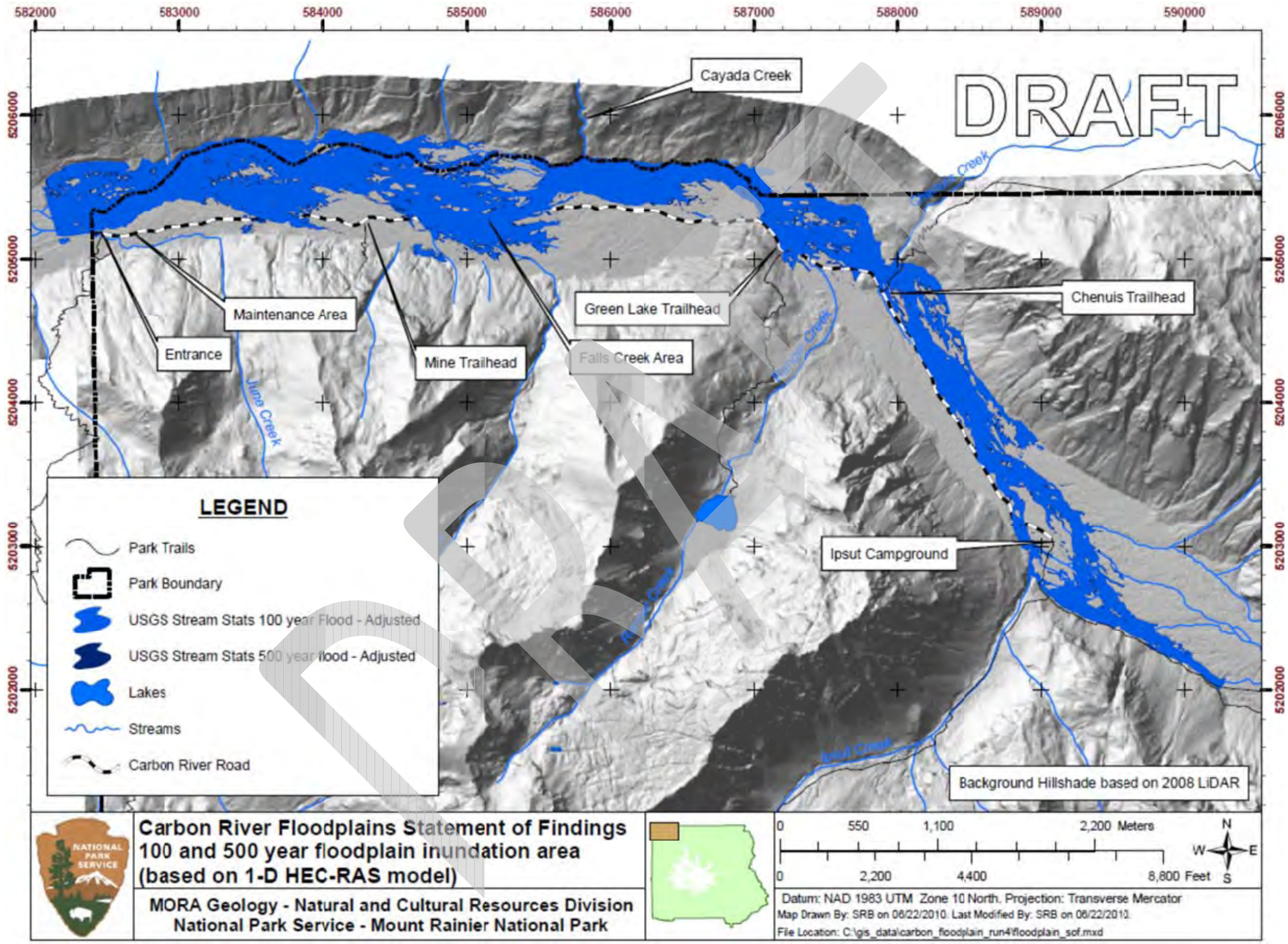

DRAFT
Cayada Creek
Chenuis Trailhead
Green Lake Trailhead
Maintenance Area
Entrance
Mine Trailhead
Falls Creek Area
Ipsut Campground
June Creek
LEGEND
Park Trails
Park Boundary
USGS Stream Stats 100 year Flood - Adjusted
USGS Stream Stats 500 year flood - Adjusted
Lakes
Streams
Carbon River Road
Background Hillshade based on 2008 LiDAR
Carbon River Floodplains Statement of Findings
100 and 500 year floodplain inundation area
(based on 1-D HEC-RAS model)
MORA Geology - Natural and Cultural Resources Division
National Park Service - Mount Rainier National Park
0 550 1,100 2,200 Meters
0 2,200 4,400 8,800 Feet
N
W
E
S
Datum: NAD 1983 UTM Zone 10 North. Projection: Transverse Mercator
Map Drawn By: SRB on 06/22/2010. Last Modified By: SRB on 06/22/2010.
File Location: C:\gis_data\carbon_floodplain_run4\floodplain_sof.mxd

TABLE 1: USGS StreamStats Basin Characteristics Report – Carbon River at the park entrance (USGS StreamStats, 2010).

Parameter	Value
Pour point latitude (NAD83)	46.9955° (46° 59' 43")
Pour point longitude (NAD83)	-121.9163 (-121° 54' 58")
Drainage basin area	52.023 square miles (134.739 square kilometers)
Maximum relief	12,300 feet (3,749 meters)
Mean basin elevation	4,800 feet (1,463 meters)
Maximum basin elevation	14,100 feet (4,298 meters)
Minimum basin elevation	1,750 feet (533 meters)
Mean basin slope	53.4%
Percent of area with slope greater than 30%	81.1%
Percent of area with slope greater than 30% facing north	30.2%
Percent of area covered by forest	57.9%
Mean annual precipitation	99.4 inches (252.5 centimeters)

TABLE 2: 15 largest flows on record for the Carbon River as recorded at Fairfax, WA.

Rank	Date	Discharge (cfs)	Damage?
1	11/06/2006	14,500	Yes
2	11/24/1990	13,000	Yes
3	02/08/1996	12,000	Yes
4	12/09/1933	11,000	No
5	12/01/1977	10,000	Yes
6	11/23/1959	9,970	Yes
7	11/18/2005	7,650	No
8	12/25/1967	7,480	No
9	12/01/1975	7,460	No
10	01/18/1975	7,320	No
11	01/31/2003	7,310	No
12	01/15/1974	7,180	No
13	11/13/1932	7,100	No
14	12/29/1998	6,900	Yes
15	12/09/1953	6,860	No

TABLE 3: Modeled flood magnitude and frequency for the Carbon River.

Location and Flood Frequency	2 yr	10 yr	25 yr	50 yr	100 yr	500 yr
Probability of exceedence in a given year	**50%**	**10%**	**4%**	**2%**	**1%**	**0.2%**
Carbon River upstream of Ipsut Campground	1,858	3,794	4,863	5,713	6,560	8,683
Carbon River downstream of Ipsut Creek	2,260	5,918	5,925	6,961	8,002	10,593
Carbon River downstream of Chenuis Creek	3,030	6,177	7,934	9,302	10,696	14,147
Carbon River downstream of Ranger Creek	3,256	6,641	8,533	10,006	11,506	15,221
Carbon River downstream of Cayada Creek	3,643	7,425	9,541	11,184	12,866	17,011
Carbon River downstream of Falls Creek	3,806	7,756	9,968	11,686	13,444	17,776

TABLE 4: Site specific 100- and 500-year recurrence interval flood conditions for locations of the Carbon River floodplain covered within the Carbon River Access Management EA. Values derived from 1-D HEC-RAS open-channel flow model results. Numbers in parenthesis are averages.

