Environmental Assessment
Diablo Powerhouse Tailrace Restoration

August 2014

North Cascades National Park Service Complex
810 State Route 20
Sedro-Woolley, WA 98284

1. Purpose of and Need for Action

1.1. Introduction

The purpose of the Diablo Tailrace Restoration Project (project) is to restore hydroelectric generating capacity at the Diablo Powerhouse, which is part of Seattle City Light's (SCL's) Skagit River Hydroelectric Project (Skagit Project). This action is needed because channel aggradation at the confluence of Stetattle Creek and Gorge Lake has reduced hydroelectric power generating capacity at Diablo Powerhouse over the past several decades. Accumulations of gravels and cobbles originating from Stetattle Creek have elevated surface water levels in the Diablo Powerhouse tailrace resulting in the loss of approximately 2.8 feet of hydraulic head at the powerhouse.

1.2. Objectives

The specific objectives of the proposed project are to:

- Restore hydroelectric power generating capacity at the Diablo Power Plant by increasing the hydraulic head levels at Diablo Powerhouse.
- Restore power generation in a manner that is as cost-effective as possible.
- Restore power generating capacity in a manner that minimizes impacts to the environment and avoids loss of aquatic habitat.

1.3. Decision to be Made

The Enabling Legislation for Ross Lake National Recreation Area (NRA), as amended by the Washington Parks Wilderness Act of 1988, provides jurisdiction to the Federal Energy Regulatory Commission (FERC) for existing hydroelectric operations and several proposed projects within Ross Lake NRA. Seattle City Light is presently authorized to operate and maintain the Skagit River Hydroelectric Project in accordance with a 30-year license provided by FERC.

This decision focuses on selecting an alternative that best achieves the purpose and objectives of this project while minimizing and mitigating impacts to the resources and values of the Ross Lake NRA. The decision will include reasonable conditions that may be needed to protect park lands and waters and mitigate adverse effects. The Superintendent, North Cascades National Park Complex (NOCA), will be the recommending official. The Regional Director, NPS Pacific West Region, will be the deciding official.

1.4. Project Area

The proposed Diablo Powerhouse Tailrace project consists of an excavation site located immediately west of the mouth of Stetattle Creek along the northern shore of Gorge Reservoir (also known as Gorge Lake) in Whatcom County, Washington (lat. 48.71649N, long. 121.15000W. The project also includes a disposal site (Copper creek pit) for excavated materials (lat. 48.59011N, long. 121.23778W) in Skagit County that is located 5.4 miles northeast of the town of Marblemount, Washington and approximately 15 miles southwest of the excavation site (Figure 1). The excavation site is located within the boundary of SCL's Skagit River Hydroelectric Project (No. 553) which is licensed by the Federal Energy Regulatory Commission

(FERC). The Skagit Hydroelectric Project consists of Gorge, Diablo, and Ross dams and their associated reservoirs, structures, and facilities. The proposed disposal site is on property owned by SCL downstream of the Skagit Project. Both the proposed excavation and disposal sites are located within the Ross Lake National Recreation Area (NRA), which is administered by the National Park Service (NPS) as part of the NOCA.

The proposed excavation area (cobble bar) is located about 6 miles north of Newhalem near the town of Diablo below the confluence of Stetattle Creek with the Skagit River. Access to the proposed excavation area is via State Route 20 (SR 20) to Diablo Road and then through an access road that would be constructed through the NPS's Gorge Lake Campground down the right bank of the river and onto the cobble bar. It is approximately 0.6 mile from the excavation area on Diablo Road to the North Cascades Highway or SR 20 and then an additional 14.5 miles to the proposed disposal area at SCL's Copper creek pit located between milepost 111 and 112 on the south side of the highway. The total distance between the excavation area and the disposal site at the Copper creek pit is about 15 miles.

1.5. Background

A large cobble and gravel bar, a portion of which pre-dates the Skagit Project, has accumulated additional alluvial materials near the mouth of Stetattle Creek at the confluence of the short free-flowing section of the Skagit River between the tailrace for Diablo Powerhouse and Diablo Lake (Figure 2). This expanded cobble bar is causing a backwater effect below the Diablo Powerhouse tailrace, which is contributing to a 2.8 foot loss of hydraulic head and 8,717 megawatts per year of lost power generation capacity at the Diablo Powerhouse tailrace.

The gravel bar aggradation is a natural process that occurs on alluvial fans, but this process has been modified by hydroelectric development activities including levee construction to protect the town of Diablo adjacent to Stetattle Creek. The rate of aggradation has increased in recent years, due to more extreme flood events that may be related to climate change. The bar has measurably grown since the 1990's, but the effects became more pronounced following severe flooding in 2003, which triggered landslides and sever erosion throughout the park, including a landslide along the west bank of Stetattle Creek about 0.4 mile upstream from the confluence with the Skagit River. Large amounts of cobble and gravel, from this landslide and from other mass wasting events and erosion in the watershed, have been transported downstream from Stetattle Creek into the Skagit River by major flood events in 2003, 2006, and 2007.

If action is not taken to reverse aggradation, the cobble bar would be expected to continue to accumulate alluvial material and expand further into the tailrace below Diablo Powerhouse. This will cause additional loss of hydraulic head and power generation capacity as more alluvial materials move downstream in Stetattle Creek and into the short stretch of the free flowing Skagit River between Diablo Lake and the Diablo Powerhouse.

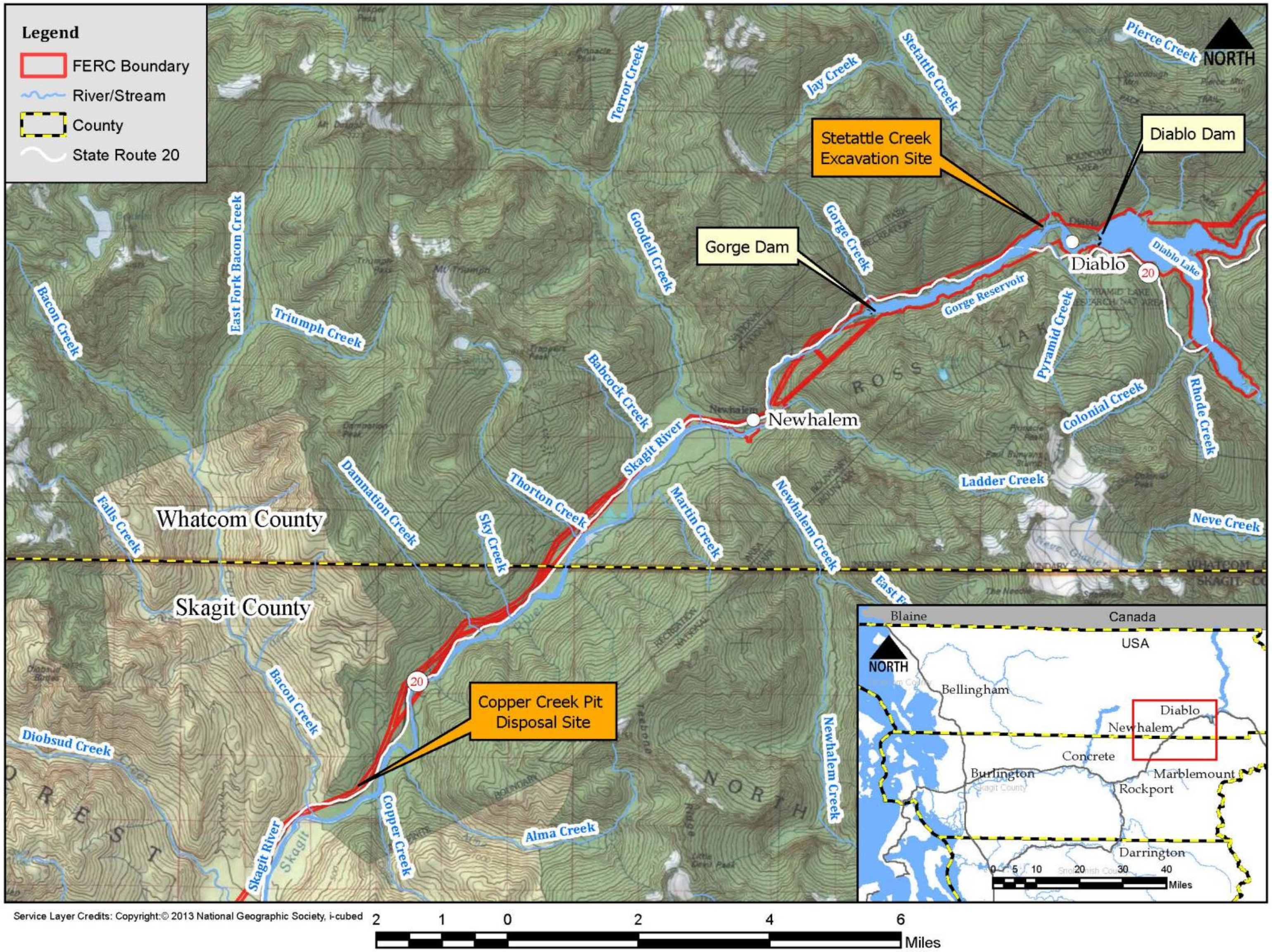


Figure 1. Location of the Diablo Powerhouse tailrace restoration project in Whatcom County and Skagit County, Washington.

Figure 2. Aggrading cobble bar at the confluence of Stetattle Creek and the Skagit River as seen from the shoreline in the Diablo. This bar is expanding upstream and filling in the tailrace below Diablo Powerhouse. Diablo Lake is in the distance downstream.

1.6. Issues to be Studied in Detail

Issues and concerns that are considered in detail in this Environmental Assessment (EA) were identified by NPS staff in consultation with Seattle City Light, and from public and agency comments received in the course of permitting and agency consultations (refer to Chapter 5 for consultation and coordination details). The following issues were identified for detailed analysis in this EA:

- Loss of generation capacity. Channel aggradation downstream of Diablo Powerhouse has reduced SCL's hydroelectric operations generation capacity by 8,717 megawatts per year at the Diablo Powerhouse. The power generating capacity of the Diablo Powerhouse has been reduced due to an enlargement of a cobble bar, following severe flooding and a landslide in 2003, but also due to long-term aggradation of the creek channel. The aggrading cobble bar has constricted the channel of the Skagit River, which has constricted flows and increased the tailwater elevation at the Diablo Powerhouse by approximately 2.8 feet. Potential impacts on head recovery and hydroelectric power generation capacity are addressed under the Environmental Consequences section under Hydroelectric Operations.
- Temporary impacts to water quality. Increased turbidity during excavation of cobble bar deposits could temporarily impact water quality. The proposed action may result in a temporary increases in turbidity (reduced water clarity) due to resuspension of sediments in Gorge Lake downstream of the excavation area, which is below the Ordinary High Water Mark (OHWM). These issues are addressed in the Environmental Consequences section under Water Resources.
- Impacts to fisheries habitat and aquatic resources. Alteration of fish habitat from excavation of the cobble bar and temporary impacts to water quality may adversely impact the Gorge Lake fishery, including native rainbow trout, dolly varden and bull trout (federally Threatened). During construction increases in suspended sediments in the lake could adversely impact fish and other aquatic life. Waters would be lowered approximately six feet to isolate the dredging area and this could strand fish in isolated shallow areas of the reservoir. Deposition of any re-suspended sediments could potentially alter fish habitat. The Gorge Lake reservoir is limited in the amounts of side channel and low gradient stream habitat that are accessible to fish, and dredging would further limit this habitat. Stetattle Creek provides almost all the spawning habitat for bull trout within the system, and the creek is designated as critical habitat. These concerns are addressed in the Environmental Consequences of the Water Resources section and also in the Fish and Wildlife, Including Rare/Listed Species section.
- Temporary noise and habitat alteration impacts on wildlife. Noise and related effects of excavation and hauling could disturb some wildlife species within the vicinity of the Project Area, and modify habitat at the confluence of Stetattle Creek and Gorge Lake. The confluence of Stetattle Creek and Gorge Lake, and the adjacent riparian area and shoreline of Gorge Lake is frequently used by realtviely common species of waterfowl such as mergansers and semi-aquatic species such as beaver. Removal of the gravel bar could adversely affect habitat for these species. Disposal of the excavated material could have beneficial or adverse impacts to wildlife habitat depending upon the location chosen for disposal and the habitat quality of the disposal site once the area is rehabilitated.

These concerns are addressed in the Environmental Consequences section on Fish and Wildlife, Including Rare/Listed Species.

- Disturbance to native plant associations. Disturbance from excavation and disposal of bar material may promote development or expansion of populations of non-native and invasive plants (weeds) in the project area. The proposed action would require removal of riparian vegetation in order to provide access for excavation of the cobble bar and would also result in minor disturbance of vegetation at the disposal site. These effects are addressed in the Environmental Consequences section under Vegetation.
- Temporary impacts to recreation and visitor use. The area including the Gorge Lake Campground will need to be closed during construction. Noise from excavation, hauling, and disposal activities may also temporarily disturb visitors recreating in the vicinity. During excavation and other project activities, the Gorge Campground and boat ramp would be temporarily closed. Closure would displace visitors who wish to camp at the Gorge Campground or use the boat ramp. These concerns are addressed in the Environmental Consequences section under Recreation and Visitor Use.
- Temporary impacts on greenhouse gas emissions. Excavation of the cobble bar and trucking excavated material offsite to an upland disposal site would generate measureable quantities of greenhouse gases, particularly carbon dioxide (CO_2). This issue is addressed in the Environmental Consequences section under Greenhouse Gases.
- Potential impacts on historic and cultural resources. Excavation and disposal activities could affect pre-historic cultural resources, which have not been documented in the area but may be unearthed during excavation. The project could also impact the abutments of the historic Stetattle Creek Bridge, if head cutting occurs in Stetattle Creek following excavation. The potential effects of project activities on historic and cultural resources are addressed in the Environmental Consequences section under Cultural Resources.
- Potential head cutting up Stetattle Creek from excavation. Excavating the cobble bar may promote head cut formation in the lower reach of Stetattle Creek. A head cut could undermine the abutments of the historic bridge over Stetattle Creek. This could harm the integrity of the historic Stetattle Creek Bridge and affect motor vehicle access to facilities, such as houses in the Diablo Townsite, the Diablo Powerhouse, Diablo Switchyard, and Diablo Sewage Treatment Plant. Head cutting also could alter fish habitat in the lower reach of the creek. These potential impacts are addressed in the Environmental Consequences sections under Cultural Resources and Water Resources.

1.7. Issues Considered but Dismissed

The following issues identified during public scoping have been dismissed by the NPS as relevant to the impact analysis for the proposed project:

Air quality. Air quality in the Ross Lake NRA is currently affected by NPS and SCL operations, maintenance, and administrative activities, as well as visitor and recreational use. These include emissions from vehicles, campfires, and motorized boats. A variety of atmospheric pollutants are also received from urban and rural sources as close by as the Puget Sound Lowlands and from as far away as Asia. Visibility monitoring in the NRA over the last six years reflects "stable or improving visibility," both on clear days and hazy days (NPS, 2011). Pertinent to this project, vegetation clearing, cobble bar excavation and other project activities may temporarily create locally dusty conditions and release pollutants such as particulate matter, carbon monoxide and carbon dioxide. Though air quality concerns have been dismissed because impacts to air quality would be temporary and likely undetectable beyond the immediate excavation area, which would be closed to visitors, potential effects on emissions of greenhouse gases are evaluated further in the sections entitled Greenhouse Gases.

Wilderness. This action would not occur in wilderness, but could potentially be heard and potentially seen within the Stephen Mather Wilderness during construction. This project is not likely to measurably affect the current baseline of intrusions from human activities occurring outside of wilderness. Given all the various activities that occur within the hydroelectric project, and activities on the adjacent highway corridor, most wilderness users would be unable to discern this activity from routine hydroelectric and NPS operations, ongoing projects, and other auditory and visual impacts, most notably including activities along the North Cascades Highway (State Route 20), which is immediately adjacent to the Project Area.

Socioeconomic Effects. Broadly speaking, socioeconomic effects include such things as patterns of consumption, the distribution of incomes and wealth, the way in which people behave (both in terms of purchase decisions and the way in which they choose to spend their time), and the overall quality of life. There may be minor disruptions to visitor access during excavation and other project related activities, but these would not disrupt patterns of consumption, distribution of incomes and wealth, or patterns in behavior. Impacts to park visitors, however, are addressed in the Recreation and Visitor Use sections.

Potential harm to genetic integrity of the bull trout population on Gorge Lake and Stetattle Creek. Genetic analysis of bull trout conducted by the University of Washington found that there is a major break in basin-wide genetic composition and diversity at Gorge Dam. There are two major genetic groups of bull trout in the Skagit, the lower Skagit group and the upper Skagit group. Populations in the Skagit River below Gorge Dam, including the mainstem Skagit as well as the Cascade, Sauk, and Suiattle river sub-basins form the first major genetic group. Populations in the upper Skagit above Gorge Dam, including populations in Gorge, Diablo, and Ross lakes form the other major genetic group. The UW analysis further shows that bull trout populations in the upper Skagit basin above Gorge Dam are genetically similar, showing much less diversity than among populations in the lower Skagit watershed below the dam. The lower genetic diversity in the upper Skagit above Gorge Dam is likely an outcome of a small founding population, geographic isolation from the lower river, and by genetic interchange among upper Skagit spawning populations. The bull trout populations present in Gorge, Diablo, and Ross Lakes are genetically distinct from populations in the river downstream of Gorge Dam. Recent analysis of mitochondrial DNA by the USFWS suggests that the bull trout populations in Gorge, Diablo, and Ross Lake descended from fish originating from the Fraser River system, while fish downstream of Gorge Dam descended from coastal Puget Sound populations.

Bull trout in Gorge Lake appear to have been isolated from populations in the lower river well before the dams were constructed, and bull trout in Gorge Lake and the upper Skagit can be delineated from bull trout in the lower Skagit with over 99% certainty using genetic markers. While bull trout in Gorge Lake are indeed isolated from upstream migration from populations in the lower river, genetic analysis indicates that this is a consequence of the geological history and natural topographic isolation of the upper Skagit basin form the lower Skagit basin. However, some bull trout are able to migrate downstream through the turbines of Ross and Diablo dams. Downstream survival rates of bull trout through the turbines have been calculated to exceed 60%, which means that gene flow is likely to occur between Ross Lake, Diablo and Gorge Reservoir in a downstream direction. These conditions indicate that risk to the genetic integrity of the bull trout population would be negligible and were therefore dismissed from further consideration.

1.8. Laws, Regulations and Policies and Administrative Procedures Guiding this Decision

This section identifies legal, regulatory, policy and administrative procedures relevant to this decision. These regulations and policies require the NPS to formally evaluate projects on NPS-managed lands.

1.8.1. Federal Power Act

The Federal Power Act (FPA) created FERC (referred to as the Federal Power Commission in the original FPA) as the licensing authority for hydroelectric projects and interstate electrical transmission, among other responsibilities. Under authority of the FPA, FERC in 1995 issued a 30-year license for the Skagit River Hydroelectric Project. The 30-year timeframe reflected the importance of the power provided by the project, and the expectation that this power source would continue to support the City of Seattle.

1.8.2. Section 4(e) of the Federal Power Act, 16 U.S. C. § 797(e)

This law requires that licenses for projects located within United States (U.S.) reservations must include all conditions the Secretary of the department under whose supervision the reservation falls shall deem necessary for the adequate protection and utilization of such reservation.

1.8.3. National Park Service Organic Act

The Organic Act of 1916 established the NPS and provided the means for the NPS to promote and regulate national parks, monuments, and other reservations. As such, the NPS is required by the Organic Act to protect and preserve unimpaired the resources and values of the National Park System, while providing for public use and enjoyment. The Organic Act provides the fundamental management direction for all units of the National Park System.

1.8.4. Enabling Legislation for the Ross Lake National Recreation Area

Title 2, Ross Lake and Lake Chelan National Recreation Areas, provides:

> …In order to provide for the public outdoor recreation use and enjoyment of portions of the Skagit River and Ross, Diablo, and Gorge Lakes, together with the surrounding lands, and for the conservation of the scenic, scientific, historic, and other values contributing to public enjoyment of such lands and waters.

Title 5, Special Provisions, as amended by the Washington Parks Wilderness Act of 1988 provides:

> …Nothing in this Act would be construed to superseded, repeal, modify, or impair the jurisdiction of the Federal Power Commission under the Federal Power Act (41 Stat. 1063), as amended (16 U.S.C. 791a et seq.), in the lands and waters within the Skagit River Hydroelectric Project, [FERC] Project 553, including the proposed Copper Creek, High Ross, and Thunder Creek elements of the project.

1.8.5. Clean Water Act

The Clean Water Act (CWA) is a national policy to restore and maintain the chemical, physical, and biological integrity of waters of the United States; to enhance the quality of water resources; and to prevent, control, and abate water pollution. Sections 404, 401, and 402 of the CWA are applicable to the Proposed Project. Section 404 of the CWA regulates the discharge of dredged or fill material into waters of the U.S. Excavation of material from below the ordinary high water mark (OHWM) is regulated under the Section 404 program administered by the U.S. Army Corps of Engineers (ACOE) with oversight from U.S. Environmental Protection Agency (EPA). Under Section 401 of the CWA, an activity that includes discharge into waters of the U.S. authorized by the 404 program must receive Water Quality Certification (WQC) from the Washington State Department of Ecology (WDOE). Section 402 of the CWA governs the discharge of pollutants to waters of the U.S., including suspended solids. If more than an acre of land would be disturbed by the proposed project, a Construction Stormwater General Permit. The Construction Stormwater General National Pollutant Discharge Elimination System (NPDES) permit is required. The Construction Stormwater General NPDES program is also administered by WDOE with oversight by the U.S. Environmental Protection Agency (EPA). As part of this NPDES permit, a Stormwater Pollution Prevention Plan (SWPPP) would need to be developed and implemented to ensure compliance with relevant state water quality standards, such as turbidity.

1.8.6. Endangered Species Act

Section 7 of the Endangered Species Act (ESA) precludes all federal agencies, including the National Park Service, from authorizing, funding, or carrying out any activity that may jeopardize the continued existence of an ESA-listed species. The Proposed Project must comply with the consultation requirements of the ESA. It is anticipated that informal consultation will be sufficient to comply with ESA and protect listed species and designated critical habitat that in the vicinity of the project area.

1.8.7. National Park Service Director's Orders

<u>Director’s Order #47: Soundscape Preservation and Noise Management</u>

The Sound Preservation and Noise Management Director’s Order provides for the protection, maintenance, or restoration of the natural soundscape resource and to maintain a condition unimpaired by inappropriate or excessive noise.

1.8.8. National Park Service Management Policies 2006

Section 4.1 of NPS Policies, *General Management Concepts*, generally discourage intervening in natural processes unless:

- directed by Congress;
- in emergencies in which human life and property are at stake;
- to restore natural ecosystem functioning that has been disrupted by past or ongoing human activities;
- or when a park plan has identified the intervention as necessary to protect other park resources, human health and safety, or facilities.

1.8.9. Ross Lake National Recreation Area Final General Management Plan

The 2012 Ross Lake National Recreation Area General Management Plan (GMP) assigns management zones to different areas of Ross Lake NRA. For each of the management zones, there are specific management goals and objectives for resource management, levels of development, and different types of potential visitors' experiences. The proposed project area lies within the Hydroelectric Zone, in which SCL operations are paramount to resource conditions and visitor experience. In this zone, most visitor experiences are linked to learning about hydroelectricity and front-country recreational activities. Most areas within the Hydroelectric Zone will be managed primarily for SCL operations. Applicable management prescriptions for the Hydroelectric Zone include:

- *Natural Resource Conditions*. Wildlife habitat, vegetation, and ecological processes could be altered to achieve other management objectives. While natural resources are not a primary management emphasis, impacts from alterations are minimized to protect resources and values, and restoration efforts occur whenever possible. Also, light and human-caused sounds are a common part of the environment. The NPS continues to work with SCL to reduce light and human-caused sounds where possible.
- *Visitor Experience and Use.* SCL provides and maintains most of the visitor services in the Hydroelectric Zone. Most visitor experiences are linked to learning about hydroelectricity and front country recreational activities. SCL continues to provide the visitors services stipulated in the Settlement Agreement and FERC license.
- *Facilities and Access.* A range of facilities and support infrastructure accommodate SCL operations and provide visitor services for both daytime and overnight use. Although not specifically cited in the GMP, appropriate facilities that are necessary for continued SCL operations and visitors services in the Hydroelectric Zone include boat docks and limited access roads. Public access is available in many areas, but certain areas are restricted for SCL operations.

1.8.10. Recreation and Aesthetics Settlement Agreement

The Recreation and Aesthetics Settlement Agreement was entered in 1991 by SCL and the NPS, in addition to other parties. The Settlement Agreement establishes the Skagit Project Recreation Plan and describes the continuing, mitigation, and enhancement measures that SCL either funds or implements. These measures include recreation facility operation and maintenance, services, studies, and capital projects. SCL has funded several upgrades to Gorge Lake Campground via this agreement.

1.8.11. Washington State Hydraulic Code

A Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (WDFW) per 75.20 RCW is required for any project that will use, divert, obstruct, or change the natural flow or bed of any fresh or salt water of the state. This includes all construction or other work waterward and over the ordinary high water line, including dry channels, and may include projects landward of the ordinary high water line (e.g., activities outside the ordinary high water line that will directly impact fish life and habitat, falling trees into streams or lakes, etc.).

1.8.12. Shoreline Management Act

The overall goal of the Shoreline Management Act (SMA) is "to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines." The SMA directs each city and county with "shorelines of the state" to prepare and adopt a Shoreline Master Program (SMP). The Skagit River is identified as a Shoreline of Statewide Significance in both Whatcom County and Skagit County. Activities within 200 feet of the Skagit River, including the excavation area and Copper Creek Pit, must comply with the SMPs of both Whatcom County and Skagit County as applicable.

1.9. Required Permits and Approvals

1.9.1. Section 404 of the Clean Water Act

An individual permit is being sought from the ACOE. Conceptual project plans have been discussed with the ACOE, and a pre-application meeting was held on August 14, 2013. A Joint Aquatic Resources Permit Application (JARPA) is expected to be submitted to the ACOE by SCL as part of obtaining an individual Section 404 permit. The proposed project would not occur until a Section 404 permit was obtained.

1.9.2. Section 401 of the Clean Water Act

The JARPA being submitted by SCL also will be provided to the WDOE for an individual Section 401 Water Quality Certification. A complete JARPA is expected to be submitted to WDOE after the NEPA process has been completed. The proposed project would not occur until a Section 401 Water Quality Certification was obtained.

1.9.3. Coastal Zone Management Act Certification

A request for Coastal Zone Management Act (CZMA) Certification is being prepared for the WDOE. A CZMA will be sought sometime in 2014 once the NEPA process has been completed. The proposed project would not occur until a CZMA Certification was obtained.

1.9.4. Endangered Species Act, Section 7 Consultation

A Biological Evaluation (BE) is being prepared to inform agencies of potential impacts to federally-listed species that are known to or may occur in the vicinity of the proposed project. It is anticipated that the effects of the proposed work on listed species will result in impacts that are insignificant and discountable. It is anticipated that concurrence from the USFWS will be obtained through the *informal* Section 7 Consultation process as discussed in an August 2013 pre-application meeting with the Army Corps of Engineers that was attended by a representative of the USFWS. The proposed project would not occur until concurrence from the USFWS has been obtained.

1.9.5. Washington State Hydraulic Project Approval

A Joint Aquatic Resources Permit Application (JARPA) is being prepared and will be submitted to obtain a Hydraulic Project Approval (HPA) from WDFW sometime in 2014 once the NEPA process has been completed. A representative of WDFW attended the pre-application meeting on August 14, 2013 where conceptual project plans were discussed with WDFW and other regulatory agencies. The proposed project would not occur until an HPA has been obtained.

1.9.6. Washington State Shoreline Substantial Development

A Shoreline Substantial Development and Conditional Use Permit application is being prepared for the Whatcom County Planning and Development Division and Skagit County Planning and

Development Services for the portions of the project within each entities jurisdiction. It is expected that application submittals will be prepared and submitted sometime in August, 2014. The proposed project would not occur until a Shoreline Substantial Development and Conditional Use Permit has been obtained as applicable from each jurisdiction.

1.9.7. Washington State Environmental Policy Act

The State Environmental Policy Act (SEPA) allows the use of NEPA documents to meet SEPA requirements [WAC 197–11–610). Thus, this NEPA EA will be adopted to satisfy the requirements of SEPA.

1.9.8. National Historic Preservation Act

The National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of projects on historic sites and cultural resources. This process includes consultation with NPS staff, and the Washington State Historic Preservation Officer (SHPO) to determine whether the project may create an adverse effect on a property that is eligible for or listed on the National Register of Historic Places. Other regulations that define the process have been promulgated by the Advisory Council on Historic Preservation and may be found at 36 C.F.R. Part 800, Subpart B.

2. Management Alternatives

2.1. Alternative A - No Action

Under the No Action Alternative the cobble bar at the mouth of Stetattle Creek would not be excavated and would remain in place. Power generation would continue to be impaired by backwater conditions created at the Diablo Powerhouse tailrace. In addition, no dredged material would be deposited at SCL's Copper Creek Pit. This alternative would not meet the purpose and need of the project of restoring lost hydroelectric power generation capacity.

Existing aquatic habitat at the mouth of Stetattle Creek would be maintained, and there would be no risk of increased erosion on the right bank of Gorge Lake (Skagit River) at the Gorge Campground. There also would be no increased risk of head cutting up Stetattle Creek because no accumulated cobbles, gravels, or boulders would be removed.

The No Action Alternative would likely contribute to additional head loss as more material is deposited on the bar from annual bedload transport down Stetattle Creek. This would lead to additional impacts on hydroelectric power generation capacity.

2.2. Action Alternatives

There are three action alternatives being considered (Table 1) to restore lost hydroelectric power generation capacity. Each would involve excavation of the cobble bar and disposal of all of the removed materials at SCL's Copper Creek Pit. More detailed descriptions of Alternatives B,C and D are provided below.

Table 1. Comparison of the excavation amount and estimated head restoration and hydropower generation benefits for the action alternatives.

	Alternative B	**Alternative C**	**Alternative D (Hybrid)**
Excavation Amount (CY)[1]	19,500	18,000	18,300
Estimated Head Recovery at 3,200 cfs (feet)[2]	2.35	2.28	2.30
Estimated Design Life (years)[3]	49 to 98	45 to 90	46 to 92
Estimated Power Generation Value for the design life (2013 $)	4,806,000 to 9,519,000	4,180,000 to 8,269,000	4,302,000 to 8,512,000

[1] Estimated excavation amounts, design life, and power generation benefits for each alternative were provided by R2 Resource Consultants, Inc.
[2] SCL normal operating hydropower flows at the Diablo Powerhouse Tailrace range from 1,400 to 6,900 cubic feet per second (cfs). Average daily flow through the powerhouse is 3,200 cfs. The estimated head recovery varies depending on operating flow.
[3] Estimated design life for each of the alternatives is varies depending on the estimated annual bedload transport values from Stetattle Creek. The lower end is based upon a value of 200 cubic yards/year (CY/yr) and the upper end is based upon a value of 400 CY/yr.

2.2.1. Alternative B – Complete Cobble Bar Removal

Alternative B would remove approximately 19,500 cubic yards (CY) of accumulated small boulders, cobbles and gravels. Construction of a temporary access road to the bar and excavation of the bar would affect riparian vegetation along approximately 350 ft. along the right (northern) bank of the river. The excavation area would be approximately 3 acres. Excavation depth would range from 5 to 9 feet, depending on the location within the cobble bar area. This alternative would provide the fullest head recovery and the greatest power generation benefits over the life of the project, according to modeling completed by R2 Resource Consultants (2013).

Estimated value of power generation benefits in 2013 dollars from excavation range from $4,806,000 over a design life of 49 years to $9,519,000 over a 98 year design life. Design life would vary depending on the amount of new sediment transported annually (bedload transport) down Stetattle Creek into the Skagit River. The shorter design life and smaller estimated power generation benefits assume an annual bedload transport from Stetattle Creek of 400 CY per year; the design life of 98 years assumes an annual bedload transport rate of 200 CY per year. Refer to the Hydroelectric Operations sections for more details on the anticipated benefits. In addition to providing the greatest hydropower generation benefits, this alternative would reduce the risk of backwater conditions at SCL's sewage treatment plant in the near term until the plant is replaced by onsite septic systems, which is presently proposed. Completion of the excavation would also increase channel capacity and slightly reduce the risk of bank erosion. Figure 3 shows the approximate extent of proposed excavation.

Excavated materials would be disposed of at the Copper Creek Pit. Dump trucks would travel about 15 miles to the disposal site to fill the abandoned pit and restore contours to a configuration that more closely resembles the surrounding landscape and natural topography. Total roundtrip for each dump truck run would be about 31 miles. The total number of dump truck trips varies depending on the capacity of the truck used and amount of material excavated. It is anticipated that 10 cubic yard capacity dump trucks will haul the material to the Copper Creek Pit. Alternative B envisions the excavation of 19,500 cubic yards; so an estimated maximum of 1,950 trips would be needed to transport the material for disposal.

The Copper Creek Pit would be rehabilitated following placement of excavated materials with a native forest plant association as part of a habitat restoration and 5-year monitoring plan to be developed by SCL in cooperation with the NPS and a consultant. The dredged material would lack fine particles (e.g. silt) so it would be a poor soil medium. As it is infeasible in the short term to cover the deposited materials with imported soil sufficient to enable the entire area to be completely revegetated, native plant rehabilitation would be accomplished by augmenting the dredge material with approximately 2000 cubic yards of wood chips, which would require approximately 200 additional truckloads. After filling the area with dredge materials and wood chips, the site would be graded to more closely match the surrounding topography. Some additional soil would be available from on site and this would be combined with wood chips and/or other organic material to create a suitable planting medium trees and shrubs. In time, the site may blend with the existing vegetation community. Invasive species such as English ivy would be controlled through regular monitoring, manual control and periodic application of approved herbicides if necessary.

2.2.2. Alternative C – Partial Cobble Bar Removal

Alternative C would remove an estimated 18,000 CY, of accumulated cobble and gravel from Stetattle Creek Bar, approximately 1,500 CY less than Alternative B. The excavation area would be a bit smaller as a10-ft-wide strip of the cobble bar extending outward from the toe of the right bank would remain unaltered. The cut from proposed excavation would trend downward from that point at a 3:1 (Horizontal:Vertical) slope to the bottom of the proposed excavation. Excavation depths within the footprint would be similar to those for Alternative B but the amount of riparian vegetation disturbed would be reduced somewhat compared to the full

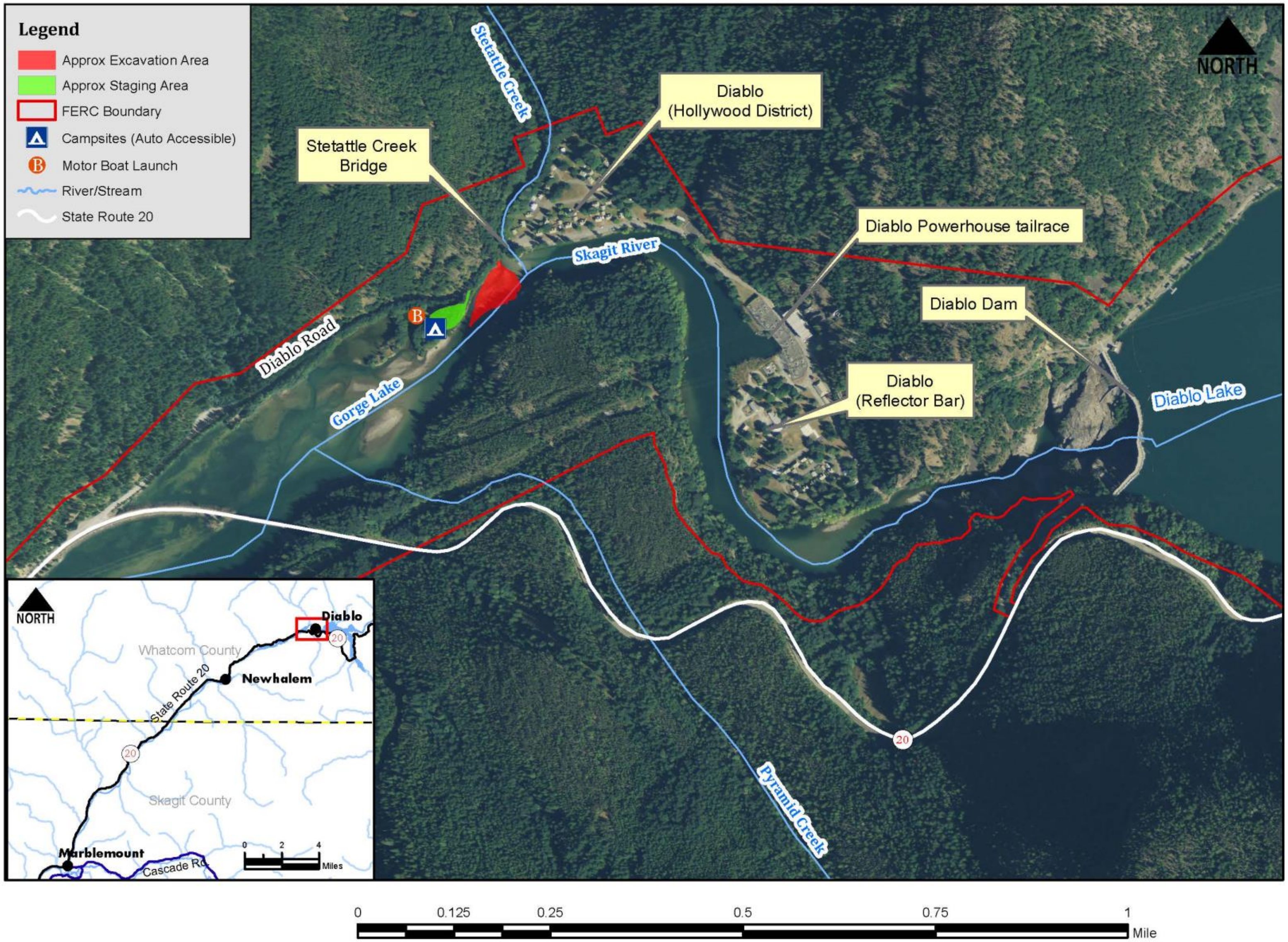


Figure 3. Water resources in the project area and the approximate extent of the cobble bar excavation and staging areas.

excavation alternative. Like Alternative B, excavated materials would be deposited at the Copper Creek Pit site for rehabilitation as described in Alternative B. The maximum number of dump truck trips needed to dispose of excavated materials would be approximately 1,800. This alternative would restore slightly less head and have somewhat lower power generation benefits than Alternative B. Estimated power generation benefits in 2013 dollars for Alternative C would range from $4,180,000 for a design life of 45 years to $8,269,000 for a design life of 90 years. This alternative also would result in a slightly higher risk of bank erosion compared to Alternative B, but this risk would be mitigated through erosion control and bioengineering. The footprint of the excavation for Alternative C is approximately the same as that shown for Alternative B at the scale shown in Figure 3. Refer to the Hydroelectric Operations sections for more details on the anticipated benefits.

2.2.3. Alternative D—Hybrid of Alternatives B and Alternative C

Alternative D is a hybrid of Alternative B and Alternative C. A total of approximately 18,300 CY of small boulders, cobbles, and gravels would be removed from the excavation area for this alternative. Within the excavation area, excavation depths would be similar to those for Alternative B and Alternative C. The primary difference between the alternatives is the footprint of the excavated area and its impact on local terrestrial and aquatic habitats. Alternative B has the largest footprint; it includes removal of a tree covered bench to the west of Stetattle Creek and a 10-foot wide buffer strip that extends along the entire northern edge of the excavation for Alternative C. Alternative D leaves the entire tree covered bench untouched but removes the 10-foot wide buffer strip to the west of the bench extending downstream along the northern edge of the excavation.

All excavated materials would be disposed of at the Copper Creek Pit similar to the other two action alternatives. The estimated number of dump truck loads needed to dispose of excavated materials would be slightly lower. Using 10-CY capacity dump trucks, a maximum of 1,830 trips would be required to transport all excavated materials to the Copper Creek Pit disposal site. Alternative D would provide slightly higher head recovery and associated power generation benefits over the estimated life of the project compared to Alternative C and slightly lower benefits than Alternative B. Estimated head recovery at an operating flow of 3,200 cfs would be about 2.30 feet. The estimated design life for Alternative D ranges from 46 to 92 years. Estimated value of power generation benefits in 2013 dollars for the design life would be between about $4,302,000 (46 years) and $8,512,000 (92 years).

In summary, Alternative D hydropower generation benefits are expected to be less than for Alternative B but greater than for Alterative C while preserving some important ecological functions associated with the tree covered bench. Similarly, the footprint of the excavation for this alternative is slightly smaller than that for Alternative B and slightly larger than that for Alternative C.

2.2.4. Elements Common to the Action Alternatives

There are a number of elements, actions and Best Management Practices common to the three action alternatives, particularly pertaining to isolating the work area and controlling potential erosion and sedimentation. Equipment used for the work, sequencing to minimize turbidity during excavation, and disposal methods and location would be the same for the three action alternatives as described in the following section. The disposal site at Copper Creek Pit would be the same for all three alternatives. Methods for rehabilitating the pit so it would support native vegetation would also be the same.

This sequencing or phasing is adapted from the Preliminary Engineering Design Report (R2 Resource Consultants 2013). An ideal method for controlling turbidity during the proposed project would be to completely dewater the excavation area by creating a watertight coffer dam capable of withstanding the water pressure and river velocities around the whole site. This, however, would require a double sheet pile wall driven down to bedrock around the proposed excavation area, which would have its own set of environmental impacts and would likely not be feasible from a cost or permitting perspective. While a water-tight barrier is infeasible due to the relatively permeable nature of the cobble bar material, bypassing the flow with a supersack barrier coupled with a system to collect, treat and dispose of the infiltration water is common practice.

Managing Diablo and Gorge powerhouse operations to lower water surface elevations will allow placement of a coffer dam to work in the dry. The following sequential phasing is proposed to accomplish this. The estimated duration of each phase is in parentheses following the title of each phase:

<u>Phase 1 – Mobilization, Site Preparation, and Initial Excavation (2 weeks)</u>

1. Wait for Stetattle Creek flow to drop down to approximately 200 cfs for the summer season, typically the latter part of July.
2. Draw down Gorge Reservoir to elevation 871.15 ft. (NAVD88) and maintain this pool elevation for the duration of the proposed project.

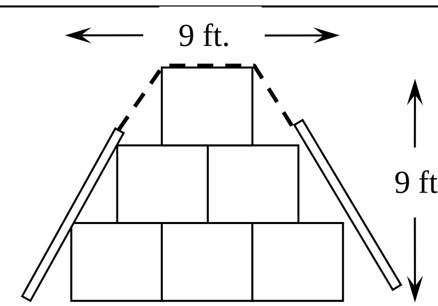


Figure 4. Typical cross section of a 3-tiered super sack coffer dam with 8-ft. x 10-ft. steel plates on sides that are chained together over the top.

3. Maintain flow from Diablo Powerhouse at an average daily flow of 2,500 cfs.
4. Remove vegetation along a section of right bank (degree of removal varies among the alternatives), clear and grub bank at the access ramp location.
5. Move an excavator down the bank to the cobble bar.
6. Build access ramp out of suitably-sized material to support use by heavy construction equipment.
7. Construction equipment, such as large excavators, a dozer, and compactor will be used to create a temporary access ramp to move to and from the bar. The method for bypassing Stetattle Creek flows and constructing coffer dams around the excavation area will be determined during the final design and permitting phase of the project. Fill super sacks with excavated materials and form a coffer dam to divert Stetattle Creek flow around the work area (Figure 4). Widths and heights of the coffer dam will vary from three-feet wide and three-feet wide (single tier) to nine-feet high and nine-feet wide, depending on flows and velocities. Super sacks

will be filled, moved, and placed with an excavator. Coffer dam construction and excavation will be phased as needed to maintain instream flows in the Skagit River below the Gorge Dam as required by SCLs FERC license and settlement agreements.

8. Construct a wheel wash in the Gorge Campground Staging Area and install and maintain other appropriate best management practices (BMPs) to control dust and erosion.
9. Excavate about 6,000 CY of bar material working backward from the water level toward the interior portion of the bar to a level just above the water level and stockpile excavated materials near the access ramp.
10. Back dump trucks down the access ramp and use excavator(s) to load trucks.
11. Release sufficient flow to draw down Diablo Reservoir and Ross Lake levels as necessary to allow at least 20 hrs with no flow from the Diablo Powerhouse for Phase 2 coffer dam placement. Figure 5 shows the approximate location of the access ramp and coffer dam used to divert Stetattle Creek flow around the excavation area during Phase 1. Final coffer dam design will be developed during permitting phase of the project.

<u>Phase 2 – Place Additional Coffer Dam to Isolate Work Area (1 week)</u>

1. Shut down flows from the Diablo Powerhouse as necessary to allow for placement of remaining coffer dam needed to isolate the work area. Flows can be totally shut down for up to a maximum of about 36 hours for a wet year before they would need to be resumed.

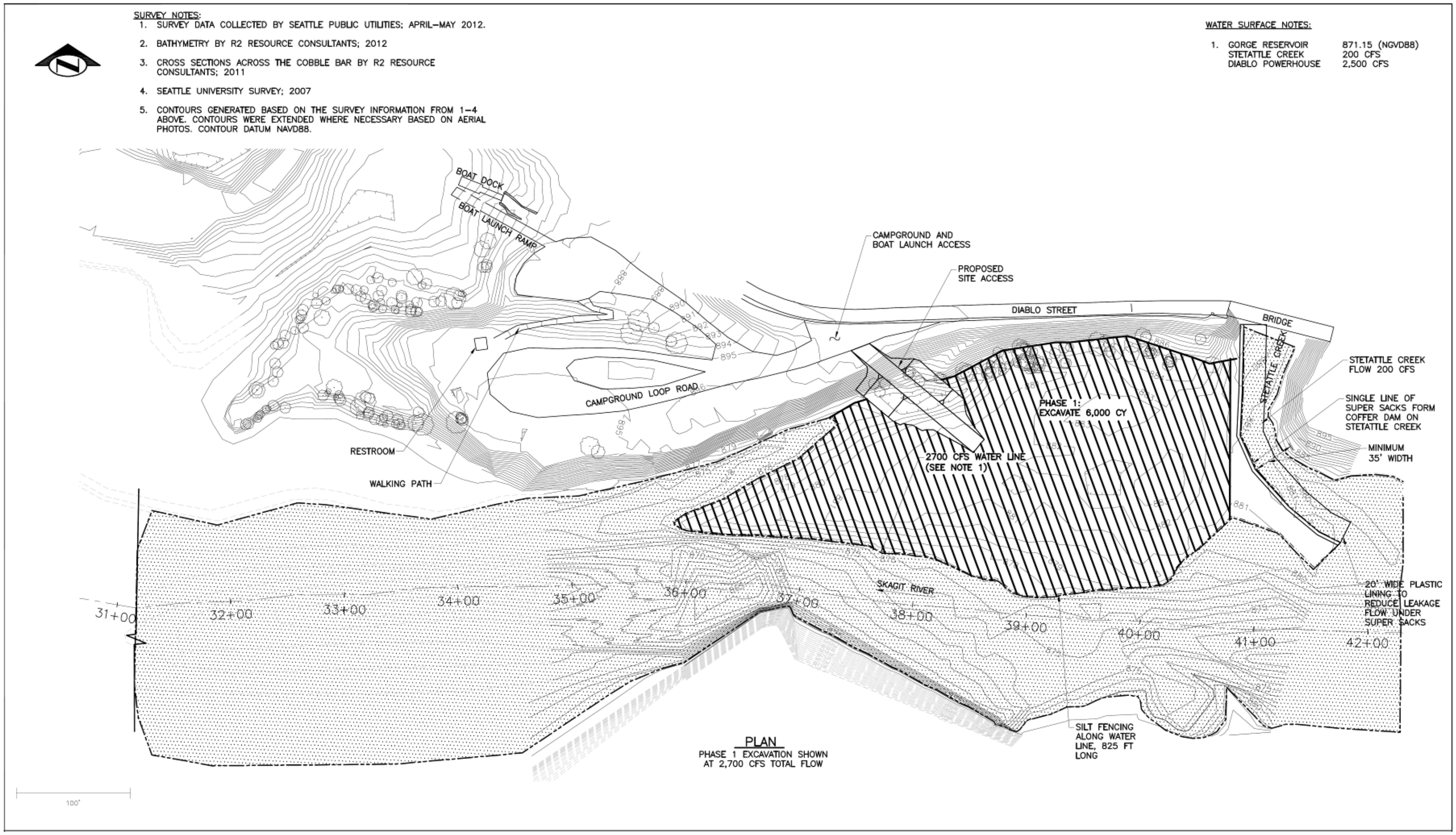


Figure 5. Approximate location of coffer dam used to divert Stetattle Creek flow around the excavation area in Phase 1 and approximate location and configuration of the access road (Source: R2 Resource Consultants 2013).

2. Place two- and three-tiered coffer dams along the remainder of the excavation site as needed to isolate the work area from Stetattle Creek and Skagit River flows. In addition to being chained together over the tops of the coffer dams as shown in Figure 4, overlap steel plates a minimum of 1 foot with the upstream plate over the downstream plate and chain them together to prevent scour underneath the coffer dams.
3. Using multiple excavators with up to 3 CY buckets excavate bar working from the waters edge back towards the middle of the bar to minimize potential resuspension of fines and increases in turbidity.
4. Stockpile material towards the middle of the bar in the vicinity of the access ramp, load, and haul materials about 15 miles to the Copper Creek Pit disposal site. The approximately 31 mile round trip is expected to take a truck about 50 minutes.
5. Resume Diablo Powerhouse flow up to the flow calculated to be safe for installed coffer dams (assumed to be 2,500 cfs).

Phase 3 – Remaining Excavation and Mitigation (3 weeks)

1. Excavate remaining cobble bar material starting at downstream end of excavation area and working back upstream.
2. Continue work in the upstream direction up to the access ramp so equipment can always stay on dry ground.
3. Leave a pad at the end of the access ramp so trucks have a place to get loaded.
4. Continue working upstream of the access ramp by starting at the upstream end and working back down to the access ramp so that at the end the access ramp is the only remaining material to excavate.
5. Remove the access ramp and install large woody debris structures and boulders as described in the Environmental Consequences sections under Water Resources and Fish and Wildlife, Including Rare/Listed Species.

Phase 4 – Remove the Coffer Dam (1 week)

1. Remove coffer dams using either a land-based crane or a crane mounted on a small barge or boat.
2. Work from downstream to upstream.
3. Use land-based crane staged near the west end of the Stetattle Creek Bridge to remove the super sacks and steel plates from the barge, the barge, and final super sacks. Equipment to be used and staging locations for this equipment will be determined during the final design and permitting phase.

2.2.5. Mitigation Measures

Mitigation measures are actions that would be taken to minimize, avoid or otherwise offset the potential effects of taking action. Table 2 describes the mitigation measures that would be employed, including the monitoring components and possible adaptive management options that would be pursued if the mitigation measures do not function as intended.

Table 2. Mitigation measures. This table summarizes the various measures proposed to minimize impacts from the proposed action and the alternatives. In keeping with principles of adaptive management, SCL in coordination with NPS would monitor the effectiveness of the measures to ensure they function as intended. If the measures do not function as intended, or unintended consequences arise, then SCL would collaborate with NPS to develop alternative means of avoiding or minimizing adverse effects.

Affected Resource	Mitigation Measure
Water resources, including fish	**Minimize turbidity using various Best Management Practices.** All relevant and appropriate best management practices (BMP) will be implemented, as necessary, to meet the state water quality standard for turbidity, which is no more than 5 Nephelometric Turbidity Units (NTU's) above background levels. Flows from Stetattle Creek and the Skagit River will be diverted around the excavation area by isolating it with cofferdams. Due to hyporheic flow into the excavation area, water will be collected, pumped, and treated as necessary to meet the state water quality standard for turbidity downstream of the project site. Treatment will depend on the particle size distribution of the bar, particularly finer-sized particles. One BMP treatment option would be to create a temporary settling basin in the Gorge Campground boat launch area by placing a temporary cofferdam or similar structure across the channel to create a temporary settling basin to settle out some larger silt-sized fractions. Clean water would be allowed to overflow this temporary basin or it could be pumped back to Gorge Lake. Turbidity in the lake would be monitored 300 feet downstream of this location, according to Ecology (2012). If pre-excavation bar sampling determines that there are finer silt and clay-sized fractions that require longer settling times, a pump and treat system using Baker tanks and sand or chitosan filtration could be used to manage turbidity to meet the state standard of being no more than 5 NTUs above background at the point of compliance. Filtered water for such a system would be pumped back into the lake in the boat launch area. If excessive sediment remains in the boat launch area after treatment (this is not anticipated), then additional measures would be taken to mitigate the effects.

Affected Resource	**Mitigation Measure**
	Install eight natural root-wad structures along the northern shore of Gorge Lake immediately west of Stetattle Creek (Figure 6). Excavation of the cobble bar would reduce habitat complexity including rearing and foraging habitat for native fish. To mitigate for habitat loss the proposed measures would provide cover, holding and forage habitat for juvenile fish, including resident rainbow trout and bull trout. The first of the root-wad structures would be placed in the transition zone between the Stetattle Creek and the backwater area of Gorge Reservoir, and would be situated immediately west of the bridge. This structure would be intended to replace juvenile rearing habitat for bull trout that is currently provided by an ephemeral side channel along the north edge of the cobble bar at the outlet of Stetattle Creek. The seven other root-wad structures would be equally spaced along the bank for a distance of 175 ft downstream of Stetattle Creek. For five years after the project, species and age classes would be monitored, including the locations of spawning fish. These data would be used to evaluate mitigation effectiveness. If adverse unintended consequences are documented (e.g. provision of habitat for non-native brook trout; excessive predation on resident rainbow trout), then SCL would collaborate with NPS to resolve these effects.
	Install a series of large boulders to form and maintain a relatively deep channel in the outflow area of Stetattle Creek downstream of bridge. These boulder structures would serve two purposes. First, they would be used to form a “training” channel and thalweg in the zone where the stream enters the reservoir backwater downstream. Once the cobble bar is removed, a gravel fan is expected to form immediately downstream of the bridge in the area where the mouth of Stetattle Creek meets the reservoir pool. The proposed boulder placement would provide the large roughness elements needed to maintain a channel and convey sediments from Stetattle Creek through this depositional fan zone. Second, the large boulders would be intended to recover juvenile rearing and spawning migration staging habitat at the mouth of the stream and produce deep “pocket” water through the gravel fan, which would provide a greater variety of velocity conditions including holding habitat for juvenile bull trout and migrating spawners.
	Install structure(s) to prevent head cutting if necessary. Monitoring of the thalweg profile of Stetattle Creek would be conducted annually for 6 years following excavation to insure that head cutting does not occur. After 5 years, monitoring would be only after a 5-year or greater magnitude flood event. In addition, the stream bed will be visually assessed on an opportunistic basis after elevated flows. If head cutting occurs, then appropriate engineering actions to arrest head cut formation would be identified within 3 months of detection and implemented within the next in-water work period.

Affected Resource	Mitigation Measure
	Save fish stranded during construction. Cobble bar excavation would require lowering the level of Diablo Lake approximately six feet (from full pool [877.2’] to 871.2’), which could strand some fish in isolated shallow areas of the reservoir west of the dredging area. Stranded fish would be collected and returned to deeper waters in the reservoir.
	Ensure fish passage into Stetattle Creek after cobble bar excavation. Following the excavation of the cobble bar the water surface of the Skagit River at its confluence with Stetattle Creek will be approximately 3 feet lower than it is today. Immediately following the removal of the cofferdam after excavation, the elevation of Stetattle Creek will be greater than the elevation at bottom of the excavated area and this could prevent fish passage due to high flow velocities until the first high flows rearrange the creek channel. Mitigation measures will be engineered to assure access to Stetattle Creek by fish. These measures will be tailored to post excavation conditions, and may include installation of large boulders to provide refuge from high velocities, and/or a pilot channel dug into the Stetattle Creek deposits.
Riparian Vegetation: **Riparian zone of the Skagit River at Copper Creek Pit**	**Rehabilitate Copper Creek Pit with native plants.** SCL in coordination with the NPS would develop a rehabilitation plan for Copper Creek Pit following disposal of excavated materials. The rock deposited from the project would be graded to simulate the surrounding topography; some soil will be available and combined with wood chips and/or other organic material to create a suitable planting medium for native trees and shrubs, which would be planted using local stocks to protect genetic integrity. In time, the site will blend with the existing vegetation community. The rehabilitation plan will include measures to monitor and control invasive plants using manual removal and spot applications of herbicides, if necessary.
	Rehabilitate the shoreline adjacent to the dredging area. In shoreline locations affected by construction (e.g. the access ramp area), SCL would prepare a revegetation plan in consultation with the park botanist. In summary, the area would be rehabilitated with compost and topsoils, and replanted with hardwood and conifer seedlings derived from local genetic stock.

Affected Resource	Mitigation Measure
Surficial Geology: Shoreline of Gorge Campground	**Rehabilitate the shoreline adjacent to Gorge Campground.** Approximately 400 feet of the shoreline along Diablo Lake Campground is eroding, lacks riparian vegetation and is potentially unsafe for campground users (Figure 8). Erosion at the toe of the slope by Gorge Lake and the Skagit River, depending on lake level, has prevented a stable slope from developing adjacent to the campground. The unstable slope is approximately 40 degrees and consists of sand and gravel, with remnants of an old stairway. At the base of the slope there are remnants of concrete and gabions that provide some erosion protection but are unsightly and not optimal for supporting riparian vegetation. NPS would implement the following mitigation actions concurrently with the proposed action as follows. Further details including conceptual drawings are provided in Appendix C: •Remove existing concrete bulkhead, wire gabion baskets and related materials. •Stabilize the toe of the slope for about 400 ft by installing native rock (potentially derived from dredging) and large woody debris. Base of slope would extend out 2-4 ft from present toe of slope to reduce steepness. •Regrade the slope to 35 degrees or less by bringing in clean sandy fill and possibly some cutting of the brow at the top of the slope. •Construct a new trail along the stabilized slope for camper access to river. •Replant the slope with native trees, shrubs and ground cover. Use willow-layering technique at top of rock and wood along lower 10 ft of slope. These conditions would not be affected by the proposed action, but should be mitigated to improve the integrity of the shoreline and reduce public safety risks. Timing this action concurrently with the proposed dredging would enable equipment access to the toe of the eroding bank. NPS staffs would assume responsibility for this erosion control measure, using funding already available from Seattle City Light for erosion control purposes. Working up from the toe of the slope, crews would remove artificial material that has been placed on the bank (concrete and gabions) and replace those materials with large rock and woody debris. Soil would be added to interstitial spaces and planted with riparian vegetation suited to the well-drained site conditions.
Cultural Resources: **Historic Stetattle Bridge**	SCL personnel would monitor the Stetattle Creek Channel for five years following excavation. If head cutting occurs, appropriate engineering actions would be implemented to arrest head cut formation and prevent undermining of the bridge. Qualified archeologist would monitor dredging activities and restoration at Copper Pit. In the event of an unantipated discovery of cultural resources, work would cease pending further evaluations of the site(s), with mitigation based upon the nature and extent of cultural resources discovered.