Site	Flood	Discharge	MAIN STEM		OVERBANK AREAS		Top Width
			Depth	Velocity	Depth	Velocity	
	RI	Cubic Feet/Second	Feet	Feet/Second	Feet	Feet/Second	Feet
Ipsut Campground (Main stem)	100	4,592	1.61-3.19 (2.34)	3.96-7.08 (5.17)	0.02-2.68 (1.25)	0.27-5.19 (2.74)	290-569 (416)
	500	6,078	1.79-3.41 (2.64)	4.45-7.56 (5.59)	0.04-3.07 (1.38)	0.26-5.78 (2.96)	307-585 (455)
Ipsut Campground (Side channel)	100	3,410	1.06-4.62 (3.43)	3.68-10.09 (6.41)	0.13-3.50 (1.81)	1.11-8.42 (3.58)	87-317 (218)
	500	4,515	1.54-5.19 (3.95)	4.08-10.45 (6.95)	0.50-4.03 (2.06)	2.01-8.76 (3.99)	102-372 (243)
Chenuis Falls Trailhead	100	10,696	2.10-4.76 (3.05)	3.09-7.08 (4.80)	0.08-3.96 (2.30)	0.36-4.88 (3.13)	355-1,198 (758)
	500	14,147	2.44-5.55 (3.54)	3.32-7.91 (5.27)	0.47-4.68 (2.69)	0.92-5.30 (3.46)	358-1,246 (792)
Green Lake Trailhead	100	11,506	1.85-3.39 (2.57)	3.79-5.79 (4.40)	0.87-7.09 (3.37)	2.27-6.27 (4.39)	527-1,264 (855)
	500	15,221	2.00-3.92 (3.08)	4.25-6.52 (4.96)	0.35-7.32 (3.39)	0.92-6.19 (4.36)	600-1,428 (989)
Falls Creek	100	12,866	1.13-3.34 (2.14)	2.19-4.67 (3.53)	0.56-4.92 (2.50)	0.98-4.71 (3.28)	773-1,784 (1,363)
	500	17,011	1.29-3.76 (2.41)	2.64-4.93 (3.84)	0.95-5.08 (2.72)	1.67-4.91 (3.50)	920-2,020 (1,575)
Maintenance Area	100	13,444	3.12-3.39 (3.27)	4.06-5.43 (4.72)	1.98-4.32 (3.04)	3.17-4.81 (3.63)	1,06-1,206 (1,141)
	500	17,776	3.56-3.89 (3.76)	4.56-5.99 (5.20)	2.18-4.76 (3.38)	3.20-5.16 (3.86)	1,180-1,363 (1,274)
Entrance Area	100	13,444	2.81-3.49 (3.16)	4.15-4.64 (4.41)	1.31-2.60 (2.18)	2.55-3.66 (3.02)	1,287-1,544 (1,386)
	500	17,776	3.13-4.06 (3.61)	4.50-5.14 (4.83)	1.58-3.07 (2.51)	2.72-3.80 (3.25)	1,405-1,617 (1,497)

Appendix 8: Draft Wetlands Statement of Findings

STATEMENT OF FINDINGS FOR EXECUTIVE ORDER 11990 (PROTECTION OF WETLANDS)

Carbon River Area Access Management Environmental Assessment Mount Rainier National Park, Washington

September 2010

Recommended:

____ Date:________________
Dave Uberuaga, Superintendent, Mount Rainier National Park

Certified for Technical Accuracy and Servicewide Consistency:

____ Date:________________
Bill Jackson, Chief, Water Resources Division

Approved:

____ Date:________________
Christine S. Lehnertz, Regional Director, Pacific West Region

1. INTRODUCTION

This Statement of Findings (SOF) was proposed as part of the Carbon River Area Access Management Environmental Assessment (EA). The Carbon River road corridor (FIGURE 1) was originally constructed in the early 1920s and has historically been an important cultural resource to the region, providing access to a uniquely wet temperate rainforest habitat on Mount Rainier National Park's (MORA) northwest side. The road corridor has also been classified in the National Register of Historic Places as part of the Mount Rainier National Historic Landmark District (NHLD). Additionally, vast tracts of designated wilderness are accessible from the northwest side of the park along the roadway. The goal of the Carbon River Area Access Management plan is to preserve year-round public access to the northwest corner of the Carbon River Valley. Executive Order 11988 (Floodplain Management) requires the National Park Service (NPS) to evaluate likely impacts of actions in floodplains. NPS Directors Order #77-2 (Floodplain Management) provide policy and procedural guidance for complying with these orders. This SOF documents compliance with these orders.

The Carbon River's headwaters are at the Carbon Glacier, the lowest elevation alpine glacier in the continental United States at approximately 3,500 feet (1,067 meters) above sea level (ASL). The Carbon River then flows north and west to the park boundary at 1,750 feet (533 meters) ASL. The Carbon Glacier begins its downward movement from near the summit of Mount Rainier at Liberty Cap, approximately 14,111 feet (4,301 meters). Along the way, the glacier scrapes and scours the volcanically-formed andesite rock below and adjacent to the glacier. The glacier acts as a giant conveyor belt and carries this rock and debris downstream to the headwaters of the Carbon River, for the river to carry out of the park. The river flows as a braided stream through a wide glacially-formed valley, constantly changing its braids and bars as sediment and water discharge fluctuate. Over time and owing to the river's exceedingly large sediment source, the riverbed is rising, or aggrading, as more sediment is provided to the river than can be conveyed out of the system. The Carbon River has historically aggraded up to 0.559 feet/year (0.170 meters/year) in a period between 1915 and 1971; or raising a total of 31.329 feet (9.549 meters) in 56 years (Beason, 2006). The Carbon River's 52.023 square mile (134.739 square kilometer) drainage basin at the park entrance receives 99.4 inches of rain and is covered with approximately 57.9% forest (TABLE 1).

In November 2006, almost 18 inches of rain fell park-wide and lead to the single longest closure in the park's history (6 months between November 6, 2006-May 5, 2007; The Carbon River Road currently remains closed to public vehicle traffic at the Carbon River Entrance). The Carbon River valley was one of many areas in the park that received significant infrastructure damage. Between November 5, 2006 at 2:00 P.M. and November 7, 2006 at 2:15 P.M., 8.76 inches (22.25 cm) of precipitation was recorded at the USGS stream gauge on the Carbon River near Fairfax, WA (USGS Gauge #12094000). Flood stage of 13.5 feet (4.1 meters) was recorded at the gauge around noon on November 6th and the stream gage reached its highest recorded gauge height of 16.93 feet (5.16 meters) about six hours later. The flood significantly damaged the Carbon River Road, especially near Falls Creek (2,600 linear feet; 792 meters) and just before Ipsut Creek Campground (1,350 linear feet; 411 meters). In these locations, the road was washed away and replaced with a gully approximately 6-10 feet (2-3 meters) deep. Also, one lane of the Carbon River Road was washed away in two locations and both lanes were removed in one location between the Green Lake Trailhead and just before the Ipsut Creek Campground. Low recurrence interval (approximately 15-year) floods since 2006 have caused more damage to both the roadway and park infrastructure, mainly the loss of a structure by bank erosion at the Carbon River maintenance area.