Affected Resource	**Mitigation Measure**
Cultural Resources: **Historic and prehistoric (pre-contact) archeological resources**	During cobble bar excavation and rehabilitation of Copper Creek Pit, SCL would have qualified professionals monitor activities and respond as necessary should there be unanticipated discovery of archeological resources.

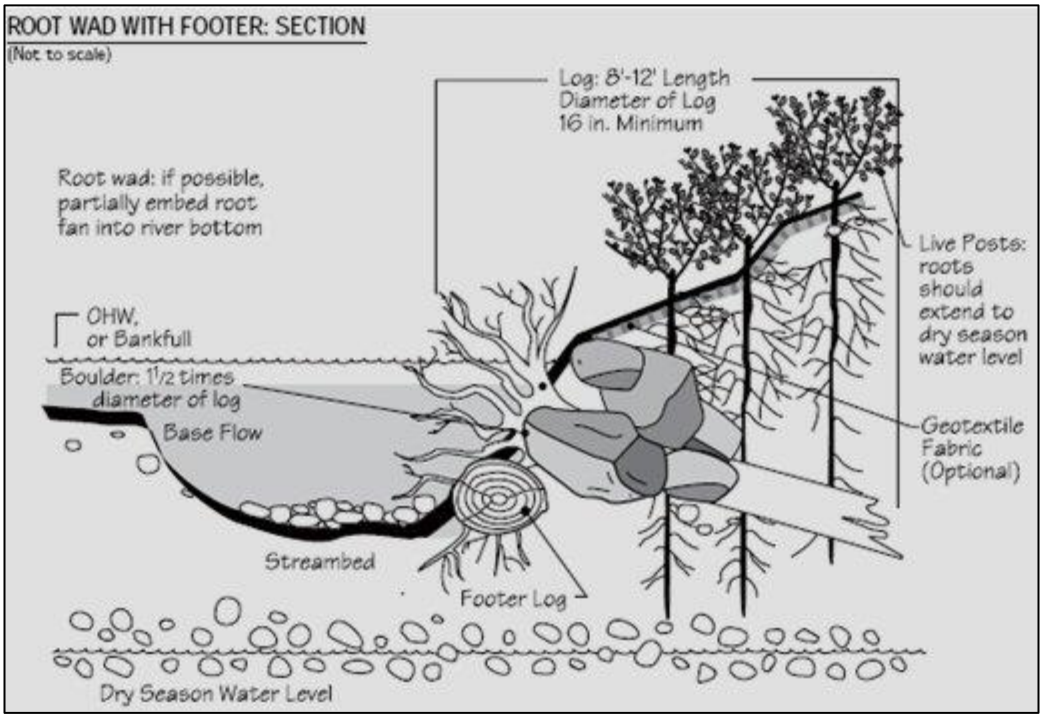


Figure 6. Typical root-wad structure intended to mitigate fish habitat impacts.

2.3. Alternatives Considered but Rejected

A number of preliminary excavation and disposal options were considered but rejected after considerable coordination, evaluation, and discussion with natural resource management agencies, including the USFWS, NPS, and ACOE. These are described briefly in this section. More detailed descriptions of the study methods, findings, and descriptions of these can be found in studies conducted by Seattle University (2008) and R2 Resource Consultants (2013).

2.3.1. Rock Spur Removal

R2 Resource Consultants modeled the effects of removing the rock spur opposite Stetattle Creek near the left bank of the Skagit River (Figure 7) using a HEC RAS model (S. Beck, P.E., R2 Resource Consultants, pers. comm. 2014). The spur was represented in the model as a mass measuring 5 feet high by 30 feet wide by 40 feet long. The 5 foot dimension represents the distance from the top of the spur down to the thalweg of the river at the hydraulic control. The modeling results show that at the low end of generation (flow = 1400 cfs) removal of the rock spur would recover less than 50 percent of the head than would be recovered by removing the cobble bar. At the top end of the generating range (flow = 6900 cfs) removal of the rock spur would recover less than 25 percent of the head that would be recovered by removing the cobble bar.

Removal of the rock spur would pose greater logistical challenges than removal of the cobble bar. The rock spur is located in the middle of the main flow of the Skagit River. Isolating the site to create a dry work area would be difficult because of high water velocities. Furthermore, the nearest shore is on the left bank where there is no access to roads, and no space to place the rock spur demolition materials. If the work were done in the wet, there would be no way to control turbidity.

Removing the rock spur was considered, but dismissed because it would not meet the purpose and need for the project of restoring lost generation capacity. In addition it would be much more difficult logistically to accomplish the work and control turbidity.

2.3.2. Disposal at Bacon Creek Quarry Site

The Bacon Creek Quarry, which is a 6-acre pit that exists on a parcel of SCL Wildlife Mitigation Land just north of SR20 and east of Bacon Creek, was considered for use as the disposal site. This location is approximately one mile roundtrip farther from the excavation site than the Copper Creek Pit. The Bacon Creek Quarry is the designated disposal site for the Gorge Second Tunnel project and thus not available as a disposal site for materials excavated for this project.

2.3.3. Disposal Below Gorge Dam

Like other in-water disposal alternatives, this alternative was rejected because of potential adverse impacts to aquatic habitat and fisheries resources. Unlike other in-water disposal alternatives, this alternative could have led to adverse impacts on salmon and steelhead, including Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*) and Puget Sound steelhead (*Oncorhynchus mykiss*). Both Puget Sound Chinook salmon and Puget Sound steelhead are federally-listed threatened species under the ESA. Two additional reasons that this alternative was rejected is that the coarse material from the excavated bar is too large and unsuitable for use as spawning habitat even for Chinook salmon and the Skagit River below Gorge Dam is not sediment starved.

2.3.4. Disposal in Gorge Lake

Nearshore and aquatic habitats in Gorge Lake were considered as potential disposal areas, including the vicinity of the Gorge Campground boat launch and historic SCL borrow pit areas east of the intersection of SR 20 and Diablo Road. Use of these areas for disposal of excavated materials would reduce potential transportation impacts to recreation and visitor use and generation of greenhouse gases by reducing truck travel distances to disposal areas. Historic borrow pit areas are degraded by a lack of riparian and aquatic vegetation, woody debris, and shallow depressions in the lake bed contribute to fish stranding when lake water levels drop below the top of the depressions. It was initially thought that filling historic borrow areas would reduce potential fish stranding and disposal areas could be used to restore riparian, wetland, and shallow nearshore habitats. However, representatives of natural resource management agencies (ACOE, WDFW, and USFWS) concluded that though these areas are degraded, the coarse nature of the excavated materials would not be conducive to restoration and filling would result in a net loss of aquatic habitat and set a harmful precedent for management of the area. Thus, in-water disposal at the four areas shown in Figure 7, which were investigated in 2012 (R2 Resource Consultants) were rejected from further consideration.

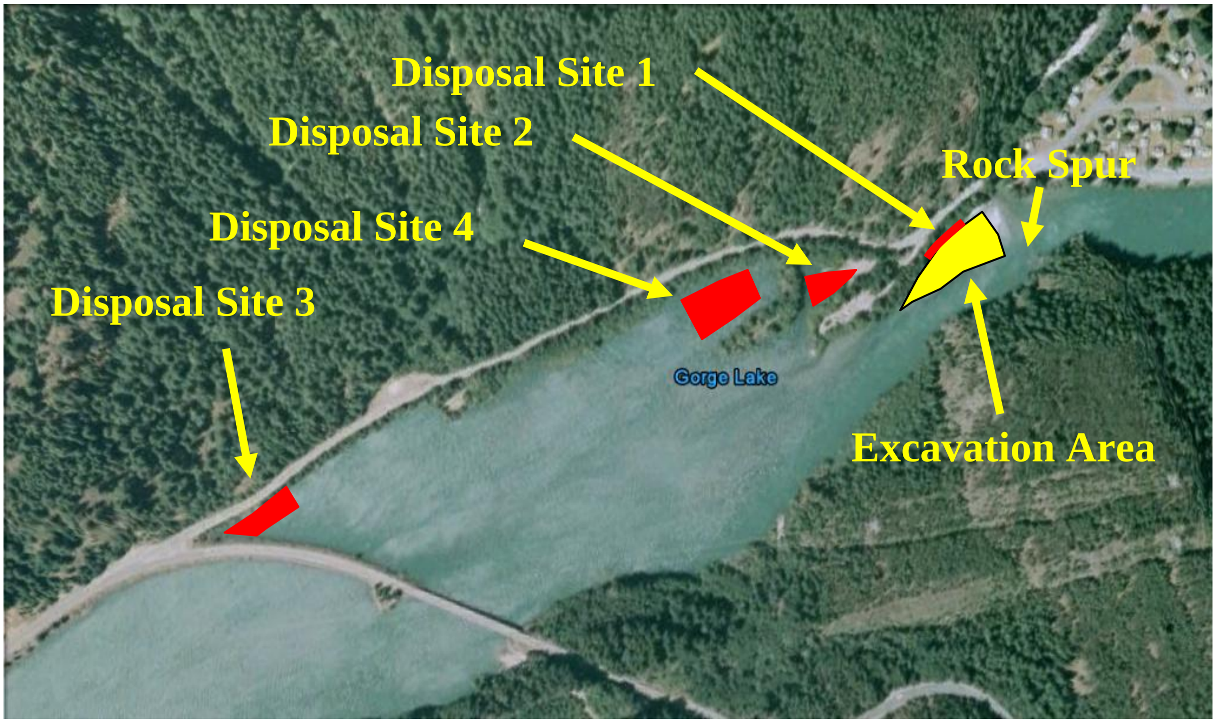


Figure 7. Four disposal alternative and a rock spur removal option considered but rejected from further consideration (Source: R2 Resource Consultants).

2.3.5. Other Excavation and In-Water Disposal Alternatives

SCL examined 5 other excavation and in-water disposal alternatives in the Preliminary Engineering Design Report (R2 Resources Consultants 2013), which were identified as Option C and Options E through H in that report. The report was provided to the NPS, WDFW, ACOE, and USFWS for review and comment. Additionally, a pre-application meeting was held with representatives from these agencies on August 14, 2013 to discuss the report and these various alternatives. These options all involved disposal of varying amounts of excavated materials or placement of materials in Diablo Lake up against the right bank of the reservoir to protect the right bank from erosion from various higher flow events ranging from 10-year to 100-year floods. Consequently, all of these resulted in a net loss of aquatic habitat.

Option C was a partial excavation that would only have partially restored lost generation capacity. All of the excavated materials (13,500 CY) would have been disposed of against the right bank of the lake, providing erosion control protection up to the 10-year flood level. In addition to not meeting the purpose and need of the project, this alternative would have resulted in a major, long-term adverse impact on aquatic habitat.

Options E through H were all full excavation alternatives that would have contributed to varying levels of habitat loss, depending on the design flood or bank protection criterion (e.g., 10-year flood, 25-year flood, etc.) and restoration of maximum hydroelectric power generation capacity. All of the excavated materials from these alternatives would have been hauled offsite to the Copper Creek Pit disposal site. All of these alternatives involved placement of varying amounts of riprap and alteration of aquatic habitat near the right bank of the Skagit River. Option E would have resulted in a moderate, long-term, adverse impact on aquatic habitat from placement of riprap for increased bank protection. Option F through H each would have resulted in incrementally greater impacts on aquatic habitat from placement of larger amounts of riprap at the toe of the campground to protect from potential erosion associated with larger design flood events. All of these options would have resulted in moderate, long-term adverse impacts on aquatic habitat and were thus rejected from further consideration.

2.4. Environmentally Preferred Alternative

NPS policies regarding implementation of the National Environmental Policy Act require the identification of the Environmentally Preferred Alternative. The Council of Environmental Quality recommends the following criteria for determining the Environmentally Preferred Alternative:

1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
2. Ensure for all Americans safe, healthful, productive, and esthetically 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 that would permit high standards of living and a wide sharing of life’s amenities.
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Alternative A, No Action, would avoid the impacts to the biological and physical environment as it would not involve any excavation of the cobble bar or associated temporary increases in noise. The various action alternatives, in contrast, would cause various short and long term adverse effects. In addition, this alternative would also comport with NPS Management Policies § 4.1, which discourage manipulation of natural processes. Therefore, the No Action Alternative would be the Environmentally Preferable Alternative.

3. Affected Environment

3.1.Biological and Physical Environment

The physical and biological environment that would be affected includes the area of immediate physical disturbance where the excavation, hauling, and disposal activities would occur. The biological environment extends beyond this area to include adjacent habitats for vegetation and wildlife. This section describes the current conditions of the resources and establishes a baseline for the impact analysis in Section 4.

3.1.1. Surficial Geology

Geologic resources for the Ross Lake NRA are described thoroughly in the *Ross Lake National Recreation Area Final GMP/EIS* (NPS 2011). Within the proposed project area boundaries, there are three sites in which surficial geology, including soils would be impacted: the cobble bar at the mouth of Stetattle Creek, the shoreline along Gorge Campground and the Copper Creek Pit sites.

The approximately 3-acre cobble bar at the mouth of Stetattle Creek would be removed under the various action alternatives. A portion of this surficial landform predates construction of the Skagit River Hydroelectric Project, as it can be seen in early 20th century photographs, where it forces the Skagit River to the left bank. A 1940 aerial photo also shows the cobble bar and the main river channel on the left bank. The large, weathered boulders, rock type, and darker overall color of the old gravel bar distinguish it from the more recent Stetattle deposits, including materials associated with a flood-triggered landslide in 2003. It appears that recent flooding, expecially the 2003 event, has caused this cobble bar to expand in size and accumulate more recent gravel from Stetattle Creek, which has a finer texture than the older landform (Jon Riedel, NPS Geologist, pers. comm.).

Figure 8. Erosion on bank of the Gorge Lake Campground showing exposed tree roots.

The Gorge Campground is situated on a nearly flat terrace, bounded on the south and west by the Skagit River. It has a long history of alteration from settlement through construction of the Skagit Hydroelectric Project and is not a natural river terrace. The southern side of the campground drops steeply, approximately 20 feet, to the Skagit River and shows significant signs of bank erosion. Riprap and cement chunks have been placed along various sections of the bank to afford protection. Several large trees along the bank have exposed roots and will eventually fall as shown in Figure 8.

Soils consist of the Thorton-Ragged-Ledeir complex, with 15 to 65 percent slopes. These soils are described in detail in the *Soil Survey of North Cascades National Park Complex, Washington* (USDA et al. 2012). Generally, these soils are well drained, typical of debris cones or aprons, and are derived from volcanic ash over glacial drift or volcanic ash mixed with alluvium.

The Copper Creek Pit was previously an upland forest that was stripped of vegetation and topsoil several decades ago. The site is an approximately 1.5-acre depression with surface topography that is 10 to 15 feet lower than the adjacent topography (Figure 9). The site is disturbed and sometimes used to stockpile organic material, such as large woody debris, for future restoration projects as shown in Figures 9 and 10.

Figure 93. View of the western end of Copper Creek Pit disposal site showing depth of previous topsoil mining activities.

Figure 40. Stockpiled large woody debris and disturbed conditions at the Copper Creek Pit disposal site.

The excavated sides of the depression remain exposed and range from a few inches to about 8-feet deep. Soils are disturbed and compacted as a result of historical borrow and excavation activities. Mapped soil associations consist of the Roland-Skymo-Deerlick complex, with 0 to

25 percent slopes. These soils are described in detail in the *Soil Survey of North Cascades National Park Complex, Washington* (USDA et al. 2012). Generally, soils of this complex are found along terraces, debris aprons and cones, and/or along alluvial fans, terraces, or floodplains. The parent material is typically volcanic ash and alluvium over glacial drift and/or alluvium.

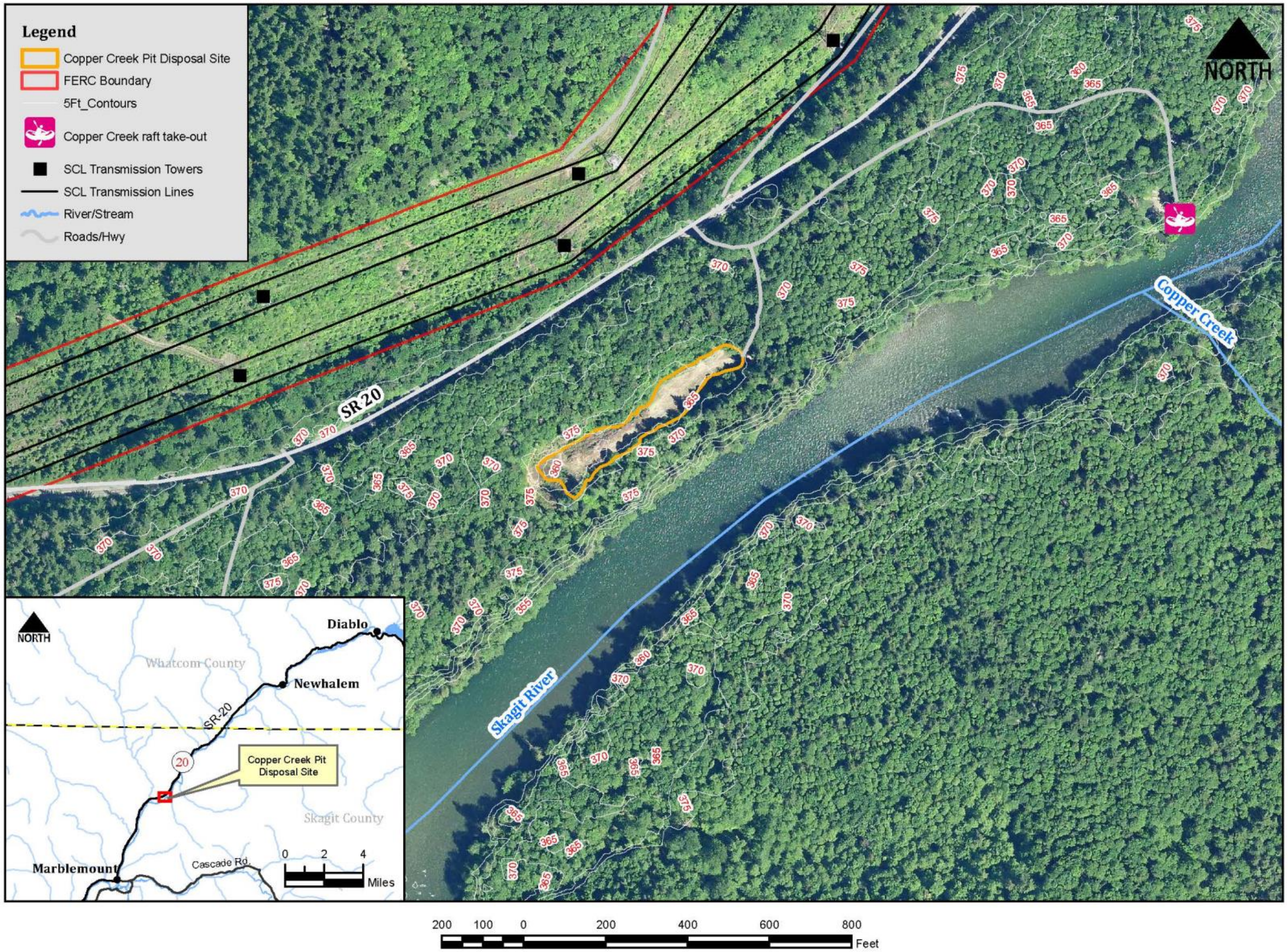


Figure 51. Physical and biological conditions at the Copper Creek Pit disposal site and adjacent areas.

3.1.2. Water Resources

Water resources in the immediate vicinity of the proposed project are Stetattle Creek, Gorge Lake or Reservoir, and the Skagit River downstream of Gorge Dam. The water quality, quantity, and beneficial uses of these are discussed below after a brief discussion of water quality standards and quality in Watershed Resource Inventory Area (WRIA) 4, which is the Upper Skagit River.

Water quality standards for freshwaters in the state of Washington, include designated uses and water quality criteria, are identified in the Washington Administrative Code (WAC) 173-201A-200. Table 3 shows the designated uses for the Upper Skagit River Watershed Resource Inventory Area (WRIA) 4, which includes all associated tributaries to the Skagit River. In addition to the designated uses, water quality criteria identified in Table 4 are applicable. Furthermore, Ecology (2006) has identified supplemental spawning and incubation criteria for the Skagit River downstream of Gorge Dam. The temperature criterion for spawning and incubation protection in upper Skagit River below Gorge Dam is 13˚C from September 1 to June 15. Water quality within the Gorge Reservoir, the Skagit River below Gorge Dam and Stetattle Creek generally complies with designated uses and water quality criteria with few exceptions. One exception is for temperature on the Skagit River in an area well downstream of the proposed project, which would be unaffected. The other exception is for fecal coliform bacteria levels on Prairie Creek, which also would be unaffected by the proposed project.

Every two years the Washington State Department of Ecology prepares an Integrated Water Quality Assessment. Included in the assessment are streams on the Clean Water Act Section 303(d) list of impaired water bodies in need of a plan that describes the impaired segment's Total Maximum Daily Load (TMDL) and measures to improve water quality in the segment. Relative to State water quality standards, the Upper Skagit Basin WRIA 4 (upstream and including the Sauk River) is in good condition. Based upon Ecology (2008), there are currently no stream segments that have a prepared TMDL, and there are only two segments within WRIA 4 that are on the 303(d) list. Long-term monitoring records do not indicate any violations of water quality standards downstream of the Skagit Hydroelectric Project with one exception. Monthly samples are collected at the nearest USGS water quality data collection site at Marblemount (RM 78.1, approximately 16 RM below the Project), and data at this sampling site exist for the years 1959 through 2006 for: fecal coliform, dissolved oxygen, pH, temperature, turbidity, and other water quality parameters for which there are no numeric standards (Washington Department of Ecology web site). One segment located on the Skagit River near the mouth of the Cascade River is listed for temperature impairment. The other listed segment is Prairie Creek, which is a tributary of the Sauk River and listed for fecal coliform.

With the exception of water temperature relatively little water quality data has been collected in WRIA 4. However, it is believed that water quality in this area is in good to excellent condition because it is primarily managed as National Park, Provincial Forest, National Forest System (NFS), Wilderness Area, and National Recreation Area lands. Some parts of NFS and Skagit Provincial Forest lands were historically managed for timber harvest, but the level of harvest management has declined considerably in recent years and currently occurs primarily in portions of the basin downstream of Gorge Dam, in British Columbia, and within the Cascade River and Sauk River basins.

Table 3. Designated uses of waters in the project area within WRIA 4 (Source: WAC 173-201A).

	Aquatic Life Uses						Recreational Uses			Water Supply Uses				Misc. Uses				
Water Body	**Char Spawning/Rearing**	**Core Summer Habitat**	**Spawning/Rearing**	**Rearing/Migration Only**	**Redband Trout**	**Warm Water Species**	**Ex Primary Contact**	**Primary Contact**	**Secondary Contact**	**Domestic Water**	**Industrial Water**	**Agricultural Water**	**Stock Water**	**Wildlife Habitat**	**Harvesting**	**Commerce/Navigation**	**Boating**	**Aesthetics**
Skagit River and all tributaries upstream of Skiyou Slough except designated tributaries[1]		✓					✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
Designated WRIA 4 tributaries[2]	✓						✓			✓	✓	✓	✓	✓	✓	✓	✓	✓

1. Unnamed Creek at 48.3813N, 122.1639W, which would be unaffected by the proposed project.
2. A number of tributaries are identified, including Stetattle Creek. Of the designated tributaries, only Stetattle Creek has the potential to be affected by the proposed project.

Overall, the ongoing operations of the Skagit Hydroelectric Project have minimal impact on the water quality of the upper Skagit River drainage, including water quality conditions in the three project reservoirs. This river drains mountainous and glacial areas located mainly within national park and wilderness areas, and water flowing through the Project remains clean and cold throughout the year. This section of the Skagit River is not listed on the State's list of impaired water bodies. The Washington State Department of Ecology has stated in a letter to SCL that they support the water quality conditions for the Project. They also have acknowledged by letter that they waived their action on Section 401 due to situations beyond their control. (Washington Department of Ecology, letters dated October 7, 1991, and December 13, 1991). The Skagit River basin supports the healthiest bull trout populations in Washington, which reflects the excellent water quality conditions in the project area (USFWS 2008a).

Stetattle Creek

Stetattle Creek has a drainage area of approximately 23 square-miles, with most of the watershed area located in the North Cascades National Park Complex. The lower reaches of Stetattle Creek are located within the Ross Lake National Recreational Area. The watershed is generally undisturbed. The lower 1,400 ft. of the stream are located along the town of Diablo, Washington. Water quality conditions in this stream are expected to be excellent. Mean daily water temperatures measured in Stetattle Creek are below 10 °C most of the year (Figure 12). Temperatures in the stream are below 9 °C maximum threshold for spawning and incubation (see Figure 12) during the late September through early November spawning period of bull trout. Bull trout require cold water temperatures of less than 9 °C for spawning and egg incubation (McPhail and Baxter 1996).

Table 4. Water quality criteria for water resources in the proposed project area (Source: WAC 173-201A).

Parameter	Water Quality Criteria
Fecal Coliform	Not to exceed a mean value of 50 colonies/100 ml with not more than 10% of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 100 colonies/100 ml
Dissolved Oxygen	Lowest 1-Day Minimum: *Char:* 9.5 milligrams per liter (mg/L) *Salmon and trout spawning, core rearing, and migration*: 9.5 mg/l *Salmon and trout spawning, noncore rearing, and migration*: 8.0 mg/l
	For lakes/reservoirs, human actions considered cumulatively may not decrease the dissolved oxygen concentration more than 0.2 mg/L below natural conditions.
Temperature	Maximum 7-day average of daily maximum temperature (7-DADMax): *Char Spawning and Egg Incubation:* 9°C (48.2°F) *Char Spawning and Rearing (summer)*: 12°C (53.6°F) *Salmon and trout spawning: 13°C (55.4°F)* *Core summer salmonid habitat(June 15 to Sept 15)*: 16°C (60.8°F) *Salmonid spawning, rearing, and migration (Sept 15 to June 14)*: 17.5°C (63.5°F) *Salmonid rearing and migration only*: 17.5°C (63.5°F)
	Skagit River (Gorge bypass reach) from Gorge Dam (river mile 96.6) to Gorge Powerhouse (river mile 94.2). Temperature shall not exceed a 1 day maximum temperature (1-DMax) of 21°C due to human activities. When natural conditions exceed a 1-DMax of 21°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 t = 34/(T + 9).
	For lakes/reservoirs, human actions considered cumulatively may not increase the 7-DADMax temperature more than 0.3°C (0.54°F) above natural conditions.
Total Dissolved Gas	Not to exceed 110% of saturation at any point of sample collection.
pH	Within 6.5 to 8.5 pH units with human caused variation of: less than 0.2 units for char and salmon and trout spawning, core rearing, and migration less than 0.5 units for salmon and trout spawning, noncore rearing, and migration
Turbidity	Shall not exceed either a 5 nephelometric turbidity unit (NTU) increase over background when the background is 50 NTU or less; or a 10% increase in turbidity when the background is more than 50 NTU

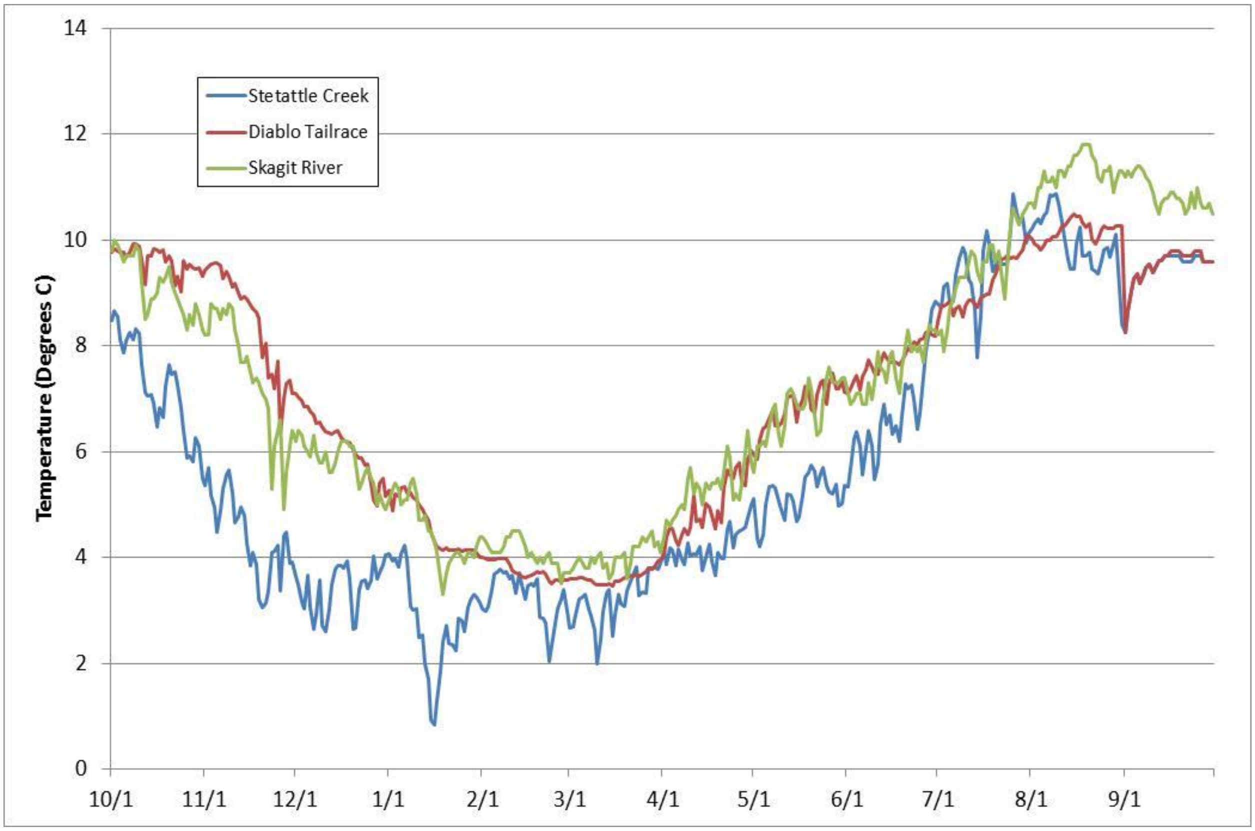


Figure 62. Mean daily water temperatures at Stetattle Creek, Gorge Lake below Diablo powerhouse tailrace, and Skagit River at Marblemount; Oct 1, 2011 – Sept. 30, 2012.

Figure 13. NPS photograph showing high turbidity waters from Stetattle Creek entering the Skagit River.

Dissolved oxygen concentrations in Stetattle Creek are expected to be at maximum saturation, due to the fast currents found in this stream. Turbidity levels are expected to be less than 5 NTU in Stetattle Creek most of the time, since this is a non-glacial stream that is largely undisturbed by human activities. However, turbidity levels in Stetattle Creek have been observed to be occasionally high when heavy rains release fine sediments into the stream (Figure 13).

Gorge Lake

Water temperatures in Gorge Lake are determined by outflow temperatures from the Ross and Diablo power project. The temperatures in Gorge Lake are typically quite cold since most of the water in Ross Lake is drawn from the hypolimnion of the reservoir (SCL 2012). Because of the short hydraulic residence time of water in Gorge Lake (typically less than 2 days), water should not stratify in this reservoir. Mean daily water temperatures in Gorge Lake are typically below 10 °C throughout the year (see Figure 12). Because water temperatures in the reservoir do not fall below 9 °C until late November, water temperatures in the reservoir may be too warm for bull trout spawning since the spawning period for this species extends from late September to early November (SCL 2012). However, Gorge Lake provides temperatures that are under the 12 °C maximum temperature threshold juvenile bull trout (see Table 4) during the summer and fall. The NPS photograph below shows high turbidity levels in the Skagit River at the mouth of Stetattle Creek during spring of 2012.

Dissolved oxygen measurements taken in Ross Lake and Diablo Lake from 2011 and 2012 indicate there is complete saturation in Ross Lake throughout the water column (A. Rawhauser, Fisheries Biologist, NOCA, pers. comm. 2013). Dissolved oxygen levels are assumed to be at complete saturation in Gorge Lake throughout the year.

Turbidity in reservoir areas upstream of the proposed project is influenced by seasonal runoff of silt and glacial flour and rain-on-snow events and varies seasonally. Suspended sediments (turbidity) are delivered in tributary flows and some finer particles, especially clays, carried through the reservoirs and into the Skagit River below Gorge Powerhouse. Measurements from the south end of Ross Reservoir taken from March to December 1973 showed that maximum turbidity (Secchi depth: 3.3 m) occurred in late May, resulting from high spring flows. Mid-July to December Secchi depth readings varied from 7.5 to 11.7 m. During the previous year, 1972, the minimum depth of water transparency was recorded on June 30 at a Secchi depth of 1.4 m (SCL 1974). The hydroelectric project does not appear to exacerbate turbidity and suspended sediments, and the section of the Skagit River downstream of Gorge Powerhouse is in compliance with the standard for turbidity.

Skagit River Adjacent to Copper Creek Pit

Temperatures in the Skagit River at the Marblemount USGS gaging station at RM 78.7, approximately 7 miles downriver from the Copper Creek Pit are warmest in July, August, September, and October. Average daily temperatures of the Skagit River typically range between 8 °C and 11°C in July, while average daily temperatures in August and September typically range from 10°C to 12°C (Figure 12). Maximum daily temperatures of the Skagit River at Marblemount usually do not exceed 14°C during the warmest periods of the year. Dissolved Oxygen levels in this reach are typically at saturation levels (WDOE ambient monitoring station data). Turbidity levels are generally below 5 NTU, through natural background levels can exceed this level during periods of high flow, or high glacier runoff from the Thunder Creek basin. High turbidity events in this section of the river are typically natural in origin (WDOE ambient monitoring station summary). For this reason, turbidity levels have not triggered any 303(d) listing for the upper Skagit River.

3.1.3. Vegetation

The project area is within the North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Ecological System, as defined by the Washington Natural Heritage Program (Rocchio and Crawford, 2009). This ecosystem, typical of interior western Washington lowlands (<2,000 foot elevation), is characterized by mild, moist maritime climate, with more precipitation occurring as rain than snow; fire is a major natural disturbance. Vegetation is dominated by Douglas-fir with western hemlock co-dominant or occasional in the canopy; sword fern is usually a major component of the understory (Rocchio and Crawford, 2009).

Vegetation in the project area consists of a mix of non-native and native species common to riparian and upland habitats in western Washington and characteristic of areas that have been previously cleared or disturbed (Table 5). Plant species composition and vegetation structure is summarized below for the excavation area and Copper Creek Pit disposal site.

Excavation Area – The excavation area is a cobble bar that is frequently inundated by high flows from Stetattle Creek and Diablo Dam spill events. About three-quarters of the bar is devoid of vegetation as a direct result of periodic scouring from higher flow events and the very droughty nature of the coarse substrate. The downstream end of the bar supports a sparse association of pioneer species, including red alder, paintbrush, broad-leaved willowherb, and fireweed, as well as a few shrubs and conifer seedlings that are adapted to the harsh conditions. Large woody debris occurs in patches throughout the bar but is concentrated at the upstream end (Figure 14).

Figure 14. September 4, 2013 photograph looking upstream at sparse pioneer vegetation and large woody debris on the cobble bar.

Gorge Campground Embankment and Access Road Area - The shoreline adjacent to the excavation area on the right bank of Gorge Lake below the Gorge Campground is steep and rocky and supports a relatively sparse plant community composed primarily of native shrubs and deciduous trees, including sapling to pole-sized big-leaf maple, red alder, and black cottonwood, primarily 6-10 inches diameter at breast height (DBH). There are a few scattered Douglas-fir trees and associated sparse understory associates, including goatsbeard and sword fern. There are few grasses or forbs present. All of the Douglas-fir trees are less than 14 inches DBH as shown in the Figure 15.

Table 5. Plant species recorded within the Diablo Powerhouse Tailrace Restoration Project Area[1,2].

Species **Common Name (*Scientific Name*)**	**Excavation Area**	**Copper Creek Pit**
Big-leaf maple (*Acer macrophyllum*)		x
Black cottonwood (*Populus balsamifera*)		x
Douglas-fir (*Pseudotsuga menziesii*)	x	x
Red alder (*Alnus rubra*)	x	x
Western red cedar (*Thuja plicata*)	x	x
Western hemlock (*Tsuga heterophylla*)		x
Shrubs		
English ivy (*Hedera helix*)*		x
Highbush cranberry (*Viburnum edule*)		
Ninebark (*Physocarpus capitatus*)	x	
Red elderberry (*Sambucus racemosa*)		x
Salmonberry (*Rubus spectabilis*)		x
Timbleberry (*Rubus pariflorus*)	x	x
Trailing blackberry (*Rubus ursinus*)		x
Vine maple (*Acer circinatum*)		x
Willow (*Salix* sp.)	x	x
Forbs & Grasses		
Aster (*Aster* sp.)	x	
Bleeding heart (*Dicentra formosa*)		x
Bracken fern (*Pteridium aquilinum*)		x
Broad-leaved willowherb (*Epilobium latifolium*)	x	
Cat's-ear (*Hypochaeris radicata*)*		x
Common plantain (*Plantago major*)*		x
Common tansy (*Tanacetum vulgare*)*	x	x
Common velvetgrass (*Holcus lanatus*)*		x
Creeping buttercup (*Ranunculus repens*)*		x
Curly dock (*Rumex crispus*)*		x
Fireweed (*Chamerion angustifolium*)	x	
Foxglove (*Digitalis purpurea*)*		x
Goatsbeard (*Aruncus dioicus*)	x	
Herb Robert (*Geranium robertianum*)*		x
Lance-leaf plantain (*Plantago lanceolota*)*		x
Meadow buttercup (*Ranunculus acris*)*		x
Oxeye daisy (*Leucanthemum vulgare*)*	x	x
Paintbrush (*Castilleja* sp.)	x	
Pearly everlasting (*Anaphalis margaritacea*)	x	x
Purple-leaved willowherb (*Epilobium ciliatum*)		x
Red clover (*Trifolium pratense*)*		x
Red columbine (*Aquilegia formosa*)	x	
Red fescue (*Festuca rubra*)		x

Table 5. Plant species recorded within the Diablo Powerhouse Tailrace Restoration Project Area[1,2].

Species **Common Name (*Scientific Name*)**	**Excavation Area**	**Copper Creek Pit**
Self-heal (*Prunella vulgaris*)	x	
Stinging nettle (*Urtica dioica*)		x
White clover (*Trifolium repens*)*		x
Woodland strawberry (*Frageria vesca*)		x
Yarrow (*Achillea millefolium*)	x	
Yellow rattle (*Rhinanthus minor*)		x

[1] Plant surveys of the excavation area, Gorge Campground and SCL Borrow Pit were conducted on May 24, 2013; the few grass species observed were not blooming and were not identified. The Copper Creek Pit was surveyed on June 12, 2013.
[2] * Indicates non-native species.

Figure 15. Looking north northeast from the southern end of the bar at typical smaller stature Douglas fir and red alder on the north bank.

Copper Creek Pit Disposal Site – The Copper Creek Pit site is surrounded by relatively mature second-growth mixed forest stands typical of riparian and adjacent uplands along the Skagit River. Trees along the road into the site are infested by English ivy. Early homesteading and historic excavation activities have resulted in disturbed conditions that favor non-native and invasive and pioneer species. Though no soil extraction has occurred for the last five years, vegetation consists of a relatively uniform cover of forbs and grasses, mostly common non-native and invasive species. A few native species, such as bracken fern, pearly everlasting, red fescue, and yellow rattle occur within the interior portions of the disposal site. A variety of native trees, shrubs, and forbs occur around the edges of the site at the interface with forested habitats as shown in Figure 16.

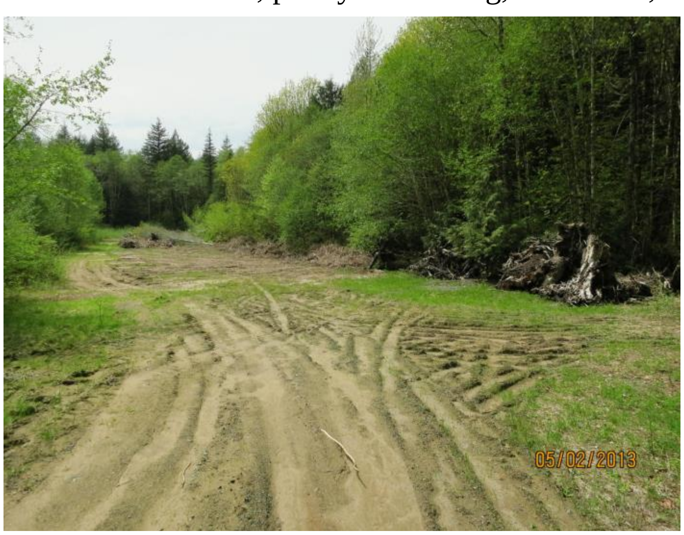


Figure 16. Looking south southwest at disturbed conditions and pioneer native and non-native vegetation at the Copper Creek Quarry disposal site.

No rare plants have been documented in the project area, and their presence is unlikely given past development and disturbed conditions present in the excavation and disposal site areas.

3.1.4. Fish and Wildlife, Including Rare/Listed Species

The North Cascades is one of the most diverse ecosystems in North America and supports at least 28 fish species, 75 mammals, over 200 birds, 10 reptiles, and 13 amphibians (NPS, 2014). Far fewer species would be expected to occur within the small, fragmented and disturbed habitats in the project area. The cobble bar excavation area and disposal site provide limited habitat, and are substantially influenced by recreational facilities and activities, past disturbance, and/or proximity to roads and other human development.

As potential project impacts are expected to be greatest to fish and other aquatic, most emphasis in this chapter is placed on aquatic habitat conditions in Gorge Lake, Stetattle Creek, and downstream of Gorge Dam. Wildlife habitat conditions and use is addressed more generally.

Fish Habitat and Fish Use

Fish species documented in Gorge Lake include bull trout (*Salvelinus confluentus*), Dolly Varden (*Salvelinus malma*), rainbow trout (*Oncorhynchus mykiss*), and a non-native char species: eastern brook trout (*Salvelinus fontinalis*). Bull trout and Dolly Varden spawn in Stetattle Creek upstream of the mouth. Redside shiners (*Richardsonius baleatus*), a minnow species native to the lower Skagit River, have been increasing rapidly in population size in Ross Lake after being introduced to this system approximately 10 years ago. Redside shiners have been observed in Diablo Lake, and are presumed to be present in Gorge Lake. See the Biological Evaluation in Appendix A for more detail on bull trout.

<u>Gorge Lake and Stetattle Creek</u>

Gorge Lake provides the least amount of lake and tributary habitat for bull trout and other fish compared to Diablo and Ross lakes. Gorge Lake has a volume of 8,158 acre-feet and surface area of 240 acres under the normal operating pool elevation of 878.2 ft (NAVD88). By comparison, Diablo Lake has a volume of 90,400 acre-feet and surface area of 910 acres and Ross Lake has a volume of 1,444,000 acre-feet and surface area of 11,700 acres under normal operating elevations.

Stetattle Creek is the only known fish-bearing tributary to Gorge Lake. A natural falls barrier is located at stream mile 1.1 just below the mouth of Bucket Creek (SCL 2012). Stettatle Creek contains high quality habitat with cold water and clean gravels though this is limited in quantity due to the short length of the stream that is accessible to fish from Gorge Lake. The total amount of spawning habitat accessible to trout in the Gorge Lake drainage is approximately 2,300 square feet (Tappel 1989). This represents only 0.7% of the total 325,300 square feet of potential bull trout spawning habitat found in the Upper Skagit Core Area, most of which is found in the Ross Lake drainage (SCL 2012).

The quantity and quality of aquatic habitat in the vicinity of the proposed excavation area varies in relation to the amount of flow released from Diablo Powerhouse, the operating level of Gorge Lake, and the amount of flow from Stetattle Creek. Under normal operating conditions, flows released from the Diablo Powerhouse range from 1,400 to 6,900 cfs (95^{th} and 5^{th} percent exceedance values, respectively, for hourly discharges). Flows at the proposed excavation area below Stetattle Creek are the sum of the Diablo Powerhouse and Stetattle Creek discharges plus any spills from Diablo Dam. Diablo Dam spills only six days per year on average, primarily during high runoff during the spring and early summer when flows from Thunder Creek in the Diablo Lake basin exceed project generation capacity.

Average monthly flows in Stetattle Creek range from 105 to 390 cfs. Lowest flows occur during the baseflow period between August through October and winter between January and March. Highest flows in Stetattle Creek and the Skagit River occur from May through July, corresponding with spring thaw and snowmelt. Mean flows at the excavation project site range from 2,400 cfs to 5,800 cfs. During the low flow months the highest daily flows are in the range of 4,000 cfs; during high flow months the lowest daily flows are around 4,200 cfs. A detailed discussion and figures presenting discharges from the Diablo Powerhouse and Stetattle Creek, the effects of power generation on lake levels, and spills from the Diablo Dam on existing aquatic habitat conditions is presented in the BE (Appendix A).

There are seven types (zones) of distinct aquatic habitats in the vicinity of the proposed excavation (Figure 17; also see BE in Appendix A for more detail and photographs of each zone and Appendix D):

Zone 1 – Mouth of Stetattle Creek. The mouth of Stetattle Creek can be subdivided into Zone 1A (plunge pool tailout that transitions to run habitat) and Zone 1B (riffle). Together the total length of these habitats is about 220 ft in length and total area about 0.49 acres under normal reservoir operating conditions. The substrate at the mouth of Stetattle Creek consists of an alluvial fan composed mainly of cobble and large gravel bed materials.

Zone 2 - Ephemeral side channel below confluence of Stetattle Creek. This habitat zone is a side channel located along the right bank of the reservoir adjacent to the cobble bar, and has surface flows only when discharge from Stetattle Creek exceeds 265 cfs, which is about 20% of the time. Thus the side channel is dry about 80% of the time, with flows present in the side channel only in spring and early summer. This area is subdivided into a bank (Zone 2A) and non-bank (Zone 2B) areas.

Zone 3 – Backwater side channel. Another side channel habitat located just downstream of Zone 2, this habitat is connected to the reservoir and is a zero-velocity backwater area except when Stetattle Creek is running high during the spring and early summer. The total area is 0.49 acres, with a wetted channel area of 0.38 acres at normal reservoir operating elevations. Juvenile rainbow trout and bull trout were observed in Zone 3 during surveys conducted by the NPS in 2013. This zone likewise is subdivided into a bank (Zone 3A) and non-bank (Zone 3B).

Zone 4 – Exposed cobble bar. This habitat area is currently a large expanse of cobble bar that is dry under typical flows from Diablo Powerhouse and Stetattle Creek. The dry portion of the cobble bar has an area of 1.06 acres. This area provides no aquatic habitat under average flow and normal reservoir operating conditions.

Zone 5 – Reservoir gravel bar located upstream of Stetattle Creek. This gravel bar area of the reservoir is located immediately upstream of the confluence of Stetattle Creek and Gorge Lake. It is relatively shallow habitat under most flow conditions. Part of this area is a dry gravel bar under low generation flow conditions (2,400 cfs) but becomes completely submerged during high generation flows (5,800 cfs). The total area of this gravel bar is 0.56 acres, of which 0.45 acres are wetted under low flow (2,400 cfs) conditions.

Zone 6 - Riverine rapids. This habitat zone is adjacent to the south side of the cobble bar within a free-flow section of Gorge Lake. This is a rapids habitat with standing waves visible during median and high generation flows. Habitat in this area is unsuitable for adult and juvenile bull trout because of high velocities. The dominant substrates in this zone are small boulders and large cobbles. This habitat zone has a wetted area of 1.08 acre under median flow conditions.

Zone 7 – Deep Riverine Run. This habitat zone is located immediately downstream of the rapids in Zone 6. Water is much deeper because it is a transition zone between the rapids adjacent to the cobble bar and the reservoir habitat formed by Gorge Dam. Velocities within Zone 7 are high and the dominant substrate is large cobble. This habitat area was observed to be used by adult rainbow trout for foraging during snorkel surveys conducted by NPS biologists (NPS 2013). However, this is a low quality habitat zone for juvenile bull trout because of high velocities and unsuitable depths.

In addition to the seven habitat zones immediately adjacent to the proposed excavation area, there are two lake zones upstream and downstream of the excavation area, as well as Stetattle Creek upstream of its confluence with Gorge Lake:

Gorge Lake above Zone 5. The outlet of Stetattle Creek and associated gravel bar forms the hydraulic control that determines the water surface elevation of the Diablo Powerhouse tailrace pool under normal operating conditions. The tailrace pool extends from this hydraulic control to the base of Diablo Dam. The tailrace pool is 5,812 ft in length and has an area of 31.5 acres. The pool is very deep in most locations with channel center depths ranging from 12.1 to 38.8 ft and an average depth of 28.8 ft (Seattle University 2008). Habitat cover in this upper section of the reservoir is provided by deep water, large boulders, turbulent surface waters in the vicinity of the Diablo powerhouse tailrace and by overhanging riparian vegetation.

Gorge Lake downstream of the excavation area. Gorge Lake downstream from the excavation area to Gorge Dam has an area of 206 acres and has lake habitat conditionswhen the reservoir is at or near full pool. The area of the reservoir immediately above the SR 20 causeway and bridge is relatively shallow with a depth of approximately 20 ft deep. A delta has formed in this area from deposition of fine sediments resulting from still water conditions in the upper portion of the reservoir. Stumps and large boulders on either side of the SR 20 and along the north shore of the delta zone provide the only habitat cover for fish in this area. The reservoir section between the SR 20 bridge and Gorge Dam gets progressively deeper downstream, from 30 feet downstream of bridge to 100 feet deep at Gorge Dam. Habitat cover in this section is provided by large boulders and stumps located along both banks of the reservoir.

Stetattle Creek upstream of Stetattle Creek Bridge. Stetattle Creek immediately upstream of the bridge has an average width of 51 ft and a wetted surface area of 1.7 acres. This section of the creek has a gradient of 1.78% and is composed primarily of riffle, run, and cascade habitats. Substrates in this section of the stream are dominated by cobbles and small boulders. Gravels suitable for spawning are scarce in this section of the stream. There is a deep pool located under

Stetattle Creek Bridge that was formed by the large riprap added to this area to protect the foundation of the bridge.

Skagit River

The 26-mile reach of the Upper Skagit River between the town of Newhalem and the confluence of the Sauk River is one of the most productive salmon, steelhead, and bull trout habitat areas in the Puget Sound Basin (SCL 2011). This section of the river has the largest number of wild Chinook salmon in the Puget Sound Basin, accounting for about 40% of all spawners in this region. The section of the river also supports the largest number of pink salmon in the Skagit River, and the largest chum salmon run in the coterminous United States (Connor and Pflug 2004). The river channel in this section is dominated by cobble and gravel substrates that are highly suitable for salmon and steelhead spawning. This section of the river possesses abundant foraging habitat for adult bull trout, and supports of estimated population of over 3,000 spawners (Lowery 2009).

The Skagit River character has been greatly influenced by historic glacial advances and recessions. As the continental ice that covered the action area melted northward, widespread deposition of glacial sediments occurred throughout the basin. The melting ice also may have modified the flow direction for portions of the river upstream of the Skagit Gorge from a historic northern path to the Fraser River to the present westward direction (Riedel et al. 2007). Ross, Diablo, and Gorge dams retain bedload material derived from the upper Skagit River and its tributaries. Although the dams clearly disrupt bedload transport, adverse effects to spawning habitat appears to be minimal in the reach between Gorge Powerhouse and the Sauk River because spawning gravel is abundant in the river below the project, and large amounts of gravel move into the river each year from glacial fed tributaries. For example, sufficient bedload sediment is recruited from Ladder Creek and other tributaries in the Gorge bypass reach to provide spawning habitat immediately downstream of the Gorge Powerhouse. Although the dams reduce gravel recruitment into the reach below Gorge Powerhouse, flow management may partially offset the reduction by reducing the frequency and magnitude of peak flow events and reducing scouring and downstream transport of spawning gravels.

The Upper Skagit River below Gorge Dam supports populations of a number of fish species. Populations of Chinook (*O. tshawytscha*), pink (*O. gorbuscha*), chum (*O. keta*), and coho (*O. kisutch*) salmon, steelhead (*O. mykiss*), cutthroat trout (*O. clarki*), and bull trout are known to occur in the river adjacent to the Copper Creek Pit disposal site. Non-commercial and non-game fish species in the Skagit River adjacent to the Copper Creek Pit disposal site include mountain whitefish (*Prosopium williamsoni*), coast range sculpin (*Cottus aleuticus*), margined sculpin (*C. marginatus*), prickly sculpin (*C. asper*), shorthead sculpin (*C. confuses*), and torrent sculpin (*C. rhotheus*).

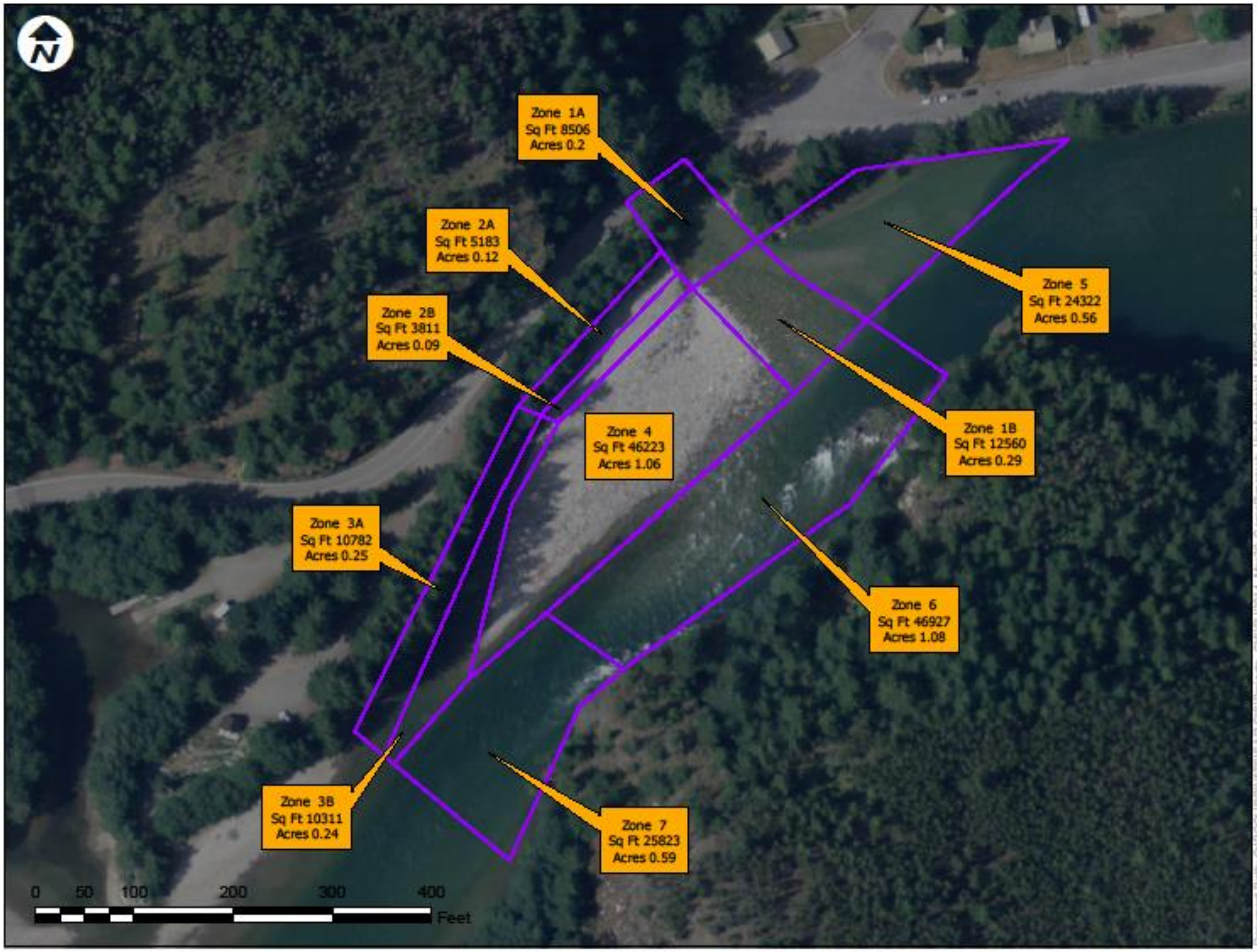


Figure 17. Map of habitat zones at cobble bar excavation site. Reservoir flow in the photo is approximately 4,000 cfs. Zones 2 and 3 were divided into two subzones for the purpose of estimating habitat mitigation benefits under post-project conditions, but can be considered to be single habitat zones under existing conditions.

Wildlife Habitat

Wildlife species observed in or near the project area include black bear (*Ursus americanus*), black-tailed deer (*Odocoileus hemionus columbianus*), Douglas squirrel (*Tamiasciurus douglasii*), bobcat (*Lynx rufus*), Canada goose (*Branta canadensis*), common merganser (*Mergus merganser*), and a variety of relatively common songbirds. Several species of bats (*Myotis* spp.) breed and use day roosts in the Hollywood area and likely forage for insects in the immediate vicinity of the excavation area and over nearby aquatic habitats.

Other wildlife inhabiting or likely to use the project area are habitat generalists including those species tolerant of relatively high levels of human activity or those that can use relatively small patches of disturbed habitat.