ENTRIX (2008) have shown that there may be an increase in the frequency and intensity of flood events as recorded by United States Geological Survey (USGS) stream gauges near the park. For instance, on the Carbon River at Fairfax, WA, the 100-year flood during the period of record from 1930-1977 now has a recurrence interval closer to 70 years when compared with the entire period of record (1930-2006) (FIGURE 2). Therefore, ENTRIX (2008) states that design conditions are changing and larger, more intense floods should be anticipated. On the Nisqually River, on the park's southwest side, there were no 10-year recurrence interval floods that occurred before 1970. Since then, there have been 6, including two events with recurrence intervals greater than 50 years. The general trend for the Nisqually River and Carbon River is an increase in the size of annual peak flows since the period of record began in 1940 and

1930, respectively. According to research by the University of Washington Climate Impacts Group (UW CIG), it is anticipated that by 2080, average yearly temperatures in the Washington Cascades region will be approximately 5.9°F warmer with an overall increase in precipitation of about 1-5%. Most of the anticipated increases in temperature will be between October and January (Mote, personal communication, 2008). The trend is for dryer summers and wetter winters, which is significant in that the largest and most destructive floods occur in the late fall during the period of record at both the Nisqually and Carbon Rivers.

The Carbon River valley has had a long history of flooding since the establishment of the Carbon River Road. Large floods in 1990, 1996 and 2006 caused major damage to the roadway (the second, third and largest floods on record since 1930, respectively) (FIGURE 3). Following the 1996 flood, MORA spent approximately $787,000 on a repair to the road. Two medium-size floods five weeks later destroyed the recently-repaired sections of roadway, washing out a 1,200 foot (366 meter) section of roadway to a depth of about 2-3 feet (0.6-1.0 meters). Even low recurrence interval floods have historically caused damage to the roadway and associated park infrastructure near the river (FIGURE 4)[3]. The MORA General Management Plan (GMP) signed in 2002 stated that the park would no longer maintain the Carbon River Road after the next major washout. The GMP did not define what a "major washout" of the road would be but under the guidance of the GMP, MORA is not considering repairing and reopening the entire road corridor in its previous condition as part of the current EA.

2. PROPOSED ACTIONS

The Carbon River Area Access Management EA has five alternatives:

6) **Continue Current Management** (*no action alternative*) – Maintain a primitive trail within the historic road corridor. The Ipsut Campground would be retained with 24 individual and 2 group sites. Public vehicle access would end at the park entrance.
7) **Hike and Bike Trail** (*preferred alternative*) – Construct a formal hike/bike trial to Ipsut Creek trailhead. Retain the Ipsut Creek Campground with 15 individual and 3 group sites. Public vehicle access would end at the Old Mine trailhead, approximately milepost 1.2 on the Carbon River Road.
8) **Public Vehicle Access** – Reconstruct a one-lane road open to public vehicle access to milepost 3.6 (near Chenuis Picnic Area). Construct a formal hike/bike trail from there to the Ipsut Creek Trailhead. Retain Ipsut Creek Campground with 15 individual and 3 group sites.
9) **Shuttle Access** – Reconstruct a one-lane road to milepost 4.4 for shuttles only. Construct a formal hike/bike trail from there to Ipsut Creek Trailhead. Retain the Ipsut Creek Campground with 20 individual and 3 group sites. Public vehicle access would end at the Old Mine trailhead, approximately milepost 1.2.
10) **Wilderness Reroute Trail** – Construct a hiking-only trail in the wilderness area from the Entrance along the south valley wall to the Ipsut Creek Trailhead. Close Ipsut Creek Campground and create a new backcountry camp elsewhere. Public vehicle access would end at the park entrance.

Alternative 2, the preferred alternative, involves the following measures:

- Visitor parking would be available at the Carbon River entrance and former Carbon River maintenance area for approximately 68 cars.
- The historic Carbon River road would be retained between the entrance to the former Old Mine trailhead, approximately 1.2 miles (1.9 kilometers). Public vehicles would be allowed to travel on this portion of the road.

[3] Chapter 1 section D of the Carbon River Area Access Management EA has a flood damage timeline that shows years and extents of flood damage.

- The Old Mine trailhead would become a vehicle turnaround area with some limited parking.
- Constructing or maintaining a 10-foot wide trail in the former road prism that can accommodate disabled visitor access, hiking, biking and occasional all-terrain vehicle (ATV) access in emergencies or for maintenance. When flood damage occurs to the roadway, a reroute trail would be constructed around the washout.
- **Carbon River entrance:** Existing buildings except vault toilets at the Carbon River entrance would be removed and the footprints from these areas would be reconfigured and replaced with formal parking and picnicking. A one-room visitor contact station would be constructed on the south side of the road at the entrance. The Carbon River entrance arch would be reconstructed.
- **Carbon River maintenance area:** All buildings and structures (except the weather station and radio tower/shed) at the Carbon River maintenance area would be removed and replaced with formal parking and picnicking.
- **Ipsut Creek campground:** Both vault toilets at the Ipsut Creek campground would be removed and replaced with backcountry (composting) toilets. All asphalt bumper-stops, buildings, some picnic tables and campsites and most signs would be removed. The former chlorinator building and amphitheater storage shed would be removed. The campground would be reduced in size and configuration, to 15 individual and 3 group sites. Bear proof storage lockers would be added. The former Ipsut Creek patrol cabin would be reconstructed at the Ipsut Campground in one of the two former parking areas at the campground (exact location to be determined).
- **Erosion protection measures:**
  - Four engineered log jams would be constructed between the Carbon River Entrance and Maintenance Area. These structures would consist of:
    - stabilization/augmentation of a large natural log jam with two log reinforcing structures (LRS) upstream and downstream of a natural log jam near the Entrance,
    - one new LRS in the Maintenance Area,
    - one LRS downstream of a natural log jam located upstream of the Maintenance Area,
    - one new ELJ upstream of the natural log jam (Maintenance Area), and
    - immediately construct two temporary barbs in the Maintenance Area - to later be converted into log jam and LRS ballast when constructed.
  - As many as 24 rock-cored, log-cored, or gravel covered log road humps would be constructed to divert sheet flow on the roadway off and back to the river.
  - Toe-roughened gabion or toe-roughened log crib walls will be constructed at milepost 3.463, 3.939 and 4.484, in areas that the river as significantly eroded the bank and road prism down to one or both lanes. These structures will be approximately 200-400 feet (61-122 meters) in length.
  - Additional log crib walls would be constructed at milepost 4.658 and milepost 4.802. These structures are much smaller (approximately 50 feet in length; 15 meters) and designed to protect rapidly bank-eroding areas that are not already exposed.
  - A "launchable" groin would be constructed at milepost 4.621, at the end of the remaining road just before Ipsut Creek campground. This structure looks similar to a complex crib wall but is buried into the extant bank with the anticipation that floods will cause bank erosion up to the structure, exposing it rather than constructing it in the already-exposed riverbed.

- o In the Falls Creek area, spanning trees whose root wads are on the left (south) bank of the river will be cut, notched and pulled into the new Carbon River side channel/former road prism. The root wad would remain on the left bank. Large woody debris would be chocked on the left side of the channel behind the structure to encourage aggradation and bank protection of the left bank.
- **Grade control structures:** Where large culverts are going to be removed (e.g., at Ranger Creek and an unnamed tributary at the Chenuis Falls trailhead), a series of 3 log grade control structures will be constructed to prevent the release of stored sediment behind the culvert.
- Several culverts will be removed and replaced with trail bridges.

3.0 WETLANDS OF THE PROJECT AREA

The project area along the Carbon River Road includes approximately 5 miles of active river channel and associated riparian habitat, from the river corridor adjacent to and just upstream of Ipsut Creek campground downstream to the park boundary (FIGURE 1). The Carbon River valley has designated wilderness beginning 100 feet south of the road centerline until Chenuis Falls, then 100 feet on both sides of the road until the Ipsut Creek Campground. The overall Carbon River watershed at the park boundary is 52.023 square miles (134.738 square kilometers), of which, 74.7% or 38.871 square miles (100.676 square kilometers) is within the park boundary. The remaining 13.152 square miles (34.062 square kilometers is within the Mount Baker-Snoqualmie National Forest, just north of MORA.