<u>Rare and Listed Species</u>

There are 10 species that are federally or state listed as threatened or endangered for which there is suitable habitat in the North Cascades west of the crest (Table 6). An additional nine species potentially occurring in this area are state listed as sensitive, or candidates for federal or state protection. Of these 19 listed species only 5 would be expected to use habitats in or near the project area. These include the northern spotted owl (*Strix occidentalis caurina*), marbled murrelet (*Brachyramphus marmoratus*), bald eagle, peregrine falcon, pileated woodpecker, common loon, and bull trout.

- <u>Bald Eagle</u> – Bald eagles are relatively common along the Skagit River, particularly during the winter. Use by breeding bald eagles is low; there are a few historic nest sites documented along the river downstream of the Sauk River and two known nest territories along Ross Lake. The primary wintering area is downstream of Newhalem where large numbers of eagles are attracted to the food provided by spawning chum salmon between November and February. The Copper Creek disposal site is within this wintering area but is not near any heavily used sites or communal winter roost sites. Bald eagles likely perch in the trees along the river near the site and feed on salmon in the adjacent stretch of the Skagit River. The excavation area and the disposal site are considerably upstream of Newhalem. Although bald eagles may occasionally forge near these sites, they are not often observed in the vicinity of Gorge Lake and Diablo town and there is a greater abundance of forage fish further downstream.
- <u>Marbled Murrelet</u> – The marbled murrelet is a small seabird that nests in old conifer forests and forages in coastal waters. There is not any suitable nesting habitat at either the excavation area or at the disposal site. The nearest detection of marbled murrelets in potential breeding habitat is in the Thornton Creek watershed, about 5.5 miles to the west of the excavation area and 5 miles northeast of the disposal site (Hamer Environmental, 2009).
- <u>Northern Spotted Owl</u> – In the North Cascades, northern spotted owls typically nest in older, multilayered forests at elevations from near sea level to 4,000 ft. Spotted owl nesting and roosting habitat is characterized by a moderate to high canopy closure; a multilayered, multi-species canopy with large overstory trees; a high incidence of large trees with large cavities, broken tops, mistletoe infections, and other evidence of decadence; large accumulations of downed trees and other woody debris; and sufficient open space below the canopy for flight

(USFWS 2008b). The northern spotted owl is considered an uncommon resident in the NOCA. Most previously known territories west of the Cascade crest are now occupied by barred owls (*Strix varia*). Based on surveys conducted by the NPS, the nearest known spotted owl nest site is located in the Newhalem Creek drainage, more than 5 miles to the southwest of the excavation area. This site was active in 2009 but no spotted owls detected in 2010, the most recent survey year (R. Kuntz, Wildlife Biologist, NOCA, pers. comm. 2011). There are no records in the last 15 years of spotted owl activity within the vicinity of the excavation area or the disposal site year (R. Kuntz, Wildlife Biologist, NOCA, pers. comm. 2011).

- Peregrine Falcon – Peregrine falcons are frequently observed perched on Gorge and Diablo dams and foraging over Diablo and Gorge lakes. They have been occasionally observed by SCL biologists perched along the Skagit River between Marblemount and Newhalem and it

Table 6. Washington state and federal Endangered (E), Threatened (T), Candidate (C) and other Sensitive (S) species in the North Cascades ecosystem west of the Cascade crest.

Common Name[1]	Scientific Name	Status[2]	
		Federal	State
Mammals			
Canada lynx*	*Lynx canadensis*	T	T
Fisher*	*Martes pennanti*	C	E
Gray wolf*	*Canus lupus*	E	E
Grizzly bear*	*Ursus arctos*	T	E
Townsend's big-eared bat*	*Corynorhinus townsendii*	-	C
Wolverine*	*Gulo gulo luteus*	C	C
Birds			
Bald eagle	*Haliaeetus leucocephalus*	-	S
Common loon	*Gavia immer*	-	S
Marbled murrelet	*Brachyramphus marmoratus*	T	T
Northern goshawk*	*Accipiter gentilis*	-	C
Northern spotted owl	*Strix occidentalis caurina*	T	E
Peregrine falcon	*Falco peregrinis*	-	S
Pileated woodpecker	*Dryocopus pileatus*	-	C
Vaux's swift*	*Chaetura vauxi*	-	C
Amphibians & Fish			
Oregon spotted frog*	*Rana pretiosa*	C	E
Western toad*	*Bufo boreas*	-	C
Chinook salmon*	*Oncorhynchus tshawytscha*	T	C
Steelhead*	*Oncorhynchus mykiss*	T	C
Bull trout	*Salvelinus confluentus*	T	C

[1] * Indicates species that are unlikely to be present in the project area. These species are not tolerant of human activity (e.g. developments, motorized vehicle use) or there is a lack of sufficient habitat in or near the project area.
[2] Status is from WDFW 2013 (http://wdfw.wa.gov/conservation/endangered/All/; accessed July 25, 2013).

is possible that nesting occurs on the cliffs west of Marblemount. Surveys conducted by the NPS, SCL, and Washington Department of Fish and Wildlife (WDFW) indicate that there are three peregrine falcon nest territories between Newhalem and Ross Dam that are consistently occupied on an annual basis. The ledges selected for nesting within each territory have varied over the last four years, with at least one within a mile of Stetattle Creek; however, none have been within line of site of the excavation area or the disposal site.

- Pileated Woodpecker – The pileated woodpecker has been observed in and around the Skagit Project, typically in forest stands with large trees and snags. The species may occasionally use the habitats near the excavation site and in forested habitats adjacent to the disposal site. Most of the trees in the project area are, however, relatively small, and it is unlikely that pileated woodpeckers use them for nesting or as significant forage sites.
- Common Loon – Common loons are occasionally observed on Gorge Lake near Diablo, mostly in the winter. The nearest known breeding site is Hozomeen Lake, nearly 30 miles north of Diablo. This species does not typically use the Skagit River, so would not be expected near the Copper Creek disposal site.
- Bull Trout – Bull trout have been documented in Gorge Lake and in the Skagit River downstream of Newhalem. The species spawns and rears in Stetattle Creek, and in major tributaries to the Skagit River between the Skagit Hydroelectric Project and the confluence with the Sauk River, including Newhalem Creek, Goodell Creek, Bacon Creek, Illabot Creek, Diabsud Creek, and the Cascade River (USFWS 2004). The bull trout population in the Skagit River between Newhalem and Rockport is estimated to be about 3,000 adults (Lowery 2009). Bull trout in Gorge Lake have an estimated population of about 100 fish and co-exist with another native char species, Dolly Varden (see Appendix A). Bull trout in Gorge Lake were originally considered to be part of the Lower Skagit Core Area in the Puget Sound Distinct Population Segment by the USFWS Recovery Unit Technical Team (USFWS 2004). This designation was based upon the presence of a large natural fish barrier that was present in the Skagit River prior to the construction of Diablo Dam in 1932. This natural fish barrier was located just downstream of the site where Diablo Dam was constructed (Smith and Anderson 1921). However, recent genetic analysis of the native char population in the Skagit River basin found that the Gorge Lake population is part of the Upper Skagit Core Area (Smith 2010). For this reason, bull trout in Gorge Lake are now considered to be part of the Upper Skagit Core Area (see attached Biological Assessment). The estimated population of bull trout in the Upper Skagit Core Area is estimated to be over 7,000 adults, with the majority of these fish in the Ross Lake drainage (SCL 2012).

3.2. Cultural Resources

Cultural resources include those Historic Properties protected under the NHPA that are prehistoric or historic era sites, structures, buildings, districts, Traditional Cultural Properties (TCP), or objects that are listed or are eligible for listing in the National Register (36 CFR 60). The potential effects to areas of cultural importance to Native Americans (e.g., sacred lands) that do not meet NHPA criteria also are considered.

The Area of Potential Effect (APE) for complying with Section 106 of the NHPA includes the cobble bar that would be excavated, Diablo Road between SR20 and the Copper Creek Pit disposal site. To account for potential visual and auditory effects, it also includes 0.8-mile, 0.5-mile, and 0.4-mile buffers around the excavation area, disposal site, and the hauling route between these areas, respectively.

The Stetattle Creek Bridge and the lowermost section of the creek itself are within the Historic Area "F" of the Skagit River Hydroelectric Project Historic District. The historic Stetattle Creek

Bridge is a contributing resource of the Hollywood Residential District of the Skagit River Hydroelectric Project Historic District. Along with the Stetattle Creek Bridge, Area F is comprised of numerous contributing resources in the Hollywood Residential Area. This steel automobile bridge supported by concrete abutments provides the only vehicular access to Diablo (see Figure 18). The bridge was built circa 1938, utilizing salvaged single track railroad trusses, and is on the site of a former railroad bridge that was built in 1927 or 1928. The Hollywood residential area dates from the 1950s, when a number of the residences were erected for Skagit River Hydroelectric Project workers.

Figure 18. Looking upstream at the deep scour pool under the historic Stetattle Creek Bridge.

Relatively little is known regarding the pre-contact, indigenous history of the upper Skagit River watershed due to the very rugged terrain. It is known that up-river bands of Skagit tribes, such as the "Miskaiwhu", occupied the mountains in the general vicinity of the project.

Approximately 0.6 mile upriver of Newhalem the steep, narrow gorge creates a barrier to salmon so the section of the Skagit River near the excavation area was not likely a fishing locality. However, the entire area in the upper Skagit River valley was important for hunting. The Upper Skagit Tribe had permanent winter villages consisting of cedar plank long houses dispersed along the Skagit River between Marblemount and Newhalem. There is no evidence of permanent villages that might have existed upriver of the town of Newhalem.

Searches of the Washington Department of Archaeology and Historic Preservation (DAHP) Washington Information System for Architectural and Archaeological Records Data (WISAARD) and National Park Service (NPS) information, indicate that there are three known post-contact archaeological sites outside of the excavation portion of the APE. All of the sites include scattered historic artifacts dated to the period of construction of the hydroelectric project but none are eligible for listing on the National Historic Register. The area just downstream of Stetattle Creek (outside the APE) was settled as part of the Davis Ranch.

The disposal site is located in area used by the Upper Skagit Tribe and which served as a travel corridor for other tribes. The area continues to be important to native peoples. This section of the Skagit was settled by miners and fur traders in the second half of the 19^{th} century. There are known prehistoric and historic archaeological sites in the general vicinity of the preferred disposal site at Copper Creek Pit (Earley and Rinck 2013). None of the sites in the vicinity of the project have been tested to determine eligibility for the National Register.

3.3. Recreation and Visitor Use

The Proposed Project is entirely within the Ross Lake National Recreation Area (NRA) which offers a variety of recreational opportunities to visitors ranging from short walks to scenic vistas to boating on and swimming in the Skagit River Hydroelectric Project reservoirs, to hiking and backpacking in the backcountry. The majority of visitors to Ross Lake NRA arrive via SR 20, also known as the North Cascades Scenic Highway. The highway provides access to a number of trails, campgrounds, and boat launches, as well as to the Skagit River, the North Cascades Visitor Center, and the SCL towns of Newhalem and Diablo (National Park Service, 2011). Though Ross Lake NRA is open to the public year-round, visitation is seasonal, with 82 percent of all visits occurring from June through September, and 28 percent of visits occurring during the peak month of August (National Park Service, 2011).

3.3.1. Gorge Lake Campground

There are five auto-accessible campgrounds within Ross Lake NRA, Goodell Creek, Newhalem Creek, Gorge Lake, Colonial Creek, and Hozomeen. All but Hozomeen are accessible from SR 20. Gorge Lake Campground, which is adjacent to the proposed excavation area, is the smallest of the five campgrounds. It is located on the bank of Gorge Lake just north of SR 20 on the access road to the town of Diablo. It is a primitive camp with no water or services, though a vault toilet is available. Camping is free of charge and sites are first-come, first-served. There are a total of eight developed campsites. Each campsite includes a graded area where a tent can be set up and a car or recreational vehicle parked and fire pit. There are also some wooden picnic tables in the campground. There is also a motor boat launch. At lower flows the ramp becomes unusable and the dock is out of the water. Most of the boat recreation on Gorge and other lakes is self-propelled and non-motorized. Figure 19 shows average monthly overnight stays from 2010 through 2012. Like overall park visitor trends, the highest overnight use is during the summer peak season.

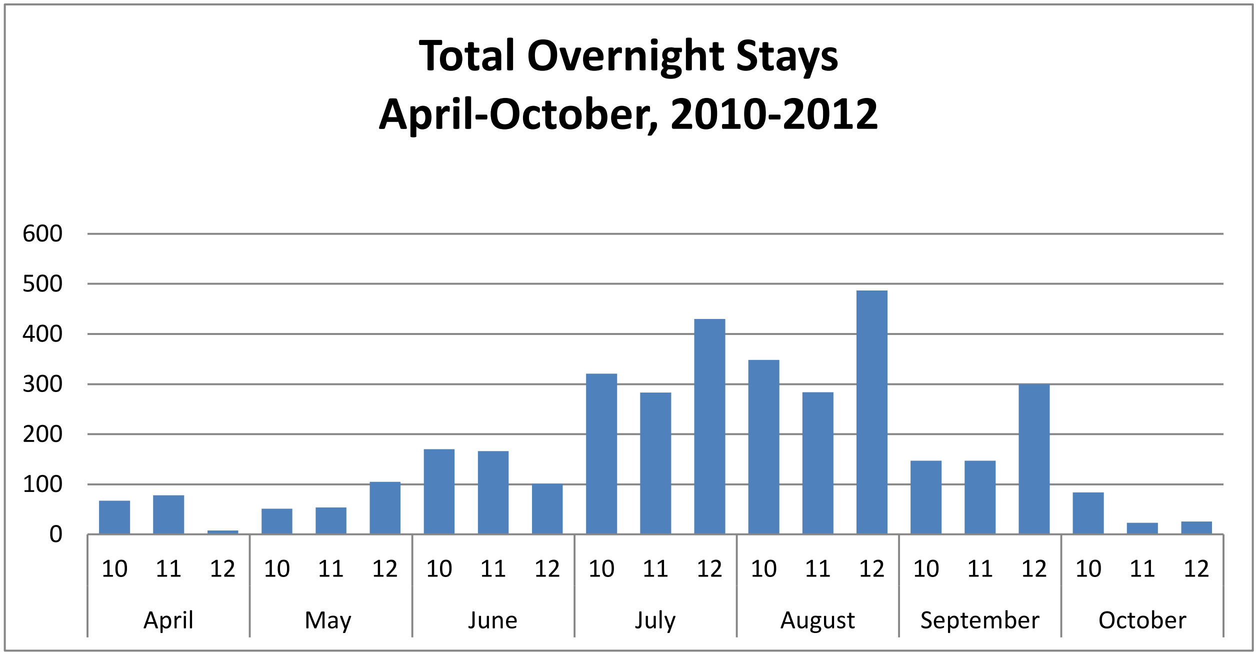


Figure 19. Average monthly overnight use of Diablo Campground.

3.3.2. Gorge Lake

Recreational activities on Gorge Lake include boating, fishing, and site seeing from turnouts on SR 20 and Diablo Road. Motor boats and self-propelled boats, such as kayaks and canoes, can be launched from the boat launch at Gorge Campground. At water levels below an elevation of about 876 ft. in the reservoir, the boat launch (Figure 19) is no longer useable for motor boat launching.

Figure 19. Motor boat launch at Gorge Lake Campground.

3.3.3. Trailhead use

There are numerous types of recreational opportunities in the Ross Lake NRA. Many of these are water related, such as boating and fishing. In addition, hiking and backpacking also are popular activities. There are many established and maintained trails throughout the Ross Lake NRA and larger Cascades National Park Complex. Two trailheads, Stetattle Creek Trailhead and Sourdough Mountain are located near the Proposed Project as shown in Figure 19. A brief description of each of these and estimated overnight (Sourdough Mountain only) and day use is provided below. While overnight stay statistics are carefully monitored, day use statistics are not as precise and estimated as a factor of ten times the number of total overnight visitors.

The **Stetattle Creek Trailhead**, located just past the Stetattle Creek Bridge at the entrance to the town of Diablo, begins by following the creek past a housing area before entering the forest. The one-way trail gains 1,100 feet in elevation over three miles, crossing several side tributaries before dwindling to an end. The first section of the trail provides views of Stetattle Creek (Figure 21). There are no designated campsites along the trail. According to Don Mann (Trail Foreman, NOCA, pers. comm. 2013), residents likely use it for recreation. Average estimated day use of this trail from 2000 to 2012 is on the order of 50 day users/year. It is expected that patterns of day use are similar to overnight with a majority of those users visiting during the peak summer season.

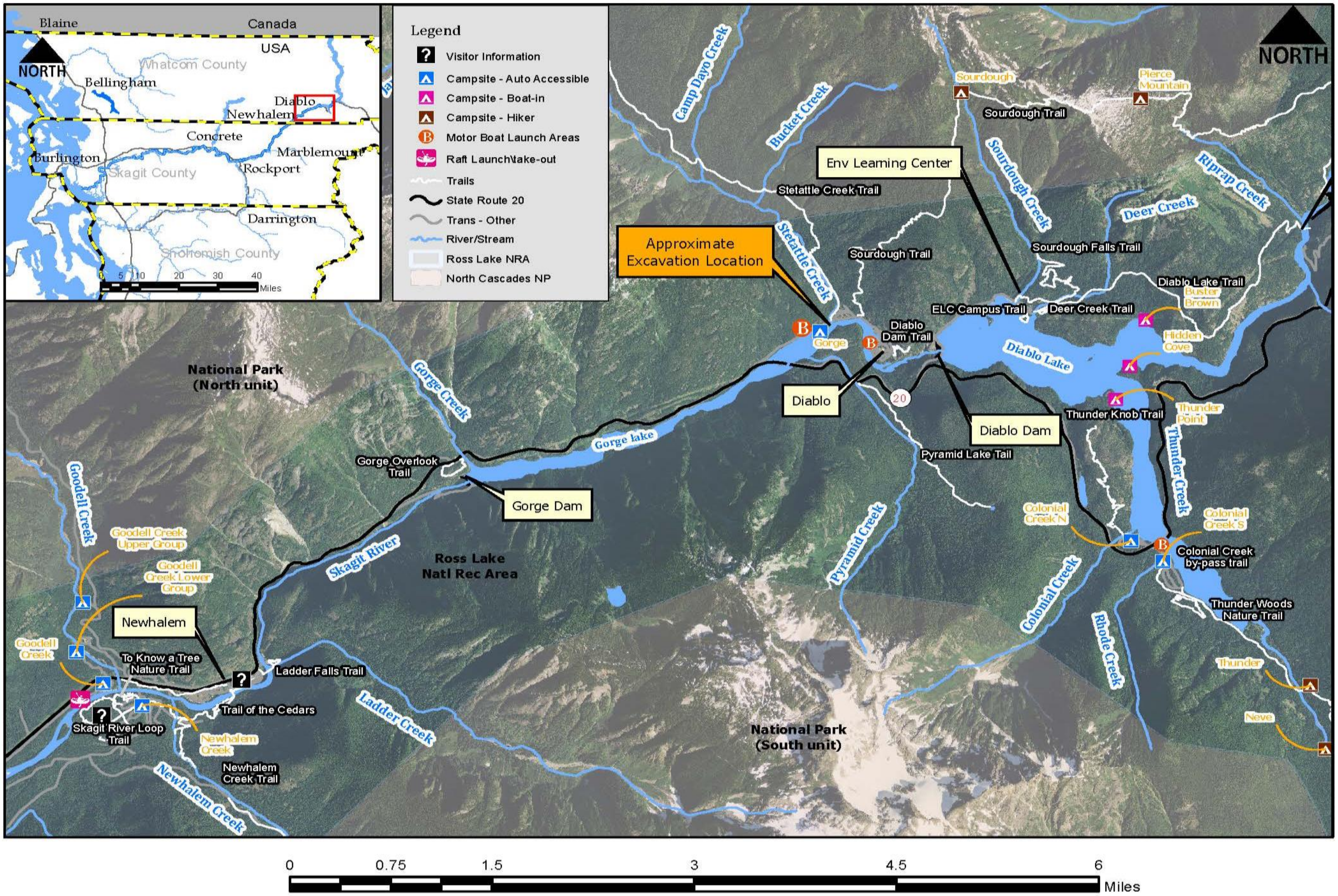


Figure 20. Campgrounds, trails and other recreational facilities in the vicinity of the Diablo Powerhouse tailrace restoration project.

- The **Sourdough Mountain Trailhead** is located in the town of Diablo behind an old concrete-block building. One of the most strenuous trails in the North Cascades National Park Complex, the steep trail passes through forest and then meadow communities before arriving at Sourdough Mountain Lookout, a historic landmark. The elevation gain from the trailhead to the lookout site is 4,870 feet over 5.2 miles. Hikers may return via the trail to Diablo or continue on a longer but less steep connecting trail on the Pierce Mountain side, which links up to the Big Beaver Trail and then Ross Dam. This is a popular but very strenuous day hike. Average estimated number of day users on this trail is on the order of 727/year (R. Seifried, Wilderness Ranger, NOCA, pers. comm. 2013).

Figure 21. View from the lower end of the Stetattle Creek Trail.

3.3.4. SR 20 Haul Road Corridor

The distance between the excavation site at the mouth of Stetattle Creek and the disposal area at the Copper Creek Pit is about 15 miles most of which is on SR 20. Other than some turnouts that offer overlooks of the Skagit River and the Thornton Lake Trail, there are no formal recreation opportunities along the southern portion of this corridor outside the area shown on Figure 19. In addition to the Gorge Lake Campground, there are three auto accessible campgrounds located in this corridor at Goodell Creek, and Newhalem Creek. Trails in close proximity to this corridor include To Know a Tree Nature Trail, Skagit River Look Trail, Ladder Falls Trail, the Newhalem Creek Trail, Gorge Overlook Trail and Pyramid Lake Trail.

3.3.5. Copper Creek Pit Area

Recreation opportunities near the Copper Creek Pit disposal site are primarily water related. The nearby Skagit River is closed to motorized boats but is popular for rafting, kayaking, and fishing. The Copper Creek raft launch/take-out is just upstream from the disposal site. The ramp is primitive and there are no associated facilities other than a vault toilet. Access to the ramp is via a dirt road (NPS Road 213) off SR 20, just north of the entrance sign for North Cascades National Park. The access road splits in about 0.25 mile, with the northern branch leading to the Copper Creek boat ramp and the southern branch to the disposal site. The Copper Creek Pit disposal site is not visible from SR 20 or the Skagit River and is not marked by any signs.

3.4. Soundscapes

The ambient noise level at the Stetattle Creek excavation area is affected largely by the flowing water of the Skagit River and Stetattle Creek, Diablo Powerhouse and switchyard operations, activities in the Hollywood residential area, recreational activities at the Gorge Campground, and vehicular traffic on SR20 and on Diablo Road. At the proposed disposal site, existing sources of noise include the Skagit River, SR20 traffic, and sporadic noise from the Copper Creek raft launch and take-out site.

No site-specific ambient noise data exists for either area but NPS did conduct a noise study in 2009 and measured a background noise level of 46 decibels – A-weighted (dBA) for Newhalem in the vicinity of Gorge Powerhouse (NPS 2009). Since the ambient noise level at the excavation and disposal site is likely no lower than what was measured at the site near Newhalem, 46 dBA is used as the ambient noise level for analysis of environmental consequences on this parameter.

3.5. Greenhouse Gases

A baseline Greenhouse Gas (GHG) emissions inventory for the NOCA was completed in 2007 using the Climate Leadership in Parks (CLIP) Tool as part of the *General Management Plan and Environmental Impact Statement* (NPS 2011). The most recent emissions inventory for the NOCA was completed in 2009 using the CLIP Tool. The CLIP Tool is an emissions inventory model developed jointly in cooperation with the EPA. More details on the CLIP Tool can be found online at http://www.nps.gov/climatefriendlyparks/CLIPtool/index.html. Both the baseline and 2009 inventories estimated and reported total gross emissions as carbon dioxide equivalents (CO_{2e}) from various sources, including stationary combustion, mobile combustion, purchased electricity, landfilled waste, and refrigeration in metric tons. A metric ton is equivalent to about 2,205 lbs. Both inventories show the same trend, indicating that combustion of fossil fuels by motor vehicles (i.e., mobile combustion) is the single biggest contributor to total emissions. As there appear to be differences in the completeness of the emissions data included in the inventories, only the more complete 2009 data are reported. Total emissions, as CO_{2e} from all sources, were 9,918 metric tons. Emissions from mobile combustion were 9,141 metric tons CO_{2e} or 92 percent of the total emissions. The next largest source was purchased electricity, which contributed only 598 metric tons CO_{2e} or about 6 percent of total emissions. All other sources were smaller and contributed to 1 percent or less of the total emissions. Net emissions for both the baseline and 2009 inventories were estimated by subtracting out carbon sequestered in vegetation, which was very conservatively assumed to be zero. Therefore, the gross and net emissions are the same.

GHG emissions from combustion of fossil fuels by motor vehicles varies by model and make (i.e., fuel efficiency) and type of fuel (e.g., diesel, compressed natural gas, or gasoline). Emissions from mobile combustion by visitors are the largest sources of total emissions in Ross Lake NRA and comprised about 86 percent or 8,579 metric tons CO_{2e}. Highway vehicle emissions accounted for 98 percent of the mobile combustion emissions. The CLIP Tool uses highway vehicle miles traveled for cars, light trucks and SUVs, Buses, heavy-duty vehicles for the various fuel types and divides these by reported average fuel efficiencies in miles per gallon (FHWA 2003) to calculate total fuel consumption. Once total fuel consumption for each fuel type is known, the model calculates total highway vehicle emissions of carbon dioxide, methane, and nitrous oxide (the major GHGs). Of these three GHGs, emissions of carbon dioxide accounted for 98 percent of total emissions from highway vehicles. Carbon dioxide emissions are calculated by multiplying fuel consumption by the carbon content for the different fuel types (EPA 2004), which is then multiplied by the percentage of the fuel oxidized to carbon dioxide by combustion (EPA 2008). Methane and nitrous oxide emissions also were calculated but these are a small fraction (2 percent) of total emissions and the reader is referred to the website above for more information on how the model calculates values for those. For both the baseline and current inventories, combustion of fossil fuel by motor vehicles is the single largest source of GHGs and an order of magnitude higher than any other source evaluated.

If the carbon sequestration of forested and other habitats within the Ross Lake NRA are considered, net emissions would be considerably lower than those identified above. As trees in forests and forest soils are known to be a major sink for carbon (i.e., sequestration) and there are large intact forested areas within the Ross Lake NRA, the net emissions above likely considerably overestimate total emissions as CO_{2e} for the Ross Lake NRA. Average annual estimated net ecosystem productivity for Pacific Northwest forests on public lands between 2003 and 2007 was estimated to be 163 gC m^{-2} yr^{-1} (Turner et al. 2011).

The total carbon sequestration of forested habitats could likely be determined by parsing the data for the NOCA from that the total of forested habitats on public lands in Oregon and Washington identified by Turner et al. (2011). The total area of the NOCA is 681,158 acres and the total area of Ross Lake NRA is 62,902 acres (NPS 2011). Even after subtracting out the areas of lakes and glaciers, it is clear that the acreage of forested habitats is substantial and the total carbon sequestration value for forests and forest soils within the NOCA and Ross Lake NRA would be a relatively large number. Therefore, the net emissions would be considerably lower than the gross emission numbers identified above.

3.6.Hydroelectric Operations

The Skagit Hydroelectric Project is owned and operated by SCL, which is a department of the City of Seattle. Construction on the Skagit Hydroelectric Project began in 1921 and power was delivered to Seattle in 1924. After several phases, construction was finalized in 1961. The North Cascades National Park and the Ross Lake National Recreation Area were established in 1968, with the enabling legislation (as modified by the Washington Parks wilderness Act of 1988; see Chapter 1.7.5) providing for development and operation of the Skagit Project, including existing developments and proposed expansion elements.

SCL provides electricity to approximately 780,800 customers within the greater Seattle area. The Skagit Hydroelectric Project supplies 18.4% of this power, a total of 711 megawatts. A series of three developments on the Upper Skagit River comprises the Skagit Hydroelectric Project, including the Ross, Diablo, and Gorge dams and powerhouses. Ross Dam is furthest upstream, Diablo Dam is in the middle, and Gorge Dam is furthest downstream. The Skagit Hydroelectric Project is the first large hydro project in the nation certified as low impact, and is certified by the Low Impact Hydropower Institute (LIHI).

Diablo Dam is located about 1 mile upstream of the proposed excavation site (see Figure 1). The concrete arch dam is 389 feet from bedrock to crest. Diablo Powerhouse is located on the north bank of the Skagit River, approximately 4,000 feet downstream form Diablo Dam, and approximately 0.3 mile southeast of the proposed excavation site. A 2,000 foot-long tunnel and two inclined steel pipelines convey water from Diablo Reservoir to Diablo Powerhouse.

Although Diablo Dam is constructed with two intakes, only one is in use. The intake gate is at the bottom of Diablo Reservoir, at elevation 1,084 feet (NAVD88). Water enters the intake through a 15-ft diameter penstock and discharges into the tailrace through a draft tube at an elevation of 850 feet, about 29 feet below the water surface of Gorge Lake. Diablo Powerhouse has four generating units with an operating capacity of 152.8 megawatts. Water used to generate power at Diablo Powerhouse exits the reservoir via a single power tunnel, approximately 15 x 20 feet in size. The average daily flow through the Diablo Powerhouse is approximately 3,200 cfs; operating flows range from a low of 1,400 cfs to a high of 6,900 cfs. Figures 22, 23, and 24 show daily maximum, average and minimum Diablo Powerhouse flows for a normal year, dry year and wet year respectively from July 15 to September 15.

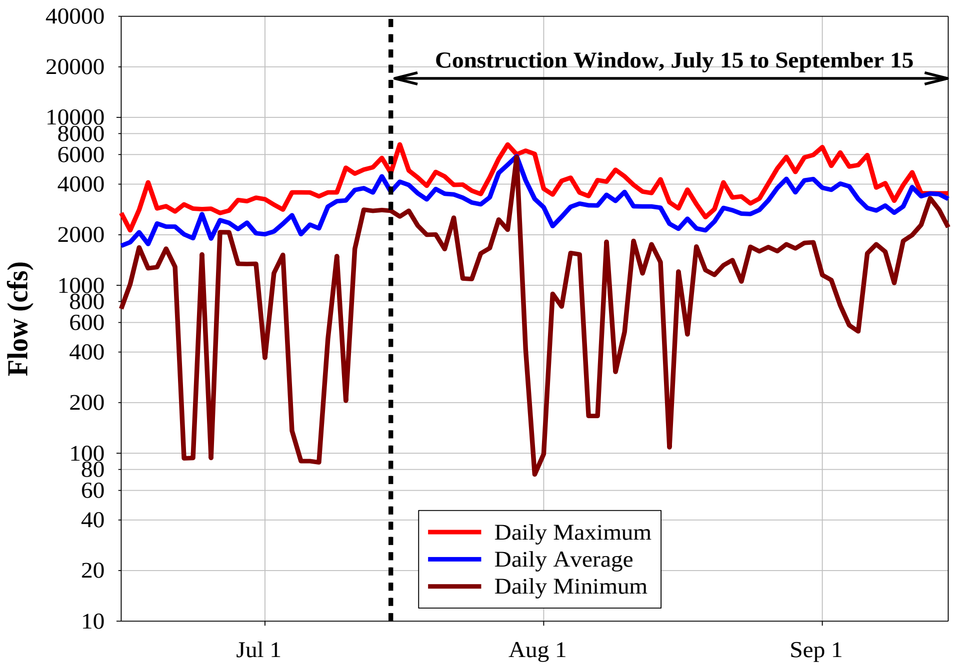


Figure 22. Daily flow releases for a normal year from Diablo Powerhouse from July 15 to September 15, 1998 (Source: R2 Resource Consultants 2013).

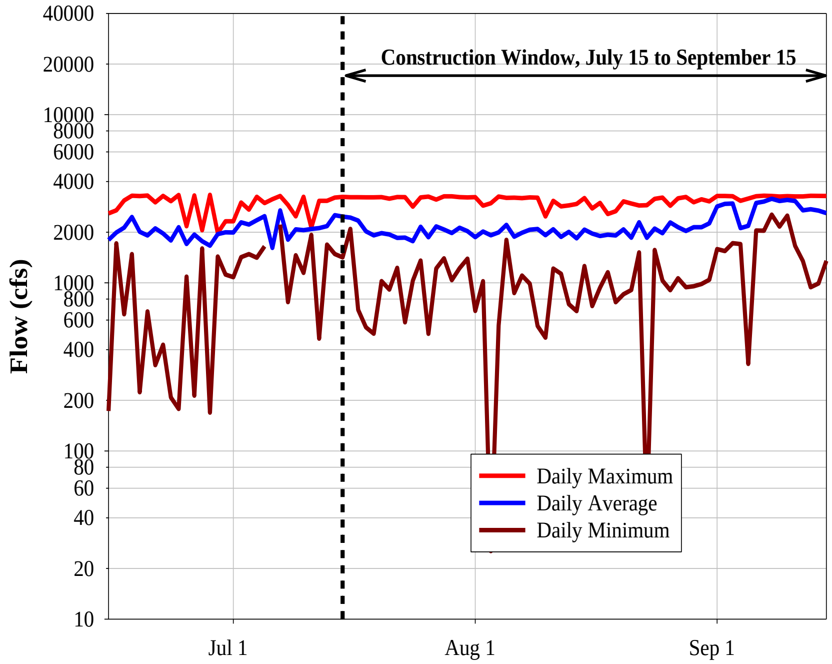


Figure 23. Daily flow releases for a dry year from Diablo Reservoir to the Skagit River from July 15 to September 15, 2005 (Source: R2 Resource Consultants 2013).

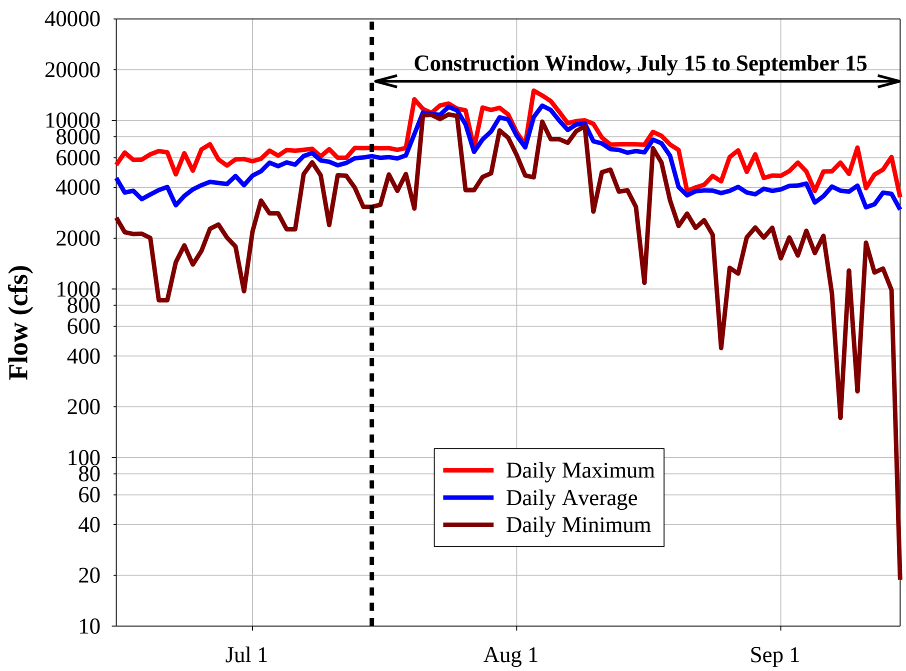


Figure 24. Daily flow releases for a wet year from Diablo Reservoir to the Skagit River from July 15 to September 15, 2005 (Source: R2 Resource Consultants 2013).

Gorge Reservoir, on the receiving end of Diablo Powerhouse, has a maximum elevation of 881.2 NAVD 88 feet and is usually kept full or near full to provide maximum head for Gorge Powerhouse. For maintenance purposes, the reservoir is occasionally drawn down about 50 feet to elevation 829 feet.

Over the last few decades, the surface water elevation at the Diablo Powerhouse tailrace has gradually increased due to the formation of a cobble bar at the mouth of Stetattle Creek in the Skagit River (which is also Gorge Reservoir). The cobble bar has constricted the Skagit River, causing a backwater effect at the tailrace. According to SCL records, there has been an average increase of approximately 3 feet over various flow rates (Figure 25). This higher surface water elevation results in a loss of head, and thus, a loss of power generation capacity. Using the average of lost revenue over the past 10 years, Seattle City Light estimates that an additional approximate $316,787 per year could be generated if the cobble bar was removed (Table 7). Table 7 shows a total loss of revenue of $3,167,869 for the period from 2004 through 2013. This value is based upon lost power of 87,173 megawatt hours (MWh) and an average calculated power price of $39.03 (D. Tinker, Resource Planning, SCL, pers. comm. 2013).

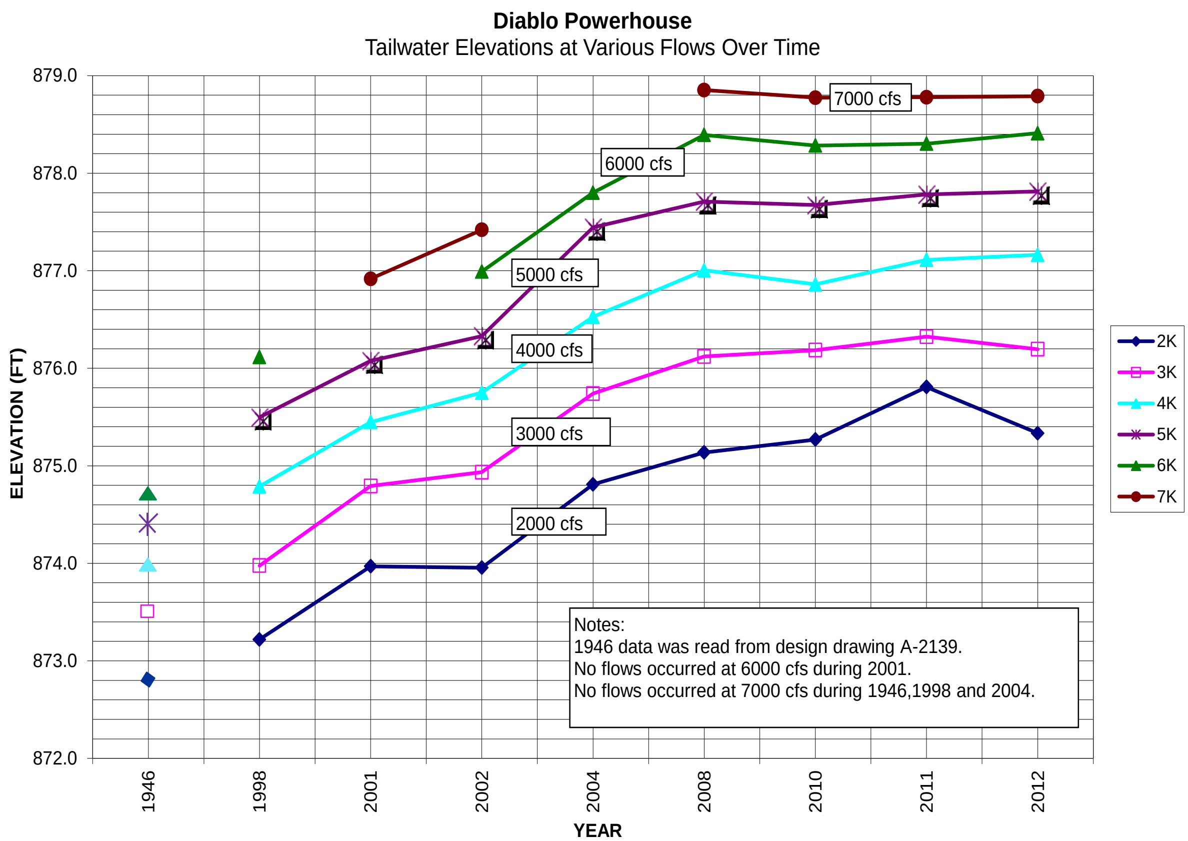


Figure 25. Increasing water surface elevations at the Diablo Powerhouse tailrace at various flows over time.

Table 7. The amount of additional head potential at the Diablo Powerhouse tailracce over the last decade, and associated lost revenue (Source: Don Tinker, Seattle City Light).

Year	Additional Head (%)	Revenue
2004	0.7065	$285,315
2005	0.7705	$363,691
2006	0.6652	$274,313
2007	1.0550	$585,177
2008	0.8451	$471,250
2009	0.8079	$227,958
2010	0.8253	$239,020
2011	0.9380	$242,897
2012	0.9533	$194,256
2013	0.9681	$283,993
	Total	**$3,167,869**

4. Chapter IV. Environmental Consequences

4.1. Introduction

This chapter describes the direct, indirect and cumulative environmental impacts, or consequences, of the management alternatives under consideration in this EA. The scope of the analysis, and the impact topics selected for analysis, are based upon the ecosystem functions, natural and cultural resources and human values described in Chapter III, Affected Environment.

4.2. Definitions and Methods for Evaluating Impacts

This EA describes the nature, duration and intensity of impacts according to the following definitions and criteria:

4.2.1. Nature of Impact

Adverse Impact: Moves the system away from the desired condition
Beneficial Impact: Moves the system toward the desired condition

4.2.2. Duration of Impact

Short-term: During construction or up to one year.
Long-term: Longer than one year.

4.2.3. Intensity of Impact

Negligible: Imperceptible, not measurable, or undetectable.

Minor: Slightly perceptible or measurable and limited in extent. Without further actions, impacts would reverse and the resource would return to the previous condition.

Moderate: Readily apparent and measurable but limited in extent. Without further actions, impacts would eventually reverse and the resource would return to the previous condition. Individuals of a species would be harmed or killed, with slightly measurable impacts to the population or surrounding community.

Major: Substantial and measurable, highly noticeable, and affecting a large area. Changes would not reverse without active management. Entire communities of species would be measurably affected.

This EA uses the following terminology to describe potential effects to federally listed species of wildlife:
No effect: When a proposed action would not affect a listed species or designated critical habitat.
May affect / not likely to adversely affect: Effects on federally listed species are discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or are completely beneficial.
May affect / likely to adversely affect: When an adverse impact to a federally listed species may occur as a direct or indirect result of proposed actions and the effect is not discountable or beneficial.

Is likely to jeopardize a species and/or adversely modify critical habitat: The appropriate conclusion when the NPS or the U.S. Fish and Wildlife Service identifies situations in which the proposal would jeopardize the continued existence of a proposed species or adversely modify critical habitat to a species within or outside the North Cascades Complex boundaries.

4.2.4. Cumulative Impacts

The analysis also includes a discussion of cumulative impacts for each proposal. Cumulative effects are the "additive" impacts from past, present or reasonably foreseeable future management actions. To determine potential cumulative impacts, projects in the general vicinity of the rock slide and the Skagit River Hydroelectric Project were identified. Projects included in this analysis were identified from the NPS GMP and other relevant documents, SCL capital improvement project lists, and information from state agencies (e.g., Washington Department of Transportation). Specific projects that were considered in the cumulative effects analysis include the following:

- *SCL operation and maintenance of the Skagit River Hydroelectric Project*. SCL continues to operate the Ross, Diablo and Gorge dams adhering to the FERC license. Dam operations result in variable reservoir water levels and river flows. Some of the common SCL maintenance activities include access road maintenance; vegetation management near dams and powerhouses, and in the towns of Diablo and Newhalem and along transmission lines; cleaning trash racks at water intakes in the three reservoirs; painting dam infrastructure; and maintenance of log booms on the reservoirs. Some of the planned projects for the purpose of operations and/or maintenance include:
- Reconstructing a permanent barge landing, boat ramp, portion of an access road destroyed by a rockslide near the Ross Powerhouse in 2010, and upgrading ferry landing facilities are planned in 2014 and 2015. It is anticipated that minor improvements of the ferry landing facilities on Diablo Lake would occur in spring and fall 2014 to minimize potential impacts to recreation and use of Ross Lake Resort and Ross Lake. Barge landing, boat ramp and access road reconstruction are anticipated to occur in summer 2014 and spring 2015 but all occur in an area with restricted public access between the powerhouse and NPS ferry landing and would have negligible effects on recreation and visitor use.
- Ross Powerhouse transformer replacement is anticipated to occur in two phases: summer/fall 2015 and summer/fall 2016 but could be 2016 and 2017.
- Upgrading existing electrical infrastructure at Ross Dam, which has only limited public access.
- Demolition of select houses and buildings, renovation of some buildings and historic structures, building a new storage building, and restoration of open space and native habitats is planned for spring 2014 and expected to take a couple of months. Construction of a large onsite septic system (LOSS) is planned in the Hollywood District of Diablo in spring/summer of 2015 and would replace the existing sewage treatment facility. Duration of the LOSS is anticipated to last a couple of months.
- Improving boat facilities on Diablo Lake jointly with the NPS. This project includes the design and modification of the existing boat house and fuel dock on Diablo Lake. Construction timing and duration are uncertain but anticipated to occur perhaps in 2016 and last a couple of months.

- Creating a second tunnel between Gorge Dam and Gorge powerhouse is anticipated but the timing of this large capital improvement project is uncertain but likely sometime in the future beyond 2017.

NPS implementation of the Ross Lake NRA General Management Plan (GMP). NPS conducts similar activities to maintain access roads and recreational facilities such as campgrounds, campsites, trails, and trailheads. Some of the specific proposed actions identified in the GMP include:

- *NPS expansion of the Ross Dam Trailhead.* The proposed project would result in an increase of approximately one acre of disturbance to provide additional parking and safe ingress/egress from the North Cascades highway.
- *North Cascades Environmental Learning Center Expansion*. The proposed project would involve additional outdoor learning structures and possibly additional campsites at Buster Brown Campground and Diablo Gorge.
- *NPS boat dock relocation*. The temporary dock used as a replacement for the dock that was destroyed in the Ross Powerhouse Rockslide would be made permanent and access to the dock would be improved.

Washington Department of Transportation routine maintenance of State Route 20. Routine maintenance of SR20 includes periodic resurfacing, vegetation clearing, and culvert maintenance.

4.3. Impact Summary

Table 9. Summary of impacts for each of the alternatives under consideration, including Alternative A, which is the no action/continue current management alternative and the baseline from which to compare the effectsof the action alternatives.

Impact Topic	*Alternative A*	*Alternative B*	*Alternative C*	*Alternative D*
Surficial Geology	• *Minor, cumulative adverse impacts* to the eroding shoreline of Diablo Campground, alluvial fan of Stetattle Creek, and the Copper Creek Pit because no action would be taken to improve current conditions.	• *Moderate, long-term impacts* from cobble bar *removal* (19,000 cubic yards). • *Long-term, beneficial impacts* to the shoreline adjacent to Gorge Camground and at Copper Creek Pit from shoreline restoration and pit rehabilitation. • *Minor cumulative adverse effects* to due to (a) proposed mitigation; and (b) the relatively small spatial scale of impact (removal of a 3-acre cobble bar) compared to the overall effects of the Skagit River Project	• *Similar to Alternative B*, except 5% less material (18,000 cubic yards) would be removed from the cobble bar.	• *Similar to Alternative B*, except 3.7% less material (18,300 cubic yards) would be removed from the cobble bar and there would be less shoreline disturbance during construction.

Impact Topic	*Alternative A*	*Alternative B*	*Alternative C*	*Alternative D*
Water Resources	• *Cumulatively beneficial effects* in vicinity of Project Area from removal of the wastewater treatment plant and restoration of the riparian zone on Reflector Bar.	• *Minor, short term adverse impacts* to water quality (turbidity) during cobble bar excavation. • *Cumulative effects similar to Alternative A, although slightly less beneficial* given the effects of the proposed action on water quality, and the potential for these effects to occur if future dredging is necessary.	• *Similar to Alternative B,* although slightly less effects due to the slightly smaller footprint of excavation	• *Similar to Alternative C*
Vegetation	• *Minor adverse cumulative effects* from the continued presence of non-native species in the vicinity of the cobble bar and at the Copper Creek pit. • *Beneficial cumulative impacts* to the riparian zone and shoreline of Diablo in the vicinity	• *Minor to moderate, long-term adverse impacts* from removal of 350 feet of riparian vegetation for construction access. Impacts would be mitigated by replanting on site, enhancing vegetation along the shoreline of Gorge Campground and	• *Similar to Alternative B* but would remove less riparian vegetation.	• *Minor, long-term adverse impacts* from removal of fewer trees for construction access compared to Alternatives B and C. • *Cumulative effects generally similar to Alternatives B and C* except less shoreline disturbance in the

Impact Topic	***Alternative A***	***Alternative B***	***Alternative C***	***Alternative D***
	of Reflector Bar.	Copper Creek Pit rehabilitation. • *Cumulative effects would be somewhat neutral* because the adverse effects would be offset by the beneficial effects of the various restoration actions in the area and the mitigation measures pertaining to the project.		vicinity of the cobble bar.
Fish and Wildlife, including Rare/Listed Species	• *Negligible direct and indirect effects* to fish or wildlife, including rare or listed species because no action would be taken to restore the tailrace and continued current management practices in the project area would be generally benign. • *Beneficial cumulative effects to fish and wildlife*	• *Negligible to minor, short-term adverse impacts to all fish species* from elevated turbidity levels during construction, with BMP's in place to control sediment and mitigate turbidity. • *Minor, short-term adverse impacts to wildlife* species commonly found in area from construction-related	• *Similar to Alternative B although slightly less adverse effects* from smaller dredging footprint and less impact to riparian vegetation and nearshore aquatic habitat	• *Similar to Alternative C, although slightly less impacts* from protecting more trees along the shoreline

Impact Topic	***Alternative A***	***Alternative B***	***Alternative C***	***Alternative D***
	habitats from ongoing and proposed operations in the area most notably including facility removal and shoreline restoration on Reflector Bar.	disturbance • *Long-term, beneficial impacts to bull trout (federally threatened) and bull trout critical habitat* from expanding favorable bull trout habitat with installation of fish cover structures as mitigation to provide habitat complexity for various age classes of bull trout. • *Long-term, beneficial impacts to rainbow trout* in Gorge Lake provided bull trout predation can be minimized with adequate cover structures. reproduction. • *Cumulative effects similar to Alternative A* with added benefit of improved bull trout habitat in Gorge Lake with		

Impact Topic	*Alternative A*	*Alternative B*	*Alternative C*	*Alternative D*
		mitigation		
Cultural Resources	• *Negligible to minor, beneficial cumulative effects* to historic cultural resources from ongoing historic preservation activities in the Hollywood portion of the Diablo Townsite.	• *Minor, short term effects* from construction to views and "feelings and associations" of the historic district of Diablo • With mitigation (if needed) to prevent head cutting on Stetattle Creek, there would be no effect to the historic Stetattle Creek bridge. • *Cumulative effects similar to Alternative A.*	• *Similar to Alternative B*	• *Similar to Alternative B*
Recreation and Visitor Use	• Short term, negligible to minor impacts from facility removal in Diablo, followed by *cumulative benefits* including better trailhead facilities and reduced risk to human health	• *Short-term, minor adverse impacts* to visitors from closure of Gorge Campground during construction, and from noise and disturbance to visitors in the general vicinity of	• *Similar to Alternative B*	• *Similar to Alternative B*

Impact Topic	***Alternative A***	***Alternative B***	***Alternative C***	***Alternative D***
	removal of the wastewater treatment plant.	the project area. • *Cumulative impacts would be beneficial* and similar to Alternative A.		
Soundscape	• Routine hydroelectric operations coupled with traffic from the North Cascades Highway would continue to cause *minor, cumulative adverse impacts* to noise levels.	• *Minor, short-term adverse impacts* to the soundscape in the general vicinity of the project area. • *Cumulative impacts similar to Alternative A*, except for the additive, very occasional effects of excavation.	• *Similar to Alternative B, although slightly less* duration of noise related to trucking materials to Copper Pit	• *Similar to Alternative C*
Greenhouse Gases	• GHG emissions associated with procuring electricity from fossil fuel fired power plants to offset lost hydropower production, which does not produce GHG emissions.	• Minor, adverse impacts from construction emissions (105 metric ton equivalent of CO2 ($MTCO_2E$) or 1.5% of annual emissions from the park complex	• Emissions would be somewhat lower (4 to 6 metric tons) than the total for Alternative B.	• Emissions would be slightly higher than Alternative C and slightly lower than Alternative B.
Hydroelectric Operations	• *Adverse effects from continued loss of 8,700 MW of power*	• *Beneficial effects from full restoration of lost power*	• *Beneficial effects slightly less than Alternative B* from	• *Beneficial effects slightly less than Alternative B and*

Impact Topic	***Alternative A***	***Alternative B***	***Alternative C***	***Alternative D***
	production and approximately $317k per year (2013 dollars) of continued lost revenue for Seattle City Light.	*production*. Estimated benefits in 2013 dollars would range from $4,806,000 for a design life of 49 years to $9,519,000 for a design life of 98 years.	almost fully restoring lost power production. Estimated benefits in 2013 dollars would range from about $4,180,000 for a design life of 45 years to $8,269,000 for a design life of 90 years.	*slightly more than Alternative C* from almost fully restoring lost power production. Estimated power generation benefits in 2013 dollars would range from about $4,302,000 for a design life of 46 years to $8,512,000 for a design life of 92 years.

4.4. Impacts of Alternative A. No Action

4.4.1. Surficial Geology

Direct and Indirect Impacts

Implementation of Alternative A would have no direct adverse effects on the project area. Instead, the cobble bar at the mouth of Stetattle Creek would continue to expand due to deposition of alluvial materials on the modified alluvial fan of Stetattle Creek at its confluence with the Skagit River. Below this area, the shoreline along the right bank would continue to be subject to erosion during higher flows on the river. Use of the campground would continue to compact soils and cause localized erosion of the river bank. These various processes and activities would continue to cause relatively minor, long-term adverse effects to the shoreline of Gorge Campground and the modified alluvial fan of Stetattle Creek.

Cumulative Impacts

The erosional and depositional processes on the alluvial fan of Stetattle Creek would continue to be substantially constrained by the levee on the west side of Hollywood. This would continue to have long-term, adverse impacts to the alluvial processes that influence surficial landforms at the mouth of Stetattle Creek, including formation of new landforms and erosion of existing landforms, which would normally occur over a much broader area if the levee were not present. This would likely cause the existing cobble bar to continue to expand in size, upstream toward the Diablo Powerhouse, where flows are reduced in the tailwater area and deposition is favorable. It is unclear how the large the cobble bar would grow over time if no action were taken to maintain the tailrace.

There may be minor adverse impacts that are long-term in duration as a result of Alternative A and the implementation of the Gorge Second Tunnel project, which is fully permitted and approved but has yet to be constructed to due unfavorable economic conditions. If implemented, this project could utilize the Copper Creek Pit for storage of organic debris. This debris would be used to restore an upland compensatory mitigation site near Bacon Creek, and have a cumulatively beneficial effect

4.4.2. Water Resources

Direct and Indirect Impacts

No direct impacts to water quality or quantity would occur under Alternative A. The cobble bar below the confluence of Stetattle Creek, and the gravel bar immediately upstream of this confluence, would continue to increase in elevation and expand in size under the No Action alternative. This aggradation of bed materials would continue to increase depths in the tailwater pool below the powerhouse and contribute to additional head loss at the Diablo Powerhouse. The mouth of Stetattle Creek would be expected to become shallower over time, though this would not have any expected impacts on water quality conditions in the project area.

Cumulative Impacts

Water resources have been substantially altered in the vicinity of the project area by development of the Skagit River Hydroelectric project. Gorge reservoir has replaced the once free-flowing Skagit River, inundating previously upland areas and altering the aquatic and riparian habitat in this formerly riverine environment. Mining of aggregrate to make concrete for the dams created artificial depressions on the landscape and enabled the footprint of the reservoir to expand into previously upland areas immediately adjacent to the project area, such as the boat launch basin and the area to the west of the launch. These areas would remain inundated when the lake is at full pool, and partially dewatered at lower lake levels. Dewatering would occasionally result in fish stranding and other minor long-term, cumulative adverse impacts to water resources, such as suppressed conditions for aquatic and riparian vegetation that would otherwise occupy these shallow wetland and open water areas.

The levee on the east bank of Stetattle Creek near Hollywood would continue to remain in order to prevent flooding and channel migration into Diablo. This levee will continue to constrain Steattle Creek and prevent alluvial fan migration and related processes in the vicinity of the confluence of Stetattle creek and the Skagit River. These baseline conditions would not change under Alternative A because no management actions would be taken, so these existing effects to the aquatic ecological functions and values of the area would persist.

In the reasonably foreseeable future, SCL is planning to implement several projects in the area surrounding the proposed excavation site. In 2015 SCL will be decommissioning an aging wastewater treatement plant in Diablo that discharges into the Skagit River slightly upstream of the project area. The plant will be replaced with two onsite septic systems: one on Reflector Bar and another in Hollywood. This action will eliminate a point source discharge, which occasionally exceeds water quality standards, with a septic system. This will eliminate a point source discharge and reduce the potential for surface water contamination and risks to public health. This pending action will have a negligible cumulative beneficial impact on water quality, primarily by lower the risk of human pathogens (e.g. fecal coliform) entering surface waters, and also by reducing inputs of various organic and inorganic contaminants (e.g. organic and suspended matter, nitrogen and phosphorus) commonly associated with wastewater effluent.

Seattle City Light is also moving forward with plans to remove several facilities on Reflector Bar, including the Cookhouse, 12 houses and associated garages and outbuildings. Following removal of these facilities, the disturbed areas and most of the shoreline along reflector bar will be rehabilitated with native plants. This action would improve the ecological functions of the riparian zone adjacent to the Skagit River, and have a cumulative beneficial effect on water resources in addition to removal of the wastewater treatment plant.

The existing conditions of the Gorge Campground include slightly elevated concentrations of metals in groundwater samples, which may be leaching from waste materials that may have been buried in the vicinity of the campground decades ago during construction of the hydroelectric facilities. Preliminary investigations by USGS researchers indicate the metals concentrations are low, and perhaps in line with the purported historical use of the site and/or the known, high mineralogy of the area (pers. Comm., Patrick Moran, Aquatic Toxicologist, USGS Washington Water Science Center.) Under current management, groundwater leachates from the campground would continue to enter surface waters, but the adverse impacts would likely be negligible due to the relatively low concentrations of metals and minimal risk to human health and the environment.