Wetland Indicator Status	Occurrence in Wetlands
OBL = Obligate wetland species	> 99%
FACW = Facultative wetland species	67 – 99%
FAC = Facultative species	34 – 66%
FACU = Facultative upland species	1 – 33%
UPL = Upland	<1%

Note: FacW, Fac and FacU have + and – values to represent species near the wetter end of the spectrum (+) and species near the drier end of the spectrum (--).

Mile 0.0 to Mile 0.5: Palustine, forested, needle-leaved evergreen seasonally flooded Cowardin wetland (Section 1 on map).

Understory vegetation adjacent to this section of the project area is dominated by obligate wetland, facultative wetland and facultative species, and is the basis for classification of this area (see description and photo 29 in Chapter IV of EA). Facultative upland and upland species also occur in this area, but are restricted to elevated logs and hummocks within the matrix of wetland associated species.

Mile 0.5 to Mile 1.5: Palustine, forested, needle-leaved evergreen seasonally flooded Cowardin wetland (Section 2 on map).

Vegetation adjacent to this section of the road is similar to the previous section, except that skunk cabbage (*Lysichiton americanum* – OBL) is much less abundant, possibly indicating a shorter hydroperiod in this area. However, the dominance of facultative wetland and facultative species in the understory gives this area its wetland character. Tree species composition also changes in this section with Sitka spruce (*Picea sitchensis* – FAC) becoming less abundant, while Douglas fir (*Pseudotsuga menziesii* – FACU) becomes co-dominant (see description and photo 30 in Chapter IV of EA). Similar to the previous section of road, facultative upland and upland species also occur in this area, but are restricted to elevated logs and hummocks within the matrix of wetland associated species.

Within this section of road there are two stream crossings that include culverts under the road bed. These areas are riverine, intermittent streambed, cobble-gravel substrate Cowardin wetlands. Edges of these stream beds support dense populations of facultative wetland and facultative species. These crossings are at approximately 1.3 miles (Site 1 on map) and 1.4 miles (Site 2 on map) and are about 60 feet wide each (see photo 31 in Chapter IV of EA).

Mile 1.5 to Mile 2.0 (Falls Creek washout area): Riverine, intermittent streambed, cobble-gravel and sand substrate Cowardin wetland (Section 3 on map).
This section of the project crosses the Falls Creek washout area where Falls Creek enters the Carbon River. The proposed trail traverses a complex of intermittent water courses with cobble-gravel and sand bottoms. The temporary trail reveals a sandy alluvium mixed with rounded river rocks. The former road bed is now occupied by a downcut side channel of the Carbon River which runs parallel to the proposed trail route and no more than 25 feet from it.

Species composition is similar to the previous section of road corridor, with devil's club forming dense populations adjacent to the intermittent stream channels (see description and photos 32 and 33 in Chapter IV of EA). The trees have formed buttresses at the base indicating a saturated soil condition for at least part of the year.

Numerous actions to establish the maintained trail are proposed within this section of the corridor. Actions include construction of gabion mat trail base, crushed rock trail base, and several bridges to cross the more incised channels. Also, the removal of 17 trees of various species ranging in size from 6 inches to 24 inches DBH is proposed.

Mile 2.0 to Mile 3.1: Non-wetland (Section 4 on map).
The road corridor heads gradually uphill from the Falls Creek area and the road bed in this area is relatively intact. The composition of the understory vegetation adjacent to this section of road is more typical of an upland environment (see description and photo 34 in Chapter IV of EA).

At approximately 2.7 miles a side channel begins to run immediately adjacent to the road corridor, and at approximately 2.9 miles the road corridor borders the open flood plain of the Carbon River with a side channel running at the base of the fill slope.

Mile 3.1: Ranger Creek Culvert: Riverine, lower perennial, cobble-gravel unconsolidated bottom and palustrine, forested, broad leaved deciduous and needle leaved evergreen Cowardin wetlands (Site 3 on map).
The road corridor crosses Ranger Creek just before it enters the Carbon River. Species associated with this wetland area are dominated by FAC and FACW species (see description in Chapter IV of EA). The road corridor crosses the creek and associated wetlands for about 100 feet associated with erosion and cutbank damage to the road bed.

Mile 3.3: Existing twin culvert: Riverine, intermittent, cobble-gravel and sand streambed and palustrine, forested, needle leaved evergreen Cowardin wetlands (Site 4 on map).
An intermittent stream crosses the road corridor through twin culverts that are plugged with debris. The water has been diverting down both sides of the road such that the road corridor is now included as part of the intermittent stream channel.

Understory species in the wetland associated with the streambed are dominated by OBL and FAC species (see description in Chapter IV of EA) The road corridor crosses the old intermittent stream channels for about 30 feet, but the evidence of water running down both sides of the road extends over 100 feet to the west.

Mile 3.5: Road Washout: Riverine, intermittent, cobble-gravel and sand streambed and palustrine, forested, needle leaved evergreen Cowardin wetlands (Site 5 on map).
Two branches of an intermittent stream come together just before the road corridor and washed out the road as it joined the Carbon River. The proposed trail crosses the intermittent streambed and associated wetlands for about 120 feet.

Dominant understory species include both FACW and FAC species (see description in Chapter IV of EA) and are the basis of the classification of these wetlands.

Mile 3.6 to Mile 3.8: Chenuis Falls Parking Area: Riverine, lower perennial, cobble-gravel unconsolidated bottom and palustrine, forested, broad leaved deciduous and needle leaved evergreen seasonally flooded Cowardin wetlands (Section 5 on map).
Two streams come together at beginning of this section and enter the Carbon River through a "hanging" culvert. East of the culvert and parking area the road corridor has a perennial branch of the carbon river on the north side and an intermittent stream bed with standing water on the south side. The trail route is river alluvium and rounded river rock as a result of water channeling down and along both sides the road bed.

The forested wetlands associated with the riverine wetlands on both sides of the road corridor are dominated by FAC tree species and both FAC and FACW understory species (see description and photo 35 in Chapter IV of EA) and are the basis of the classification in this area.

Mile 3.9: Riverine, intermittent, cobble-gravel bottom streambed Cowardin wetland (Site 6 on map).
An intermittent side channel of the Carbon River crosses the road corridor and continues south into the surrounding forest. The proposed route crosses the intermittent channel for about 30 feet (See photo 36 Chapter IV of EA).

Mile 3.9 to Mile 4.5: Palustrine, forested, needle-leaved evergreen seasonally flooded Cowardin wetland (Section 6 on map).
This section of the road corridor is similar to the second section described above. Understory vegetation is dominated by facultative wetland and facultative species and are the basis for the classification of this area (see description and photo 37 in Chapter IV of EA). Facultative upland and upland species also occur in this area, but are restricted to elevated logs and hummocks within the matrix of wetland associated species.

Mile 4.5 to Mile 4.8: Palustrine, forested, needle-leaved evergreen seasonally flooded Cowardin wetland (Section 7 on map).
This section of the road corridor is where the former road bed is now occupied by a perennial branch of Ipsut Creek, therefore the proposed trail is through previously undisturbed vegetation. Numerous blow-down trees have exposed the river alluvium and rounded river rock that is below 4" to 6" of organic matter. This area is a forested wetland because the understory vegetation is dominated by FAC and FACW species, including dense patches of FAC and FACW ferns in the lower, wetter spots (see description and photo 38 in Chapter IV of EA).

Mile 4.7: Riverine, intermittent, bedrock bottom streambed (Site 7 on map)
Proposed trail route crosses an intermittent stream bed. Crossing is about 60 feet wide. A 30"X30" culvert is proposed for this site to accommodate seasonal flows.

Mile 4.8: Riverine, lower perennial, bedrock and rubble bottom Cowardin wetland (Site 8 on map).
Existing log bridge over Ipsut/Carbon River is about 40 feet long. Existing concrete bridge over Ipsut/Carbon is about 70 feet long, and would be maintained as long as practical. A new log bridge is proposed that would be aligned with the old road bed and the existing concrete bridge.

Mile 4.9: Ipsut Campground: Non-Wetland.
End of project.

4.0 WETLAND FUNCTIONS OF THE PROJECT AREA

The primary functions of the wetlands in the project area include recharge of groundwater, support of biogeochemical processes, support of a characteristic plant community, and provision of suitable habitat for native fish and wildlife.

Forested wetland habitats, and intermittent and perennial riverine wetland habitats are used by a variety of birds, fish and other wildlife. The forested wetland along the first section of the road corridor supports a population of Sitka spruce (*Picea sitchensis*) that is the furthest inland from the coast of any known population. Some of the fish habitat has been degraded by culverts along the road corridor that do not provide for fish passage.

5.0 SPECIAL STATUS SPECIES

Five federally listed species occur in the project area, two bird and three fish species.
The Northern Spotted Owl (*Strix occidentalis caurina*) is listed as a threatened species. Northern spotted owls are long-lived, non-migratory birds that establish territories that they defend against other owls and avian predators. Suitable spotted owl habitat is generally mature or old-growth forest that has a moderate to high canopy closure; a multi-layered, multi-species canopy dominated by large overstory trees; numerous large snags and down logs; and sufficient open space below the canopy for owls to fly through. Forests with these characteristics provide nesting and roosting sites for spotted owls and support the highest densities of northern flying squirrels.

The Marbled Murrelet (*Brachyramphus marmoratus marmoratus*) is listed as a threatened species. Marbled Murrelets are small, diving seabirds that spend most of their life in nearshore marine waters foraging on small fish and inverterbrates, but use old-growth forests for nesting. Murrelets nest in forested areas up to 52 miles inland from their saltwater foraging areas. Nests occur primarily in large, old-growth trees, with large branches or deformities that provide a suitable nest platform. Murrelets do not build a nest, but rather create a nest depression in moss or litter on large branches.

Bull Trout (*Salvelinus confluentus*) are listed as a threatened species. The project area contains designated critical habitat for bull trout. Bull trout are salmonid fishes native to the Pacific Northwest and western Canada. Bull trout exhibit both resident and migratory life-history strategies. Resident bull trout completed their life cycles in the streams in which they spawn and rear. Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form), or saltwater (anadromous form) to rear as subadults and to live as adults. They are iteroparous (they spawn more than once in a lifetime).

Puget Sound Chinook Salmon (*Oncorhynchus tshawytscha*) are listed as a threatened species. The project area contains designated critical habitat for Puget Sound Chinook Salmon. The Puyallup River basin has two historically independent populations of Chinook: Puyallup River fall-run and White River spring-run. The Puyallup River fall-run includes Chinook that spawn and rear in the Carbon River and its tributaries.
Puget Sound Steelhead (*Oncorhynchus mykiss*) are listed as a threatened species. The steelhead is the anadromous form of rainbow trout; offspring from either steelhead or rainbow trout can become anadromous, or remain in freshwater (resident form) their entire lives. However, the Federal threatened species status does not pertain to resident rainbow trout. Steelhead are generally categorized as winter-run or summer-run, depending on the time of the year they return to freshwater river systems to reproduce. The majority of steelhead returning to the Puyallup River system are winter-run fish that generally enter the river beginning in winter.

6.0 WETLAND IMPACTS OF THE PREFERRED ALTERNATIVE

Direct impacts to wetlands are quantified as the areal extent of wetlands occupied by the proposed maintained trail constructed outside of the footprint of the former road. The preferred alternative would construct approximately 4,224 linear feet of maintained trail outside the footprint of the road, or about 0.97 acre. This includes 2,640 feet in the Falls Creek washout area (Section 3 on the map) and 1,584 feet in the Ipsut Creek area (Section 7 on the map). Four logjams near the entrance area would fill another approximately 0.50 acre. While adding material to the riverine wetland, these structures would provide a beneficial effect to the fish habitat function of these wetlands. Proposed erosion protection structures, including the toe-roughened gabion or log crib walls, additional log crib walls, and “launchable” groin, would be within the prism of the former road and are not included as fill impacts to wetlands of the proposed action. Therefore, the preferred alternative would adversely impact approximately 0.97 acres of wetland through fill activities.

Design to Reduce Impacts and Mitigation of Impacts

The project would reduce and mitigate impacts to wetlands by replacing existing culverts that are barriers to fish passage with bridges and culverts designed to facilitate fish passage. This would open up approximately 1.3 acres of fish habitat within Ranger Creek, the unnamed tributary, and the Falls Creek area. However, the unnamed tributary and the Falls Creek area are intermittent streams currently, so may not be effective fish habitat. Ranger Creek would provide approximately 0.9 acre of fish habitat with perennial water flow. The trail tread would be designed to allow water to pass through the tread and thereby reduce the impacts of the trail on water movement. Within sections of the road classified as wetlands, remnants of the 20 foot wide road that were not destroyed or severely eroded by the floods would be removed and replaced by the 10 foot wide trail tread, which would be a reduction of the footprint within wetlands and a long-term beneficial effect. Additionally, any asphalt that remains in the project area from the road would be removed.

7.0 JUSTIFICATION FOR USE OF WETLANDS

The park's General Management Plan (GMP) Record of Decision states that the park would eventually "close the Carbon River Road to private vehicles when there is a major washout of the road and convert the Ipsut Creek Campground to a walk-in / bike-in camping area." The 2006 fall flooding was a major washout. The Mount Rainier National Park GMP, however, also calls for the preservation of the Carbon River Road corridor so as to have no adverse effect on the Mount Rainier National Historic Landmark District. Although the GMP calls for closure of the Carbon River Road to private vehicles following a major washout, it also provides for continued use by administrative vehicles and conversion of the road to a hike and bike trail. The preferred alternative was thought to meet both management direction from the GMP and the Park's goal to preserve year round public access to the northwest corner of the park including the unique and popular natural, historical and recreational features of the Carbon River Valley.

8.0 CONCLUSION

The project under the preferred alternative would adversely affect up to 0.97 acres of wetlands by removal of vegetation and filling wetlands through construction of a maintained trail tread, and placement of bridge pilings and supports. However, the project would have beneficial effects to wetlands through replacement of existing culverts that block fish passage with bridges and culverts designed to facilitate fish passage, and make an additional 1.3 acres of wetland habitat available to fish, including three federally listed species. The addition of wood to the river through construction of the four logjams would be another 0.5 acre of beneficial effects to the fish habitat function of the wetlands. Therefore, compensation actions would total 1.8 acres and give a compensation ratio of 1.9:1.

The NPS finds that the proposed action (preferred Alternative) is consistent with the servicewide no net loss of wetland policy and is acceptable under Executive Order 11990 for the protection of wetlands.

9.0 REFERENCES

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. USDOI, USFWS, Office of Biological Services, Washington D.C. FWS/OBS-79/31. 131 pp.