4.4.3. Vegetation

Direct and Indirect Impacts

Under the No Action Alternative, the cobble bar would potentially increase in size over the long-term as Stetattle Creek bedload material continues to be deposited on the bar. As the bar builds up it would continue to be colonized by a mixture of native and non-native, pioneer plant species such as fireweed, willow, herbs, willows, red alder common tansy, and oxeye daisy. Larger floods periodically scour the bar and populations and extent of these species likely would continue to vary in in response to such events. No trees or shrubs would be removed along the riverbank. The continued presence of non-native plant species in the vicinity of Gorge Lake and Stetattle Creek would have long term adverse effects to native riparian vegetation. The magnitude of effect would be negligible because invasive and non-native weeds are common in the area under existing conditions, and continued current management is not likely to promote weed expansion in the reasonably foreseeable future.

The Copper Creek Pit would not be restored but would be left to natural revegetation processes. Existing populations of non-native and invasive species, including English ivy, creeping buttercup, common tansy, foxglove, and oxeye daisy, would likely expand at this site. In addition this area would serve as a source of seed that could cause new infestations elsewhere in the park and/or Ross Lake NRA. Expansion of invasive plant populations in the area and development of new invasive plant populations would likely contribute to minor, long term adverse impacts to native plant associations. With the exception of English ivy, most of the known invasive plants that exist in the area are shade intolerant and do not effectively compete with native forest vegetation associations, which are the predominant habitat types in the area.

Cumulative Impacts

Removal of the wastewater treatment plant and replacement with on site septic systems in Diablo, along with removal of various houses and structures will adversely impact existing vegetation surrounding the footprints of these facilities. The area of adverse impact will be much smaller than the proposed location for restoration of the riparian zone and shoreline on reflector bar, so the net result will be long-term, beneficial effects to riparian vegetation in the vicinity of Diablo. These restoration plans will cumulatively contribute to minor, long-term beneficial impacts on native plant communities within the Ross Lake RNA.

4.4.4. Fish and Wildlife, including Rare/Listed Species

Direct and Indirect Impacts

The No Action Alternative would have negligible effects fish or wildlife, including rare or listed species because no action would be taken to restore the tailrace. The river and cobble bar area would continue to provide habitat for waterfowl, wading birds, and other relatively common wildlife species that tend to frequent the project area. The narrow band of second growth riparian alder trees and shrubs between Stetattle Creek and the Gorge Campground would continue to develop and provide habitat for wildlife such as passerine birds, small mammals, and amphibians although the fragmented nature of the habitat in this area limits habitat quality.

Habitat in the Copper Creek Pit would continue to be of poor quality because of the sparse cover and dominance by non-native and invasive plants. Overall, this alternative would likely have negligible, long-term, adverse impacts on wildlife in the general vicinity of the pit until natural succession or active restoration of the area improves the habitat quality if the site.

Cumulative Impacts

The impacts to fish and wildlife habitat from other ongoing and planned projects, is expected to cause minor, short-term adverse impacts to common terrestrial wildlife species in and around town of Diablo. None of the future activities is expected to directly adversely affect riparian vegetation. So, there is likely to be negligible or minor effects to waterfowl and other species of wildlife that may use riparian and aquatic habitats in the vicinity of these projects.

4.4.5. Cultural Resources

Direct and Indirect Impacts

Under the No Action Alternative, historic properties in the project area would not be affected because no action would be taken that could affect resources within the project area.

Cumulative Impacts

Continued current management practices would have minor, beneficial cumulative effects to historic cultural resources in the vicinity of the Project Area. For example, many of the houses in the Hollywood Residential area (contributing resources of the Historic District) are currently being renovated to ensure that they can continue to be used for housing. SCL would continue to maintain the remaining buildings in a manner that maintains the integrity of the Historic District. Most of the pre-contact surfaces that could have contained Native American cultural materials and artifacts in the Hollywood area, previously known as "cedar bar" during the homesteading era, have been removed or heavily modified by the settlement that started in the 1800s and culminated with the development of the Skagit River Hydroelectric Project. Archaeological surveys have been conducted in the area where septic systems will be installed, and no cultural resources were found, so there should be no impacts to cultural resources from that project. The routine operation and maintenance of the Skagit River Hydroelectric Project in the vicinity of the project area would not affect cultural resources.

4.4.6. Recreation and Visitor Use

Direct and Indirect Impacts

The No Action Alternative would not have any impact on recreation or visitor use at the Gorge Lake Campground, Stetattle Creek and Sourdough trail use. Lower Stetattle Creek and the Skagit River would continue to be accessible. Ongoing activities would result in noise levels that are similar to existing conditions.

Cumulative Impacts

Removal of the wastewater treatment plan on Reflector Bar and replacement with septic systems will cause noise and construction-related disturbance (e.g. trucking materials) in the vicinity of Sourdough Mountain trailhead and Gorge Campground. These activities would have short-term, negligible to minor adverse effect on visitors during construction, with long-term, negligible to minor benefits to visitors due to improved trailhead facilities and reduced risks of exposure to pathogens following removal of the wastewater treatment plant on Reflector Bar.

The restoration of Reflector Bar and proposed consolidation of the Sourdough and Stetattle Creek trailheads would have beneficial cumulative effects to recreational opportunities in the Diablo area by providing a more functional and aesthetically pleasing recreational amenities. Riparian restoration on Reflector Bar would also enhance visitor use and enjoyment of that area by providing a modest shoreline trail and informal picnic area along the shoreline of Reflector Bar.

4.4.7. Soundscape

Direct and Indirect Impacts

Under the No Action Alternative, the ambient noise level would continue to be similar to existing conditions (46 dBA). There would be occasional short-term minor spikes in noises from routine SCL maintenance activities. Although elevated above ambient levels, those noise levels would be expected to cause only minor, short-term, adverse impacts to the sound environment near Stetattle Creek and Hollywood District of the town of Diablo.

Cumulative Impacts

The noise levels in the Stetattle Creek area would continue to be affected by the flowing water and the SCL operations, which includes electricity generation noises from the Diablo Powerhouse and vehicular and maintenance equipment noises in the area. Traffic on the North Cascades Highway, most notably including motorcycles and trucks using compression brakes, would also continue to contribute to human-caused noise in the vicinity of the Project area.

The planned demolitions and renovations of Hollywood District buildings, LOSS construction, Reflector Bar restoration, and creation of a new Sourdough and Stetattle Creek trailhead area would result in minor short-term adverse impacts to noise levels.

4.4.8. Greenhouse Gases

Direct and Indirect Impacts

The No Action Alternative would not change the gross or net emissions of GHGs within the Ross Lake NRA.

Cumulative Impacts

The No Action Alternative would not contribute to cumulative effects on emissions of GHGs for the Skagit Project. However, to offset lost power generation, power would need to be purchased from other sources, including sources such as fossil-fueled power plants that would continue to emit greenhouse gases, although the magnitude of GHG emissions has not been quantified.

4.4.9. Hydroelectric Operations

Direct and Indirect Impacts

Alternative A would result in a continuing loss of hydroelectric power generation capacity due to backwater conditions created at the Diablo Powerhouse tailrace by the cobble bar. No action would contribute to additional head loss as more cobble and gravel is deposited on the bar from annual bedload transport down Stetattle Creek. This would lead to additional head loss and adverse impacts on power generation capacity. Cumulative lost revenue from lost generation capacity would continue to increase at a rate of at least $316,787 per year based on the average annual lost revenue rate over the last 10 years (see Table 6).

The Skagit Hydroelectric Project would remain certified by the Low Impact Hydropower Institute (LIHI) certification. This certification means the Skagit Project would continue to meet or exceed criteria for: river flows, water quality, fish passage and protection, watershed protection, threatened and endangered species protection, cultural resource protection, recreation, and facilities recommended for removal due to SCL's avoidance or reduction in environmental impacts. Not taking action to excavating the cobble bar, the Skagit Hydroelectric Project would run with greater efficiency, using the same amount of water to create more power. If SCL cannot supply enough energy to customers with their existing hydroelectric projects, including the Skagit, SCL must purchase power. These other power sources often have greater environmental impacts than the Skagit Hydroelectric Project.

The No Action Alternative (Alternative A) would result in moderate, adverse, long-term impacts to hydroelectric operations via lost power production and the new to acquire power from other sources.

Cumulative Impacts

Facility upgrades and replacements in the vicinity of the Project Area would provide various operational benefits to Seattle City Light such as reduced maintenance and operational expenses. These cumulatively beneficial effects would be eclipsed by continued loss of power production and the costs of acquiring power from other sources.

4.5. Impacts of Alternative B

4.5.1. Surficial Geology

Direct and Indirect Impacts

Under Alternative B, approximately 19,500 cubic yards (CY) of accumulated materials would be excavated from the bar at the mouth of Stetattle Creek. Compared to Alternative A, this action would have a moderate, relatively long-term impact by removing a cobble bar landform that likely predates the Skagit River Hydroelectric Project.

Compared to Alternative A, removal of the cobble bar would slightly reduce the risk of bank erosion along the shoreline adjacent to Gorge Campground as from a 1.25-year event to a 1.4-year event, meaning that slightly higher flows would be needed before those flows would have an erosive effect on the shoreline because the Skagit River channel would be deepened. The NPS, in coordination with SCL, would further reduce the risk of shoreline erosion by stabilizing approximately 400 feet of the shoreline in this area by installing structural erosion control measures (native rock and woody debris) and planting riparian vegetation. The combined effects of these actions would be relatively long-term and beneficial for the shoreline compared to Alternative A.

Soils at the Gorge Campground and along approximately 350 ft. of the northern riverbank along the shoreline between the entrance road to Gorge Campground and the Bridge over Stetattle Creek would be temporarily adversely impacted during excavation due to heavy equipment accessing the project site, vegetation clearing, grading, and using the campground as a staging and stockpiling area. Sediment may enter the Skagit River during construction, but the potential would be reduced to a negligible amount through the use of Best Management Practices including: designating and fencing off specific areas for staging and stockpiling; utilizing a stabilized construction entrance and wheel wash to prevent track out; and using silt fences and/or sediment wattles to prevent or minimize erosion and sedimentation. These BMPs would reduce soil impacts to a short-term, moderate level because the construction footprint would be minimized to the extent necessary, the clearing limits would be marked, and the slope would be protected and stabilized and bank would be restored with native vegetation following construction. All of the aforementioned BMPs would be included in a Stormwater Pollution Prevention Plan (SWPPP) that would be developed for the project.

At the Copper Creek Pit, there are currently no topsoils to affect as they have been previously removed, leaving only subsoil. Placement of dredge spoils and rehabilitation of the area using wood chips and vegetation would generally rehabilitate the alluvial terrace landform to its previous contours. In the long term, this action would set the stage for topsoil to form again. The soils would not revert to pre-excavation conditions because the dredge spoils would not be the same as the soils that were mined from the area. But over time, conditions would favor plant development and soil formation. Compared to Alternative A, surficial geology, including soil at this site would be beneficially affected over the long term.

<u>Cumulative Impacts</u>

This alternative would result in removal of the cobble bar landform and rehabilitation of the copper pit with the removed material. Cobble bar removal would permanently remove this approximately 3-acre landform. This action would expand the overall wetted footprint of Gorge Lake and its adjacent mixing zone by approximately 1.5 acres, from 240 acres to 241.5 acres, a 0.6% increase.

Engineering analyses indicate that following removal, the cobble bar would gradually rebuild at an approximate rate of 200-400 cubic yards per year. This would yield a design life of 49-98 years (R2 Consultants, 2013). There is some uncertainty associated with these predictions, including potential role that increased flooding and channel aggradation could play in future years. Notwithstanding this uncertainty, further action would likely be needed in the future to maintain the tailrace and prevent power loss from channel aggradation, and this would have cumulative adverse effects. These cumulative effects would likely be minor given they would occur in the same area of previous disturbance, and would be of relatively small scale compared to the overall impacts of the Skagit River Hydroelectric Project, reasonably foreseeable activities such as construction of the second Gorge Tunnel, and other human activities in the project area such as operation and maintenance of the North Cascades Highway and NPS facilities.

Rehabilitation of the Copper Creek Pit would reestablish the landform contours that existed prior to mining topsoil from the area. This would be a permanent rehabilitation of approximately 1.5 acres of land. Seattle City Light owns approximately 1130 acres of land within Ross Lake NRA, and much of this land base has been previously disturbed in order to construct and maintain the Skagit River Hydroelectric Project. Thus rehabilitation of the 1.5 acre Copper Creek Pit would help restore a relatively small amount of land that has been affected by hydroelectric operations.

The cumulative impacts to surficial geology from this alternative would include a mixture of beneficial and adverse effects. The magnitude of these effects would be minor to moderate due to the relatively small spatial scale of effect from this proposal compared to the relatively large scale and widespread effects of the Skagit River Project.

4.5.2. Water Resources

<u>Direct and Indirect Impacts</u>

Alternative B would adversely impact suspended sediment and turbidity levels in the Gorge Lake downstream of excavation site on a short-term basis. No other water quality metrics would be measurably affected.

Cobble bar excavation would increase the level of fine and suspended sediment in the waters surrounding the project area. The depth of the cobble bar excavation would range from 5 ft deep at the upstream end near Stetattle Creek, to 9 ft deep at the downstream end. During Phase I of the project a coffer dam would be installed to isolate Stetattle Creek from the excavation area during construction. This coffer dam will narrow the creek outlet channel downstream of the bridge from 70 ft to 35 ft. The bed materials upon which this coffer dam would be placed are relatively loose cobbles and large gravels, which are permeable to subsurface water flows. Given the difference in the elevation between the Stetattle Creek bed and the excavation area, and the relatively high permeability of the bed materials to subsurface flows, a significant amount of water from the creek is expected to infiltrate into the excavation site. To reduce this rate of infiltration (estimated between 3-10 cfs), plastic sheeting will be installed along the Stetattle Creek channel on the water side of the coffer dam. Water that enters the excavation area would likely need to be pumped out and may need to be treated, depending on turbidity levels. If necessary, standard pump and treat best management practices (BMPs), such as temporary settling ponds or Baker tanks equipped with chitosan or sand filters could be used to remove suspended solids. Following application of all necessary and appropriate BMPs, treated water could be discharged back to the lake. At the point of compliance 300 feet downstream of the excavation area, the state water quality standard for turbidity would be met (see Appendix A, Biological Evaluation, for a more detailed explanation of compliance with the turbidity standard).

This analysis assumes five percent by volume of the cobble bar is composed of fine sediments that could become entrained in the water column and impact turbidity. If no turbidity BMP's were implemented, then as a worst case scenario approximately 2,238,000 pounds of sediment could be delivered to the reservoir downstream of the excavation area. This would be an increase in sediment loading on the order of 7 mg/l (compared to background conditions), which was estimated to increase turbidity by 4 NTUs. Assuming that background was less than 1 NTU, this would be near the maximum 5 NTU increase above background allowed by the state water quality standard for native char spawning and rearing waters. However, only a fraction of these fine sediments (one percent by volume or 446,000 lbs) within the excavation area would reach the reservoir with the proposed mitigation measures including a settling basin and filtration. With these measures in place, impacts to water quality from elevated turbidity levels would be negligible to minor and short term.

Alternative B would not be expected to have any impacts on water temperatures and dissolved oxygen levels in the reservoir downstream of the excavation site. However, this alternative would increase the size of the confluence mixing zone at the mouth of Stetattle Creek where colder water from the stream combines with warmer water in the reservoir.

Under existing conditions, the confluence mixing zone is located at the confluence of Stetattle Creek and Gorge Lake, and is approximately 1 acre in size. The confluence mixing zone would increase to approximately 3 acres in size under Alternative B. Following removal of the cobble bar, the confluence mixing zone would include the current area where the cobble bar is presently located, which would be inundated by the reservoir. The confluence mixing zone would also include the area where the mouth of Stetattle Creek is presently located, which would also be inundated by the reservoir. The expanded mixing zone would have no measureable impact water quantity or water quality except at a very local scale, but would modify fisheries habitat (refer to Section 4.4.4. and Appendix D).

<u>Cumulative Impacts</u>
Cumulative impacts to water quality would generally be similar to alternative A and beneficial, except for the very occasional (e.g. once every 50 years) effects if dredging is needed in the future, and related hydroelectric activities that may adversely affect water quality in the future.

4.5.3. Vegetation

<u>Direct and Indirect Impacts</u>
Alternative B would result in minor to moderate, long-term adverse impacts on riparian vegetation from removal of native plants and potential introduction or spread of non-native and invasive plant species and associated impacts, such as competitive exclusion of native plant associations. A total of 64 deciduous trees (red alder) and 6 evergreen (Douglas fir) trees and associated understory vegetation would be removed along approximately 350 ft. of riverbank to construct the access ramp and complete the excavation of the cobble bar. The trees range between 6 and 30 inches in diameter, although most are less than 10 inches. In addition, the excavation of the cobble bar would remove a small amount of sparse pioneer vegetation consisting of a mixture of native and non-native and invasive species on the downstream end of the bar. In the years following project completion, flushing flows would be used to periodically transport new bedload deposits at the mouth of the Stetattle Creek downstream to prevent reformation of the bar in the future. These flows would be within the normal operating range permitted by the FERC license and settlement agreements and would likely have negligible

impacts on riparian vegetation. To mitigate potential adverse impacts to riparian vegetation and stabilize the right bank at the Gorge Campground where vegetation is removed to construct the access to the bar, native riparian plant associations would be restored following removal of the access ramp and coffer dams. This mitigation would ensure that adverse impacts to riparian vegetation are limited to a moderate level.

Once the excavated material has been disposed of at the Copper Creek Pit and recontoured, SCL would implement a revegetation and restoration plan in collaboration with Skagit County. It is infeasible to import sufficient volumes of topsoil to cover and revegetate the entire area. But native plant associations would be restored through importation of certified weed free soil or by using a combination of compost, mulch, and plantings of native species that do not require deep soils. It would be monitored as required by Skagit County to demonstrate successful attainment of performance standards that may be specified in the revegetation and restoration plan. Revegetation and restoration of the Copper Creek Pit would result in a moderate long-term, beneficial impact on native vegetation through control of invasive species and restoration of native plant associations, although it will take a number of years for trees to grow to significant heights.

<u>Cumulative Impacts</u>
Past actions in the region, including clearing vegetation for logging, mining, grazing, settlements, gravel pits, hydroelectric development and operations, roads and NRA recreational developments, have all affected vegetation resources in the project area. The previous activities have also promoted the introduction and spread of invasive weeds in some locations, although the project area is relatively weed-free. Vegetation in the project area is generally not diverse compared to other areas of the Ross Lake NRA, and no rare or sensitive species are known to occur here.

Implementation of Alternative B would result in the removal of 64 deciduous (mainly alder) trees and 6 evergreen trees. Sixty-two of the deciduous trees are ≤ 12 inches DBH. The other two deciduous trees are 13 inches DBH and 30 inches DBH, respectively. Five of the six evergreen trees are ≤ 12 inches DBH and the sixth is 13 inches DBH. Associated sparse understory, riparian vegetation also would be removed. This second-growth riparian vegetation association has been altered by Gorge Campground, Diablo Road, associated use of these and hydropower operations compared to those native plant associations around less disturbed riparian zones around unregulated creeks and lakes within the Ross Lake RNA and park. Higher quality, more diverse riparian vegetation associations are common, widespread, and abundant throughout the Ross Lake RNA and larger North Cascades National Park Complex. The cumulative effects of removing small amounts of riparian vegetation from the right bank of Gorge Lake for construction access to the cobble bar, and removal of small amounts of pioneer species from excavation of the cobble bar would have a negligible, cumulative adverse impact given the very small scale of the action relative to the widespread disturbed conditions that exist in the project area.

Disposal of excavated cobbles and gravels at the Copper Creek Pit and planned revegetation and restoration would have minor cumulative beneficial impacts on native plant species diversity and vegetation. As noted in the affected environment section on vegetation, the quarry is primarily composed of non-native and invasive forbs and grasses associated with disturbed areas. Disposal of excavated materials would deeply bury these populations and eliminate a potential source of weed seeds that could otherwise be dispersed by wind, animals, insects, and other dispersal mechanisms to other areas within the Ross Lake RNA. Control of non-native and invasive plants and restoration and vegetation of native plant associations would have minor, long-term beneficial impacts on native plant species diversity and vegetation within the Ross Lake RNA.

4.5.4. Fish and Wildlife, Including Rare/Listed Species

Direct and Indirect Impacts
Alternative B would have minor to moderate, short-term adverse impacts on fish and common wildlife species within the project area. Potential impacts to ESA-listed bull trout and wildlife species, are described in detail in the Biological Evaluation (BE) for this project (Appendix A). In summary, there would be *no effects* to marbled murrelets, gray wolves, grizzly bears or Canada lynx. This action would create noise disturbance that *may affect, but is not likely to adversely affect* northern spotted owls. Alternative B, when combined with the proposed onsite mitigation measures, will result in a net increase in habitat suitable for juvenile and adult bull trout in the project area. The proposed project "*may affect, but is not likely to adversely affect"* bull trout.

Potential short-term impacts to fish and other aquatic biota would result from increased turbidity during construction. Cobble bar removal would potentially have longer term impacts on aquatic habitat structure and productivity. These impacts are summarized below; a more detailed and technical analysis of these impacts is provided in the BE (Appendix A).

Potential impacts on water quality from elevated levels of turbidity would be primarily be short-term and limited to the excavation period. With the proposed mitigation measures, elevated turbidity from excavation is likely to result in negligible to minor, short-term adverse impacts from elevated turbidity. The most likely effect of temporary, low level increases in suspended solids would be behavioral modification (avoidance of turbid waters). Salmonids are known to exhibit alarm reaction, abandonment of habitat cover, and avoidance when exposed to suspended sediment levels as low as 3 mg/l for a week or more (Wilber and Clarke 2001; Newcombe and Jensen 1996). Levels of suspended sediments would be several orders of magnitude below those known to cause physical injury or mortality to fish or other aquatic biota. The maximum estimated sediment concentration during excavation is 7 mg/l. Suspended sediment loads would have to exceed 1,000 mg/l over a period of at least 30 days to cause mortality levels of 25 percent or greater in juvenile and adult salmonids (Wilber and Clarke 2001). Potential duration of exposure also would be for much shorter duration (a few days or weeks).

According to recent acoustic tagging data, most adult bull trout in the reservoir have been found to reside in the Diablo Powerhouse Tailrace pool upstream of the excavation area throughout the entire year. The few adults that may occur downstream of the excavation area would likely move upstream to the tailrace pool and deeper water to avoid turbid waters and would not be affected. Juvenile bull trout in areas downstream would be impacted by reduced foraging success from reduced water clarity and visibility (Berg and Northcoat 1985; Newcombe 2003). Reduced foraging efficiency over a short duration would not be expected to adversely affect growth or survival of either juvenile or adult bull and rainbow trout or other fish species (Refer to the BE in Appendix A for a more detailed discussion).

Excavation of the cobble bar would result in a long-term change in habitat structure and productivity. Removal of accumulated cobbles and gravels would result in minor, short-term adverse impacts on aquatic invertebrates. However, similar, highly productive substrate would remain or be deposited from Stetattle Creek, and there would be a substantial net increase in the total quantity of aquatic habitat from bar removal. Aquatic invertebrates would rapidly recolonize by drifting into the completed project from upstream areas. Alternative B would result in slightly greater short-term, minor adverse impacts on habitat structure and aquatic invertebrate productivity associated with the larger amount of excavation area.

There would be net beneficial impacts to fish habitat and fish use considering the suite of proposed mitigation proposed. Alternative B would result in removal of riparian vegetation along 350 of the bank below the Gorge Campground, eliminating a small flood channel, and overhanging vegetation that provide cover and terrestrial invertebrate prey to juvenile salmonids (bull trout and rainbow trout) that use existing habitat in this area. It would take many years before new deposits of gravel would occur in the nearshore area to a sufficient extent that new riparian vegetation with comparable structure to existing conditions colonizes such sediments and develops. With proposed natural rootwad woody debris, large boulder, and other proposed mitigation velocities and habitat structure would be more favorable to juvenile bull and rainbow trout resulting in long-term beneficial impacts to these species. Long-term beneficial impacts to rainbow trout are predicated on the premise that adult bull trout predation on juvenile rainbow will not be increased. If monitoring indicates otherwise, then in accordance with the principles of adaptive management, NPS in coordination with SCL would pursue alternative mitigation strategies.

Wildlife impacts would be greatest from this alternative compared to other action alternatives. Loss of riverine bar and riparian forest habitat would displace waterfowl, wading birds, American dippers, mink, weasels, and other species that forage or rest in these habitats. Because cobble bars are relatively abundant and widespread throughout the Gorge Lake area and Skagit River, the effects of the project would be limited and relatively minor. Given the natural dynamic nature (i.e., formation and erosion) of gravel bars in large rivers and at the mouths of creeks entering the lakes created by the Skagit Hydroelectric Project, future annual bedload transport of cobble and gravel down Stetattle Creek that will provide a source for gravel bar expansion downstream near upstream end of Gorge Lake, these would be minor, short-term adverse impacts. It would take a number of years to reestablish the understory plants and approximately 70 riparian trees (64 deciduous and 6 conifer) that would be removed along the 350 ft. of the riverbank resulting in a moderate, long-term adverse impact to riparian dependent wildlife, including various species of small mammals, songbirds, and amphibians.

Disposal of the material at the Copper Creek Pit would cause short-term loss of low-quality vegetation in the pit and could compact soils reducing suitability for ground-foraging birds, burrowing mammals (mice, moles, and voles), and invertebrates. It is possible that some low-mobility animals such as burrowing mammals would be directly killed as construction equipment travels over the pit. After completion, the revegetation and restoration of the quarry would result in a long-term, moderate beneficial impact to a wide variety of wildlife species that are known to frequent the riparian zone of the Skagit River.

In addition to short-term losses of habitat, the noise from construction activities during the 7-week project could cause minor, short-term, adverse impacts to wildlife in the project area (see Noise Section 4.4.2). Mobile species, such as birds and medium and large mammals, would likely avoid or be displaced from near the excavation area, the disposal site, and possibly along the haul route between the two areas. While noise levels are expected to exceed ambient levels up to 4,456 ft. from the cobble bar, disturbance would most likely be limited to a much smaller area because most of the resident wildlife are somewhat habituated to the high levels of human activities and noise from existing activities in the Hollywood area and Diablo Powerhouse and automobile and truck traffic on the highway. Activities at the disposal site would increase noise levels up to 2,812 ft. from the site. Assuming any importation of topsoil and/or compost for restoration purposes is placed concurrently or immediately following final re-contouring and all plantings of will be done by hand in the fall, elevated noise levels would last somewhat longer perhaps up to a few weeks at the Copper Creek Pit disposal site. It is anticipated that Dump truck noise would be above ambient levels along SR20 up to 2,339 ft. from the road. Because SR 20 is a commonly used route during the summer and fall, this adverse impact would likely be minor. All adverse impacts from noise would be short-term and minor to moderate an on wildlife common in the area.

There would be no effect to federally- or state-listed wildlife species because these species are not normally in the area that would experience elevated noise levels during the project (Refer to the BE in Appendix A for more details).

<u>Cumulative Impacts</u>

Cumulative effects of reasonably foreseeable and planned projects would likely have minor, long-term benefits to fish and wildlife habitat and habitat use. Though Alternative B would be beneficial to bull trout population in Gorge Lake, such benefits are likely to be negligible in terms of cumulative impacts on the entire Upper Skagit Core Area population. Historical activities, especially the introduction of redside shiners to Ross Lake and reservoir operations that favor redside shiner production, have resulted in conditions that favor bull trout (Refer to the BE in Appendix A for more details).

Cumulatively upland and riparian habitat restoration proposed as part of this and other planned and reasonably foreseeable projects would have minor, long-term benefits on wildlife habitat and habitat use. Streambank restoration and installation of natural root-wad structures and boulder clusters combined with water quality benefits from constructing a more effective wastewater treatment system serving the town of Diablo and restoration of native riparian plant associations at Reflector Bar are expected to contribute to minor improvements in aquatic habitat and water quality. In addition, wildlife habitat at the disposal site is expected to improve in the long term.

4.5.5. Cultural Resources

<u>Direct and Indirect Impacts</u>

The proposed project activities would not affect any historic properties listed or eligible for listing on the National Register of Historic Places (NRHP). The Washington SHPO has concurred with this determination (Whitlam, 2013). SCL has also consulted with affected tribes and addressed their concerns, as described below. There is no risk of disturbing intact archaeological sites because the excavation area is within the active river channel and work on the riverbank would take place in an area that has previously been heavily disturbed. NPS archaeologists had previously surveyed the NPS land in the APE and concluded that there is low risk of encountering cultural material. The portion of the riverbank that would be used for the access ramp and the bank that would be partially excavated downstream of Stetattle Creek might have historical era debris but the site has been evaluated by the NPS archaeologist and determined not eligible for the National Register. Backfilling the Copper Creek Pit disposal site would not affect any intact surfaces that could have buried cultural materials.

SCL analyses indicate cobble bar excavation would not lead to immediate or long-term changes to streambank conditions that could affect the historic Stetattle Creek Bridge. The streambanks near the bridge are heavily armored with large riprap so the bridge is partially protected from potential undercutting, but could be affected by head cutting. To mitigate the potential effects of head cutting undermining the bridge abutments, the stream channel would be monitored and head cutting prevention measures would be implemented if needed. The truck and equipment traffic that would use the bridge would not affect the structural integrity of the bridge. SCL would closely monitor the conditions just in case conditions change in the future and implement an existing Unexpected Discovery Plan (UDP) to minimize potential impacts.