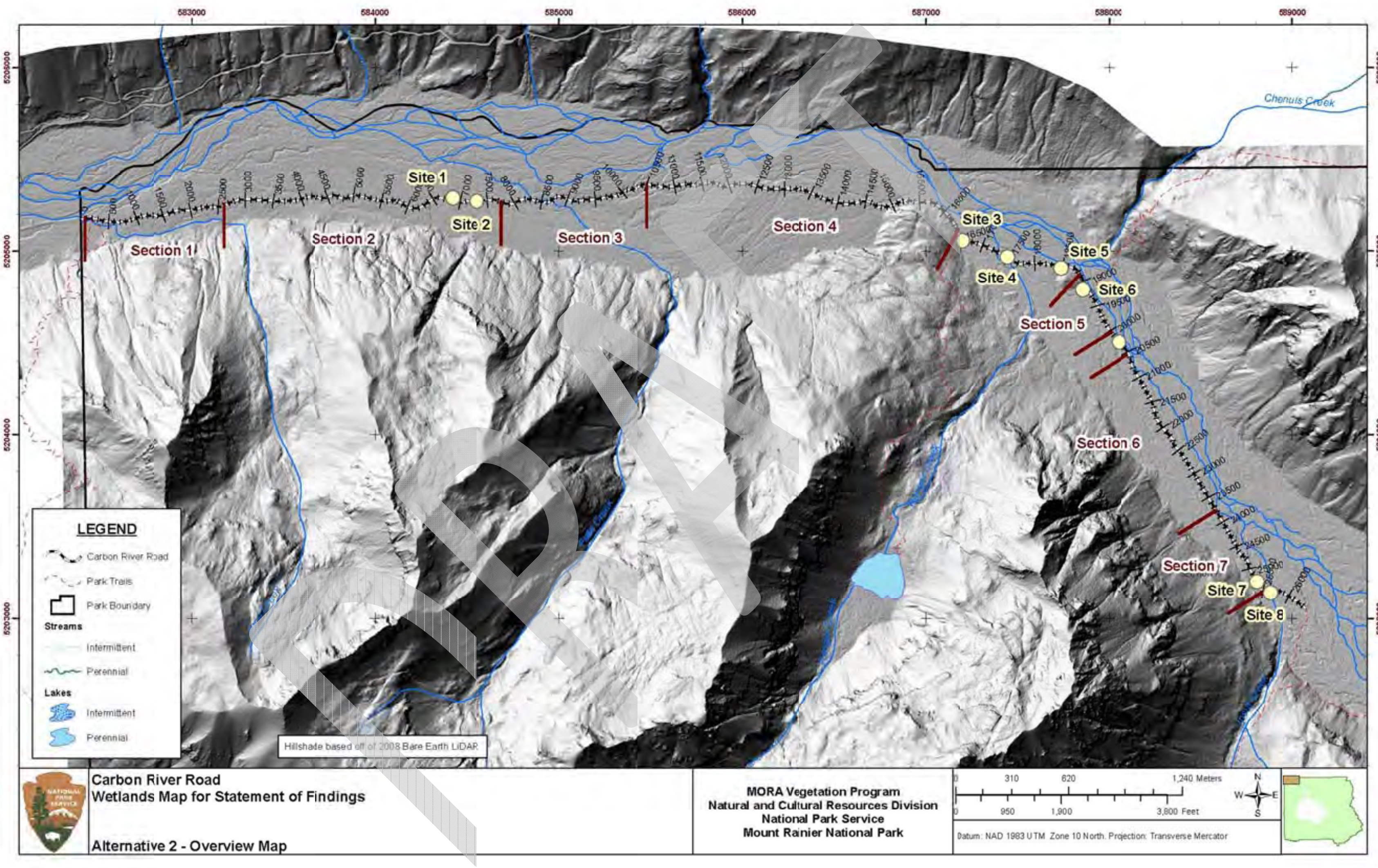


Figure 1: Wetland Site Map

Appendix 9: Draft Biological Assessment (detached)

This detachment is available on the park's website located at http://www.nps.gov/mora and on the Planning, Environment and Public Comment (PEPC) website located at http://parkplanning.nps.gov/mora.

Appendix 10: Draft Impairment Analysis for Carbon River Area Access Management Environmental Assessment Preferred Alternative

Alternative 2: Improved Hiking and Bicycling Trail in Historic Carbon River Road Corridor (Preferred)

New NPS guidelines require this draft analysis be prepared for the preferred alternative.

The following impact topics are considered in the Carbon River Area Access Management Environmental Assessment (EA).

Step 1: Resource Impact Topics Considered in Carbon River Area Access Management Environmental Assessment

<u>Physical Resources</u>

- Air Quality
- Geology / Geological Hazards
- Soils
- Water Resources (including water quality, wetlands and floodplains)

<u>Biological Resources</u>

- Vegetation
- Wildlife
- Special Status Species

<u>Cultural Resources</u>

- Prehistoric and Historic Archeological Resources
- Ethnography
- Historic Structures/Cultural Landscapes

<u>Recreational / Social Resources</u>

- Wilderness
- Wild and Scenic Rivers

Impairment analyses are not provided for the following topics also considered in the Carbon River Access Management EA because these are not required:

- Visitor Experience
- Socioeconomics
- Park Operations

Impairment findings relate to park resources and values and these impact topics are not generally considered to be park resources or values according to the Organic Act, and therefore cannot be impaired the same way that an action can impair park resources and values (NPS 2010:4).

Step 2: Brief Description of Condition of Resource

See descriptions combined under d) below.

Step 3: Analysis of Impairment

a) Whether the resource is necessary to fulfill the purposes for which the park was established;
b) Whether the resource is key to the natural or cultural integrity of the park or to the opportunity for enjoyment of the park;

c) Whether the resource is identified as a significant resource in the park's planning documents; and
d) A "because statement" as to why the action will or will not result in impairment of the resource. This "because statement" should include a discussion of the context, severity, duration and timing of any impacts and also discussion of any mitigation measures, if applicable.

a) Whether the resource is necessary to fulfill the purposes for which the park was established
b) Whether the resource is key to the natural or cultural integrity of the park or to the opportunity for enjoyment of the park
All of the following park resources analyzed in the EA are necessary to fulfill the purposes for which the park was established and are important to the natural or cultural integrity of the park or to the opportunity for enjoyment of the park:

- Air Quality
- Geology / Geological Hazards
- Soils
- Water Resources (including water quality, wetlands and floodplains)
- Vegetation
- Wildlife
- Special Status Species
- Prehistoric and Historic Archeological Resources
- Ethnography
- Historic Structures/Cultural Landscapes

In addition, park values were enhanced by the designation of wilderness and would potentially be enhanced if the Carbon River was designated as a wild and scenic river for its recreational, scenic or wild values.

These resources contribute to the purpose and significance identified in the enabling legislation for the park, including the purposes and significance of the park as identified in the General Management Plan (NPS 2002) and as noted in the EA.

c) Whether the resource is identified as a significant resource in the park's planning documents
As noted above, the following resources are recognized as significant (named) in the park planning documents, notably the GMP (NPS 2002):

- Geology (volcanism, Mount Rainier, geological hazards history)
- Water Resources (alpine glacial system, glaciers, watersheds, water)
- Vegetation (diverse, old-growth forest, rainforests, wildflower meadows, ancient alpine heather, ecosystem processes)
- Wildlife (habitat, island of protected area)
- Ethnography (Native American traditional uses, spiritual and cultural sustenance)
- Historic Structures / Cultural Landscapes (buildings, roads and trails of Mount Rainier National Historic Landmark District, NPS Rustic architecture)
- Scenic Resources (opportunities to experience unique vegetation, glaciers)
- Wilderness (values and experiences).

d) A "because statement" as to why the action will or will not result in impairment of the resource. This "because statement" should include a discussion of the context, severity, duration and timing of any impacts and also discussion of any mitigation measures, if applicable.

- **Air Quality**

Mount Rainier National Park is designated a class I area under the Clean Air Act (1977). Class I areas are afforded the highest degree of protection under the Clean Air Act. Activities such as campfires and the operation of vehicles and equipment and heating of buildings cause air quality degradation in the park, although most impacts are attributable to stationary and mobile emissions from the Puget Sound area and increasingly to pollutants transported long distances through the upper atmosphere. While some air quality parameters have shown decreases in recent measurements (wet sulfate, wet ammonium, and wet nitrate and ammonium concentration), others show no trend (dry nitrogen or sulfur deposition) or increases (episodic acidification of mountain lakes from atmospheric deposition, decreases in visibility). Ozone currently meets NAAQS standards, however if new standards are set as proposed, currently monitored ground level ozone concentrations would exceed these.

Good air quality is necessary to fulfill the purposes for which the park was established and is key to the natural integrity and enjoyment of the park. In the preferred alternative, long-term impacts would continue to occur from access to the area and short-term impacts from construction. These would be combined with long-term beneficial effects from restoration and from an overall reduction in vehicles on the roadway compared to use before flooding. These impacts would be localized and would not be detectable over ambient conditions except in the vicinity of the roadway. There would be no impairment of air quality or air quality related values from the actions in the preferred alternative.

- **Geology / Soils**

Mount Rainier, an active volcano is the 5th highest peak in the continental United States. As a result, Mount Rainier presents considerable geologic hazards, including the potential for debris flows, avalanches, floods, as well as pyroclastic flows, ash fall, and lava flows if the volcano erupts, to park visitors, employees, and infrastructure.) The Carbon River Road is an extreme floodplain, a Case III debris flow hazard zone. Case III areas are subject to debris flow hazards on an average recurrence interval of one event every 100 years.

The park contains areas of high elevation solid rock and talus slopes with virtually no soil to low elevation glacial valleys with well-developed organic soils. Park soils have been divided into four types: tephra soils (pyroclastic deposits identified by individual ash layers); colluvial soils (coarse, unconsolidated soils of mixed parent materials); alluvial soils (river or glacially deposited soils); and mudflow soils (surface or subsurface parent materials resulting from volcanic mudflows).

Geological resources and healthy soils are necessary to fulfill the purposes for which the park was established, are identified in park planning documents as significant, and are key to the natural integrity and enjoyment of the park. The preferred alternative would have long-term impacts from excavation of foundations for new structures (visitor contact station, entrance arch, backcountry toilets) and short- and long-term impacts from the construction of erosion protection measures and construction of a formal improved trail. Beneficial effects would occur from restoration of portions of the former road. As a result, there would be no impairment of geological resources or values.

- **Water Resources (including water quality, wetlands and floodplains)**

Mount Rainier contains the largest single-peak glacial system in the United States, with 26 named glaciers and many smaller unnamed glaciers. The Carbon River flows north from the Carbon Glacier and joins with the Puyallup River before flowing into the Puget Sound at Commencement Bay in Tacoma. The Carbon River has been shown to aggrade more quickly than any other river in the park, at a rate of nearly 0.5 ft per year (31 feet between 1915 and1971). Peak flow data from the gauge on the Carbon River (near Fairfax) show an increasing frequency and occurrence of floods, from below 4,000 cfs in 1927 to above 6,000 cfs in 2006. With the exception of the Falls Creek area, the majority of the NPS road and visitor facilities lay outside of the regulatory 100 and 500 year floodplains. A portion of the roadway between the park entrance and maintenance area as well as a large portion of the roadway from the Chenuis Falls trailhead to Ipsut Creek campground, however, has the main stem river flowing within 10-50 feet of the roadway. Wetlands in the project area, along the Carbon River Road and Ipsut Creek include perennial and intermittent riverine, palustrine forested, and palustrine shrub scrub wetlands. Water quality in the

Carbon River and Ipsut Creek is not routinely monitored but from existing data collected by NPS staff meets standards for Clean Water Act designated Class AA (extraordinary) water quality standards.

Water resources are necessary to fulfill the purposes for which the park was established, are identified in park planning documents as significant, and are key to the natural integrity and enjoyment of the park. The preferred alternatives would have short- and long-term adverse impacts on physical hydrology, floodplains and wetlands and short-term adverse impacts on water quality. Most long-term impacts would be associated with maintenance of the trail and with placement of logjams, span log check dams and cribwalls. Except for the logjams, these erosion protection measures would be constructed within the former footprint of the road. Because mitigation measures would be used to limit impacts and because most of the river within the park would continue to flow freely, there would be no impairment of water resources or water resources values.

- **Vegetation**

The Carbon River area is within the forested zone, which comprises approximately 58 percent of the park. Stands of 500 to 600-year old western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*) and western red cedar (*Thuja plicata*) are the dominant vegetation in the Carbon River area. Sitka spruce (*Picea sitchensis*), Pacific yew (*Taxus brevifolia*), silver fir (*Abies amabilis*) and vine maple (*Acer circinatum*) are intermixed in the stands. Non-native invasive plants are found within the whole Carbon River corridor in relatively low density, frequency and abundance.

Vegetation resources are necessary to fulfill the purposes for which the park was established, are identified in park planning documents as significant, and are key to the natural integrity and enjoyment of the park. Trail construction would require the removal of approximately 15 trees between 10 and 24 inches dbh as well as some very large stumps and 29 trees less than 10 inches dbh. Additional vegetation impacts would occur from maintenance of the trail and from conversion of currently developed areas at the entrance to parking. Restoration would include approximately 10 feet of the former roadway plus parking areas along the road and at Ipsut Creek. Because there would be impacts to individual plants, but not communities, vegetation in the Carbon River area would remain intact and there would be no impairment of vegetation or the values associated with it.

- **Wildlife**

Mount Rainier is home to at least 60 species of mammals, 229 birds (80 breeding), five reptiles, 20 amphibians, and seven species of trout, steelhead and whitefish. In addition, there is a wide variety of known and unknown invertebrates, including insects, spiders, worms, and freshwater mollusks.

Healthy wildlife populations are necessary to fulfill the purposes for which the park was established, are identified in park planning documents as significant, and are key to the natural integrity and enjoyment of the park. There would be a variety of short-term adverse impacts to wildlife combined with some long-term impacts associated with removal of some vegetation. Restoration of 10 feet of former roadway and parking areas would have long-term beneficial effects. Because individual animals, rather than wildlife populations and communities would be affected, there would be no impairment of wildlife or wildlife values.

- **Special Status Species**

Mount Rainier contains habitat for eight wildlife species listed as threatened or endangered by the U.S. Fish and Wildlife Service, including marbled murrelet, northern spotted owl, gray wolf, grizzly bear, Canada lynx, Pacific fisher, bull trout, Puget Sound steelhead and Puget Sound Chinook salmon. It also contains critical habitat for bull trout and Puget Sound Chinook and essential fish habitat for Chinook and coho salmon. The Pacific fisher and Mardon skipper butterfly area candidates for federal listing. The peregrine falcon, bald eagle, northern goshawk, Oregon vesper sparrow, olive-sided flycatcher, California wolverine, soliperlan stonefly, Pacific Townsend’s big-eared bat, long-eared myotis, long-legged myotis, coho salmon, coastal cutthroat trout, Cascades frog, tailed frog, western toad, larch mountain salamander, Columbia torrent salamander, Van Dyke's salamander, and California floater mussel are considered species of special concern. In addition there are an additional five state species of concern (not mentioned above).

There are no federally listed plants in the park. Approximately 37 species on the Washington Natural Heritage Program list of state endangered, threatened or sensitive plants are either known to occur in the park or are likely to occur there based on the presence of suitable habitat, however none are known to occur in the Carbon River area.

Viable populations of special status species are necessary to fulfill the purposes for which the park was established and are key to the natural integrity of the park. Although the preferred alternative, like other alternatives is considered likely to adversely affect marbled murrelets, northern spotted owls, bull trout, bull trout critical habitat, and steelhead and not likely to adversely affect Chinook salmon. All alternatives would also adversely affect essential fish habitat for Chinook and coho salmon. There would no effect on the grizzly bear, gray wolf, Canada lynx, or fisher. Because effects to these wildlife species would result primarily from noise and disturbance, because a wide range of mitigation measures would be applied to limit impacts, and because the proposed actions under Alternative 2 are not expected to result in the loss of individuals or in jeopardy to the species, there would be no impairment of special status species or values associated with them.

- **Prehistoric and Historic Archeological Resources**

Despite limited survey, 176 archaeological properties have been documented in Mount Rainier National Park through June 2006. Seventy-seven (77) of these properties are of solely prehistoric origin, 13 have both prehistoric and historic period components; and 86 sites date only to the historic period.

Prehistoric archaeological sites are found predominantly in high elevation forest, subalpine and alpine environmental contexts. The pattern reflects the enhanced abundance of economically useful plants and animals present in these upper elevation patchy forest and meadow communities. The oldest, firmly aged, prehistoric deposits date to approximately 4,500 years before the present. Research into the earliest use of Mount Rainier landscapes continues; it is possible that the prehistoric human record ultimately will be shown to extend to over 8,500 years ago.

Historic-period sites are widely distributed throughout the park in a variety of elevations and environmental settings. Most of the historic properties are associated with late 19th and early 20th century mining activities, and with development of early park infrastructure. Seven historic archeological sites have been documented in the Carbon River project area.

Intact prehistoric and historic archeological resources are necessary to fulfill the purposes for which the park was established and are key to the cultural integrity and enjoyment of the park.

- **Ethnography**

The upper Carbon River valley was important to pre-contact Native American people for its suite of floral and faunal resources, and as a travel route to higher elevation habitats on Mount Rainier. Both overstory and understory constituents of Carbon River's temperate rainforest were used by Indian people in pre-contact times. Substantial evidence exists for early Native American use of the river valleys around Mount Rainier. Numerous prehistoric sites have been documented in the subalpine parklands above the Carbon River Valley. Six descendant tribes are associated with Mount Rainier National Park, including two with direct ties to the Carbon River Valley – the Puyallup Tribe of Indians and the Muckleshoot Indian Tribe. Four ethnographic sites documented in the park date to recent times, indicating continuing Native American use of the mountain.

Acknowledgement and preservation of ethnographic resources (Native American traditional uses, spiritual and cultural sustenance) is identified in park planning documents as significant and is key to the cultural integrity and enjoyment of the park. With the Old Mine Trailhead turnaround, there would be improved access to the trail. In addition, there would be both adverse and beneficial impacts to fisheries. The ability to enter the park and to access traditional resources would not be affected. There would be no impairment of ethnographic resources or the values associated with them.

- **Historic Structures/Cultural Landscapes**

The Mount Rainier NHLD was designated in 1997. This large and exceptional District, now on the National Register of Historic Places (under landscape architecture) and which includes Camp Muir, contains 97 historic buildings and 60 historic structures (including most of the park's road system and the Wonderland and Northern Loop trails) as well as 31 other listed features. Together, these resources are considered to be the best example of park master planning in the National Park System. Collectively, they represent an important stage in national park development history. At Mount Rainier in the 1920s and 1930s, the NPS Landscape Planning Division invented and defined modern national park planning. Consequently, the Master Plan for Mount Rainier, completed in 1929, was the first national park master plan developed by the NPS and it was and is considered a model of NPS planning. The degree of conformance to the plan still present in the park is outstanding. As a whole, no other collection of park roads, bridges, developed areas and trails is more completely preserved as an intact example of national park planning and design of the period 1904-1957. The goal, then as now, was to integrate all park systems and facilities in a unified plan that would ensure the best possible visitor experience while severely limiting how much development would be permitted in the park (Carr 1998). The master plan was executed in the rustic style of architecture and the naturalistic style of landscape architecture, using native materials and natural forms to blend constructed works with their environment.

There are approximately 158 historic resources in the park individually and collectively listed on the National Register of Historic Places, including those designated as part of the NHLD. Many more sites, structures and objects are potentially eligible for the National Register.

The Carbon River Road, a 4.9 mile long unpaved spur, is identified as a structure contributing to the significance of the NHLD and is included within the district's discontinuous boundaries (NPS 1997). The draft CLI also identifies it as an eligible cultural landscape. According to the CLI, for the most part, its alignment and ancillary structures of the Carbon River Road are original and intact. Because this is the only road in the park built entirely by the National Park Service; because the centerline of the road follows (mostly) the alignment of the road during the period of significance; and because almost all of the major structures associated with the road are original, the road can be said to have excellent integrity overall to the period of significance (1920s-1930s). The draft CLI, completed just prior to the 2006 flood, states that the naturalistic character of the road is evident in its remaining landscape characteristics: spatial organization, circulation, topography, views and vistas, vegetation, natural systems and features, and archaeological sites. These patterns and their surviving features continued to exist as originally planned in 2006, conveying the integrity of the road as a scenic highway.

Increased aggradation in the Carbon River bed combined with the location of the road at grade along the river bed has resulted in large, devastating floods impacting the road relentlessly over its lifespan.

Intact historic structures and cultural landscapes are necessary to fulfill the purposes for which the park was established, are identified in park planning documents as significant, and are key to the cultural integrity and enjoyment of the park. The preferred alternative, like all alternatives would have an adverse effect on the Mount Rainier NHLD. Although most features of the Carbon River Road that contribute to its significance and listing on the National Register as part of the Mount Rainier NHLD would eventually be lost, the road is but one part of the overall NHLD and implementation of Alternative 2 would not result in impairment of this resource or the values associated with it. There would be no impairment of historic structures or cultural landscapes or their values.

- **Wilderness**

In 1988, Congress designated approximately 97 percent (228,480 acres) of Mount Rainier National Park as wilderness. Park wilderness includes a wide array of undisturbed lands encompassing ancient rainforest, pristine rivers and brilliant subalpine meadows. Park wilderness values include natural, ecological, geological, cultural, scenic, scientific and recreational opportunities. Natural quiet and natural darkness are also considered wilderness values. The Washington National Parks Wilderness Act (1989) established a wilderness boundary that generally begins two hundred feet from the center line of paved roads and developed areas and one hundred feet from the center line of unpaved roads, including the Carbon River Road. Designated wilderness is located on the southern edge of the Carbon River Road from park entrance to west of Chenuis and then on both sides of the road east of Chenuis, with the boundary beginning 100 feet from the centerline of the road.

Wilderness values and experiences are necessary to fulfill the purposes for which the park was established, are identified in park planning documents as significant, and are key to the natural and cultural integrity of the park. There would be short-term minor adverse impacts on nearby wilderness from constructing the improved trail in the preferred alternative. There is a potential in the preferred alternative that moving of the trail away from damaged areas could eventually result in some construction of short segments of trail in wilderness. If this became necessary, additional environmental analysis (a minimum requirement / minimum tool analysis) would be completed. Because most (or all, depending on river movement) impacts to wilderness would be short-term, there would be no impairment of wilderness or wilderness values.

- **Wild and Scenic Rivers**

Approximately eight miles of the Carbon River are eligible for inclusion in the national wild and scenic rivers system (NPS 2002:30). As noted in the eligibility memo, additional designation as part of the wild and scenic rivers system would not provide additional protection because they are protected 1) because of their location in the park and 2) because of inclusion in wilderness (NPS 1990:3). While the wilderness inclusion is true of Segment 1 (from the Carbon Glacier to Ipsut Creek Campground), only a portion of Segment 2 is located in wilderness.

Wild and Scenic Rivers are key to the natural integrity of the park. The preferred alternative would result in limited adverse effects from construction of four logjams and erosion protection measures. Because these would not affect the eligibility of the Carbon River as a wild and scenic river, there would be no impairment of wild and scenic rivers or values.

Conclusion

Because there would be no significant adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for the enjoyment of the park, or (3) identified as a goal in the park's *General Management Plan* or other relevant National Park Service planning documents, there would be no impairment of park resources and values.