The excavation activities would be visible from the Hollywood residential area, resulting in minor, short-term degradation of views from the Historic District. The disposal site is not visible from SR 20, the river, or sensitive viewpoints and would have no impacts on views. Overall, there would be minor, short-term, adverse impacts to views, particularly when considering traffic delays and control activities.

Noise levels would be elevated relative to background from excavation and hauling activities up to 4,456 ft. from the cobble bar, resulting in potential short-term auditory impacts in the Historic District and nearby areas. However, no TCPs or other important cultural sites have been identified that would be affected. Proposed activities would not harm the physical integrity of the historic resources, but they would indirectly, temporarily detract from the feeling and association one would experience at the site itself.

Impacts to cultural resources would be minimized by implementation of the following measures:

- While there is very low probability of encountering any intact buried cultural resource features, SCL would, as requested by the tribes, have a professional archaeologist inspect samples of the excavated material for any cultural materials that could have been transported downstream as part of the natural erosion and deposition processes. A qualified archaeologist would also work with an SCL on-site environmental monitor to ensure that there are no impacts to any archaeological materials that could be present near the disposal site.
- SCL would follow an existing UDP if archaeological or historic resource artifacts are uncovered during construction. An unanticipated discovery would require an immediate work stoppage; inspection of the discovery by the qualified archaeologist; consultation

with the Washington DAHP, affected tribes, and NPS; and appropriate site mitigation before work is allowed to continue.

- Following excavation, SCL would restore the temporarily disturbed riverbank that is visible from the Hollywood residential area of the Historic District following an NPS-approved revegetation and restoration plan.

Cumulative Impacts

The proposed project and all other SCL projects must follow the existing UDP. Ongoing and planned SCL and NPS projects undergo evaluations for potential impacts to historic properties and cultural resources. In addition, ongoing management of the Historic Districts follows a Historic Resources Mitigation and Management Plan while archaeological resources near Ross Lake are managed according to an Archaeological Resources Mitigation and Management Plan. Implementation of and compliance with these plans will protect existing historical and cultural resources and there is expected to be no short- or long-term cumulative impacts to historical or cultural resources.

4.5.6. Recreation and Visitor Use

Direct and Indirect Impacts

Under Alternative B, Gorge Lake Campground would be closed for the estimated 7-week period during the summer peak season from about August to September when the project is expected to occur. Visitors wishing to use the auto-accessible facilities would be displaced to other nearby auto-accessible campgrounds at Goodell Creek, Newhalem Creek, and Colonial Creek campgrounds (see Figure 19). These areas have the capacity to absorb the few visitors that would potentially be displaced during the proposed project. Similarly, visitors wishing to use the boat launch for launching motor boats or rafts would be displaced to other locations. Gorge Lake would be inaccessible to motor boat use during the draw down but kayakers and canoers could launch boats at the small ramp on Reflector Bar and negotiate the rapids to access portions of the lake below the proposed project. Though other auto-accessible facilities will be available during the project, Gorge Lake Campground would be closed contributing to a short-term, minor adverse impact to users of these facilities.

Hikers wishing to use the Stetattle Creek and Sourdough trails would still be able to do so during the project but might be delayed by trucks entering and exiting the Gorge Campground at the excavation area and entering and exiting SR 20 at the Copper Creek Pit disposal area. A traffic control plan will be developed by the SCL contractor that complies with WSDOT signage and other safety requirements. This plan is expected to protect the public, minimize potential delays and ensure visitors safe access to facilities within the Ross Lake RNA and park or passage through these to other areas accessible from SR 20. Stetattle Creek and Sourdough trail user experiences may be slightly influenced by heavy equipment noise on the lower portions of the trail. Noise from the project would only be noticeable along the lower portion of the trails. Beyond that zone, noise from the project would be inaudible (i.e., at normal background levels). Noise from additional truck traffic, 6 to 10 loads per hour, also would influence noise levels at facilities around the approximately 15.5-mile long by 1-mile wide noise corridor from Gorge Campground to the Copper Creek disposal site. Though the attenuation zone indicates that truck traffic would be audible in this corridor and there is clearly some additive level of noise from trucks associated with this project, the level is similar to other heavy truck traffic (not associated with the project), which routinely travels the North Cascades Highway. Stetattle Creek, Sourdough trail and other facilities in the corridor will remain open. Recreational users experience may be slightly reduced by noise associated with the project. These would be minor adverse, short-term impacts.

Recreation and visitor use impacts would be similar at and around the Copper Creek Pit disposal area. The raft launch and take out just northeast of the disposal area would remain open. Use of this facility is likely primarily by guides or locals that are familiar with this location as it is primitive and unmarked. It is thought that this facility is used rather sparingly but there are no reliable use statistics. Implementation of the traffic plan developed by the SCL contractor will ensure safe access to the facility is maintained during the project. As such, the only potential impact to recreational and visitor use might be slight delays in access to and from the site as trucks are entering or leaving the quarry disposal area. Similarly access to other recreational destinations east or west of the disposal area may be somewhat delayed during the project but otherwise remain available. User experiences within the noise corridor may be slightly diminished by the higher noise levels. These would be minor, short-term adverse impacts.

<u>Cumulative Impacts</u>

Cumulative impacts from Alternative B and other planned projects would be similar to those from the proposed project alone. Other projects are generally of relatively short duration a few weeks or months and separated in time and space so that impacts to recreation and visitor use would likely be of short duration and minor.

4.5.7. Soundscape

<u>Direct and Indirect Impacts</u>

Alternative B noise impacts are based on the area in which project-generated noise levels will be above ambient levels. The distance at which project noise attenuates to ambient levels was calculated using the following assumptions:

- Major work elements include installation and removal of coffer dams, excavation of cobble bar material, hauling excavated materials in dump trucks to the disposal site, and grading and restoration activities at the disposal site. These activities will require a variety of heavy construction equipment and vehicles (Table 8). The sound levels for individual equipment range from 76 to 82 dBA at 50 ft. (Table 8). Several pieces of equipment are likely to be in use at a single time, resulting in additive effects. 85 dBA would be the assumed noise level 50 ft. from the work area at the excavation site; 81 dBA would be the combined noise level at the disposal site. Traffic noise is assumed to be 63 dBA.
- Topography and vegetation serve to dampen noise levels more than flat, hard surfaces such as concrete, rock, and water. While the excavation site consists of bare rock, the surface area of adjacent water is small and most of the surrounding area is forested and steeply sloped. These features are expected to provide a dampening effect of 7.5 dB per doubling distance from the noise source (WSDOT 2011). Using this dampening factor, noise at the excavation area would attenuate to the ambient level (46 dBA) at 4,456 ft. from the project site; noise at the disposal site would be somewhat less and would

attenuate at 2,812 ft. The highway noise created by 6 to 10 dump trucks working simultaneously to move the excavated material and returning empty to the excavation site would extend about 2,400 ft from SR20.Alternative B would have minor, short-term, adverse impacts on the soundscape in the vicinity of the Project Area.

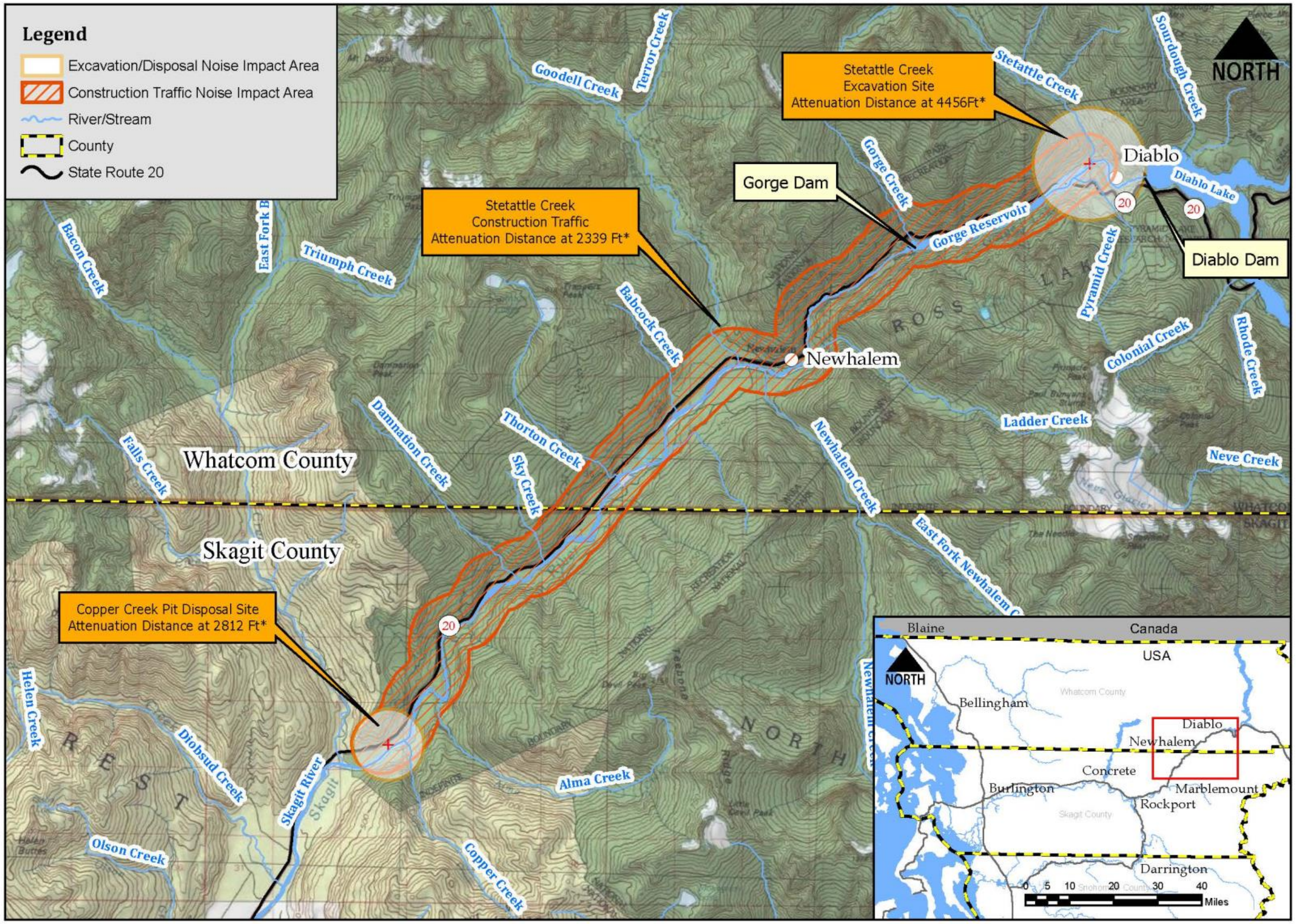
Cumulative Impacts

Ongoing and future projects in the Hollywood District would generate additional noise in the area. Collectively, these projects would have incremental additive effects on noise where project timing and noise attenuation distances overlap and the magnitude of those incremental increases would depend on the type of equipment used. It is expected that similar heavy construction equipment would be used and the incremental increase would be nominal in both the Hollywood District and on the highway. Therefore, cumulative these projects would have moderate, adverse, short-term impact to noise levels in the Hollywood District, at the Gorge Campground, and on SR 20.

4.5.8. Greenhouse Gases

Direct and Indirect Impacts

Mobilization, demobilization and use of heavy equipment to remove vegetation, construct a temporary access ramp, and excavate the cobble bar would generate greenhouse gases, particularly CO2 from combustion of diesel fuel over the approximately 7 week duration of the project. The amount of methane and nitrous oxide generated is inconsequential and discounted. Assuming 1,800 truck trips, emissions from hauling would be about 79 metric tons of CO2. Estimated emissions from cranes, loaders, and the tugboat would be about 26 metric tons. Total estimated emissions of all equipment would be approximately 105 metric tons of CO2 (Appendix B). Alternative B would constitute a minor, short-term, adverse impact.



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2 1 0 2 4 6

*Attenuation Distance is the distance to which noise levels from construction equipment and traffic during construction attenuate to

Figure 25. Extent of noise at the excavation and disposal sites and within the haul road corridor of the project.

Table 8. Project Noise Attenuation Distances

Construction Activity/Location	Equipment	Lmax (dBA) @ 50 ft[2] (specifications with actual measured levels in parentheses)	Total Lmax (dBA) at 50 ft[3]	Ambient Level (dBA)[5]	Attenuation Distance (in feet)4
Excavation Area	10 CY Dump Trucks	76	85	46	4,456
	Cat 336EL Excavators	81			
	Crane and Barge	81			
	Cat D-6 Dozer	82			
	Cat 938H Wheel Loader	79			
Disposal Site	Dump Trucks	76	81	46	2,812
	Cat D-6 Dozer	82			
	Backhoe	78			
Construction Traffic[1]	N/A	63	63	46	2,339

Notes:

1. Construction traffic represents the traffic along SR-20 in Newhalem during the peak season (July) plus construction truck trips anticipated between Diablo and the disposal site. The construction traffic noise levels represents the worst-hour noise level (i.e. the hour during which the noise level is anticipated to be highest).
2. Lmax (dBA) values for all pieces of equipment were taken from Table 7-4 of WSDOT's Biological Assessment Preparation Advanced Training Manual.
3. The total Lmax (dBA) represents the total noise level from the 3 loudest pieces of equipment, per WSDOT's BA Assessment Prep. Manual. of the manual, of the 3 loudest pieces, the two lowest pieces are added first. That total is then added to the remaining piece of equipment in the original group of 3 pieces.
4. Attenuation Distance is the distance to which noise levels from construction equipment and traffic during construction attenuate to the ambient level of 46 dBA. The equation used to calculate the attenuation distance (found on pgs. 7.22-7.23 of WSDOT's BA Assessment Prep Manual) to ambient levels is given by:

   D=Do*10^((Construction Noise Level-Ambient Sound Level)/alpha)

   where D=distance from noise source (in feet)

   Do=reference measurement distance (50 feet) for source

   alpha=20 for hard ground for point sources; 10 for hard ground for line sources (i.e. traffic along SR-20)
5. The ambient level was determined based on the NPS Natural Sounds Program (North Cascades National Park Service Complex Acoustic Monitoring Newhalem, 2009).

Estimated CO_2 emissions from excavating and hauling excavated materials and the time it takes to complete the project would vary depending on the number of dump trucks used and dump truck capacity. The larger the volume of material a dump truck can carry, the fewer the total number of truck trips would be required to move the same amount of material. As the number of truck trips is reduced so too would be the amount of fuel combusted and CO_2 emissions generated. The capacity of a standard dump truck is 10 CY (struck), according to the specifications for this equipment. This would translate to a total of 1,950 truck trips to the Copper Creek disposal site. Emissions from hauling would be about 85 metric tons of CO2. Estimated emissions of cranes, loaders, and the tugboat would be about 28 metric tons. Total estimated emissions of all equipment would approximately 113 metric tons of CO2 (Appendix B).

Cumulative Impacts

Without considering carbon sequestration by vegetation and soils, Alternative B combined with other reasonably foreseeable and planned projects would have minor, adverse impacts on GHG emissions.

4.5.9. Hydroelectric Operations

Direct and Indirect Impacts

Alternative B would remove much of the accumulated material that has been deposited on the bar and provides the fullest head recovery, based upon modeling completed by R2 Resource Consultants (2013) for SCL. Head recovery would be vary depending on flow but be up to about 2.5 feet at 4,000 cfs. This alternative would also reduce the risk of backwater conditions at SCL's sewage treatment plant, which is slated for removal. Approximately 19,500 cubic yards (CY) of accumulated materials would be excavated.

Implementation of Alternative B would restore lost generation capacity. It is anticipated that the design life of the project would range from 49 to 98 years, depending on the estimated annual sediment load from Stetattle Creek. Using an estimated annual sediment load of 200 CY per year, the estimated design life would be 98 years. The design life drops to 49 years using an estimated annual sediment load of 400 CY per year. Estimated power benefits in 2013 dollars ranges from $4,806,000 for a design life of 49 years to $9,519,000 for a design life of 98 years. Using periodic flushing flows from Diablo Dam timed to coincide with peak flows from Stetattle Creek could be used to push newly deposited materials from Stetattle Creek farther downstream to prolong the design life and reduce the rate of regrowth of a new bar and loss of head that would require future excavations. In other words, flushing flows could be used to avoid future excavations or at least the frequency of these.

On the other hand, operational adjustments would be required during the entire duration of the project in order to isolate the excavation site and minimize potential water quality impacts. These operational adjustments include reducing or entirely shutting off flows through the Diablo Powerhouse as well as carefully controlling the water level in the Gorge Reservoir, which could negatively impact hydroelectric operations by temporarily reducing the amount of generated power. Water levels in the reservoir and releases of flows through the Diablo Powerhouse are described in detail in the Preliminary Engineering Design Report (R2 Resource Consultants 2013).

Implementation of Alternative B would result in moderate, long-term beneficial impacts to hydroelectric operations.

Cumulative Impacts

Within the reasonably foreseeable planning horizon, there is some uncertainty associated with implementation of various projects, such as the Gorge Tunnel project, that would increase hydroelectric generation capacity and have a beneficial effect on hydroelectric operations by producing more power through efficiency gains without changing overall generation capacity. In addition, within this planning horizon Seattle City Light will be undergoing relicensing, and this creates additional uncertainty as to reasonably foreseeable activities and there potential cumulative effects to hydroelectric operations. Alternative B combined with the foreseeable and planned projects would not contribute any notable cumulative impacts to hydroelectric operations beyond the potential for gradual loss of power generation over time as a result of channel aggradation that may occur following excavation of the cobble bar. If the bar aggrades quickly (e.g. in less than 50 years), then cumulative adverse effects to hydroelectric operations would be incrementally greater than those that would occur under slower aggradation rates, because more frequent action would be needed to restore lost power generation. In conclusion, cumulative effects would be somewhat uncertain, but likely negligible to minor and adverse given the various ways power production and related operations could be affected.

4.6. Impacts of Alternative C

4.6.1. Surficial Geology

Direct and Indirect Impacts

Alternative C would remove an estimated 18,000 CY of accumulated cobble and gravel from Stetattle Creek Bar, approximately 1,500 CY less than Alternative B. Compared to Alternative B, the footprint of excavation would be slightly smaller but generally similar in scale and therefore similar in the degree of effect. Compared to Alternative A, this action would have a moderate, relatively long-term impact by removing a cobble bar landform that likely predates the Skagit River Hydroelectric Project.

Alternative C would result in a negligible reduction in the amount of bank erosion as compared to the baseline (No action—Alternative A), from a 1.25-year event to a 1.3-year event that would be needed to cause shoreline erosion. Similar to Alternative B, the potential for erosion would be mitigated through shoreline stabilization and bioengineering.

Soils at the Gorge Campground, which have been previously disturbed in many areas, would be temporarily adversely impacted during construction from heavy equipment accessing the project site, and use of the campground as a staging and stockpiling area. Sediment may enter the Skagit River during construction, but the potential would be reduced to a negligible amount due to implementation of BMPs including: designating and fencing off specific areas for staging and stockpiling; utilizing a stabilized construction entrance and wheel wash to prevent tracking out; and using silt fences and/or sediment wattles to prevent or minimize erosion and sedimentation.

In addition, there is potential for erosion and sedimentation due to the removal of trees on the right bank of the Skagit River. Impacts would be reduced to a minor amount because the footprint would be minimized to the extent necessary, the clearing limits would be marked, and the slope would be protected and stabilized. The bank would be restored with native vegetation following construction. All of the aforementioned BMPs would be included in a StormwPollution Prevention Plan that would be developed for the project.

At the Copper Creek Pit, soils would be temporarily disturbed during construction, but due to the topography of the site, there would be minimal risk of sedimentation to the Skagit River. BMPs similar to those described above would be used for this site. In the long term, soils would be beneficially impacted, because the site would be restored and topsoil would begin to form again. Therefore, implementation of Alternative C would result in minor adverse impacts that would be short-term in duration at the Gorge Campground. However, at the Copper Creek Pit impacts would be beneficial and long-term in duration.

<u>Cumulative Impacts</u>

Considering the foreseeable projects, cumulative impacts to hydroelectric operations are not anticipated.

4.6.2. Water Resources

<u>Direct and Indirect Impacts</u>

The impacts to water resources from Alternative C would be the same in nature and duration as those described under Alternative B. However, the intensity of these impacts would be slightly less under Alternative C due by reducing the excavation area and the number of trees removed along the right (north) bank of Gorge Lake.

<u>Cumulative Impacts</u>

Similar to Alternative B.

4.6.3. Vegetation

<u>Direct and Indirect Impacts</u>

Adverse and beneficial impacts on vegetation from Alternative C would be similar to those from Alternative B. Minor, adverse short-term impacts of Alternative C on vegetation would be incrementally lower than those from Alternative B. The preservation of a 10-foot-wide strip along the shoreline adjacent to Diablo Road would require removal of fewer trees and associated understory vegetation in the riparian zone.

A total of 39 deciduous trees and 5 evergreen trees and associated understory vegetation would be removed on the bar near the toe of the slope and for the access road. All of the deciduous trees are < 10 inches DBH. The three evergreen trees are all ≤ 13 inches DBH.

Impacts on sparse pioneer vegetation on the cobble bar would be identical to those from Alternative B. Though the total quantity of excavated material disposed of at the Copper Creek Pit would be lower than that for Alternative B, beneficial impacts from restoration and control of invasive species are expected to be similar duration and intensity for this alternative. It is anticipated that the footprint of the deposited material would be comparable and only the height and final contours of the restored topography would vary compared to Alternative B; resultant ecological functions would be similar.

Cumulative Impacts

Potential cumulative adverse and beneficial impacts on vegetation from Alternative C and other projects would be the same duration and intensity but incrementally lower than those from Alternative B and other projects.

4.6.4. Fish and Wildlife, Including Rare/Listed Species

Direct and Indirect Impacts

The impacts of Alternative C on fish and wildlife habitat and habitat use would be nearly identical to Alternative B. Slightly less riparian habitat would be lost or temporarily altered from partial bar removal though the intensity (minor) would remain the same. Fewer trees would be removed from the right (north) bank of the reservoir. Retaining these trees would provide improved habitat cover from overhanging branches, and greater inputs of terrestrial invertebrates living on this vegetation upon which fish, including juvenile bull trout feed.

Partial bar excavation would take a couple of days less but the duration of the adverse impacts on water quality and feeding behavior would still be short-term and adverse. With the mitigation described above, Alternative C also would result in moderate to high long-term, beneficial impacts on the bull trout use and population in Gorge Lake. Likewise, the duration of beneficial impacts from restoration at the disposal site and control of invasive plants would remain the same though the configuration of the restoration area would be slightly different.

Impacts to federally listed wildlife species would be similar to Alternative B.

Cumulative Impacts

The nature, duration, and intensity of cumulative impacts of the partial bar excavation and other projects on fish and wildlife would be the same as those from Alternative B and other projects.

4.6.5. Cultural Resources

Direct and Indirect Impacts

Alternative C, the partial bar removal, would reduce the potential for impacts to the historic era debris scatter located on the riverbank downstream of Stetattle Creek. Because the riverbank is not eligible for the National Register, there is no difference between the alternatives relative to impacts on Historic Properties or cultural resources.

Cumulative Impacts

Cumulative impacts of the partial bar removal and other projects would be the same as those from Alternative B and other projects.

4.6.6. Recreation and Visitor Use

Direct and Indirect Impacts

Potential impacts from Alternative C on recreation and visitor use would be very similar but incrementally less than those from Alternative B. This would be related to the slightly shorter (2 days) duration of Alternative C.

Cumulative Impacts

Potential cumulative impacts from Alternatives C and other planned projects would be very similar but incrementally lower than Alternative B.

4.6.7. Soundscape

Direct and Indirect Impacts

Alternative C has an expected duration of a couple days less than the full bar removal alternative (Alternative B). Though elevated noise levels would be slightly shorter, Alternative C also would have minor, short-term, adverse impacts on noise within the project area.

Cumulative Impacts

Cumulative impacts from Alternative C and other projects would be the same as those for Alternative B.

4.6.8. Greenhouse Gases

Direct and Indirect Impacts

The duration needed to complete Alternative C would be a couple days less than that for Alternative B. Fewer truck trips (between 818 and 1059) would be required to haul and dispose of the estimated 18,000 CY of excavated material at the Copper Creek Pit disposal site. Emissions from hauling would range from about 36 to 46 metric tons of CO_2. Estimated emissions from cranes, loaders, and the tugboat would be about 26 metric tons. Total estimated emissions of all equipment would range from about 62 to 72 metric tons of CO2 (Appendix B). Though emissions would be somewhat lower (4 to 6 metric tons) than the total for Alternative B, the total emissions would still constitute a minor, short-term, adverse impact.

Cumulative Impacts

Cumulative impacts of Alternative C and other reasonably foreseeable and planned projects would be similar though 4 to 6 metric tons lower than those compared to those from Alternative B and other projects. Cumulatively, these would be still constitute minor, short-term adverse impacts on GHG emissions.

4.6.9. Hydroelectric Operations

Direct and Indirect Impacts

Alternative C would remove an estimated 1,500 CY less material from the cobble bar (an estimated 18,000 CY). This alternative would restore generation capacity, but to a somewhat lesser extent than Alternative B. Head recovery would be about 2.4 feet at the Diablo Powerhouse tailrace at a flow of 4,000 cfs.

It is anticipated that the design life of Alternative C would range from 45 to 90 years, depending on the annual bedload transport rates from Stettatle Creek, which is slightly less than Alternative B. The estimated power generation benefits in 2013 dollars would range from about $4,180,000 for a design life of 45 years to $8,269,000 for a design life of 90 years, which is also slightly less than Alternative B. Periodic release of flushing flows as described above for Alternative B could reduce the rate of accumulation of sediments from Stetattle Creek and prolong the design life. These benefits likewise would be expected to be proportionally less than those estimated for Alternative B. Nonetheless, operational flushing could reduce the need for future excavations, depending on the effectiveness of flushing flows in reducing bar reformation.
Similar operational adjustments as those for Alternative B would be required during construction in order to isolate the site and complete the excavation. The slightly shorter duration that is anticipate to be needed to complete this alternative could have slightly lower potential to harm SCL power generation at the Skagit Hydroelectric Project than Alternative B.
Implementation of Alternative C would result in moderate, long-term beneficial impacts to hydroelectric operations. These would be expected to be slightly less beneficial than those from Alternative B.

Cumulative Impacts

Alternative C combined with the foreseeable and planned projects would not be expected to contribute to any cumulative impacts to hydroelectric operations.

Conclusions

4.7. Impacts of Alternative D (Hybrid of Alternatives B and Alternative C)

4.7.1. Surficial Geology

Direct and Indirect Impacts

The amount of excavation (18,300 CY) would result in somewhat lower impacts to surficial geology than Alternative B, and slightly higher impacts than Alternative C. The risk of bank erosion would be slightly higher compared to the full excavation alternative (Alternative B) and slightly lower than Alternative C. These impacts would be minor and short-term.

Cumulative Impacts

There would be no cumulative impacts from this alternative and other planned projects, which is the same as for the other alternatives and planned projects.

4.7.2. Water Resources

Alternative D would result in lower direct and indirect impacts on water resources compared to Alternative B and slightly greater impacts compared to Alternative C. This is direct correlation to the reduction in the amount of excavation (2,200 CY) compared to Alternative B and slightly greater amount of excavation (300 CY) compared to Alternative C. Impacts to water quality from suspended sediments would be minor and short-term.

Cumulative Impacts
Similar to Alternative C.

4.7.3. Vegetation

Fewer trees would be removed for this alternative compared to either Alternative B or Alternative C. Only a small number of trees would be removed in the access ramp area for Alternative D. This alternative would result in minor, long-term impacts to riparian vegetation in the immediate vicinity of the construction access area.

Cumulative Impacts
Cumulative adverse impacts to vegetation from Alternative D would be the same in duration and intensity but incrementally lower than from the other alternatives and planned projects. Cumulative beneficial impacts would be the same as for the other alternatives and planned projects.

4.7.4. Fish and Wildlife, Including Rare/Listed Species

Direct and Indirect Effects
Alternative D would result in reduced impacts to terrestrial habitat and wildlife compared to Alternative B or C because fewer trees would be removed. Impacts would be minor and short-term.

Impacts on aquatic habitat would be similar to Alternative C and would be minor and short-term. When taking into consideration proposed mitigation, Alternative D would result in minor, long-term beneficial impacts to aquatic habitat and biota, including the Gorge Lake population of bull trout.

Cumulative Impacts
Cumulative adverse impacts from this alternative and other planned projects on fish and wildlife would be similar to that from the other alternatives and other planned projects but incrementally lower. Cumulative beneficial impacts on aquatic habitat would be the same as for the other alternatives.

Rare/Listed Species

4.7.5. Cultural Resources

Direct and Indirect Impacts
Alternative D would result in comparable and inconsequential impacts to historic and cultural resources similar to the other alternatives.

Cumulative Impacts
There would be no cumulative impacts of this alternative and other foreseeable projects, which is the same as that for the other alternatives.

4.7.6. Recreation and Visitor Use

Direct and Indirect Impacts

Impacts to recreation and visitor use from Alternative D would be of shorter duration than those from Alternative B and slightly greater duration than those from Alternative C. This is again a correlation to the amount of material being excavated and the time needed to complete excavation and mitigation actions. These would be minor and short-term, lasting not quite a couple of months.

Cumulative Impacts

Potential cumulative impacts from Alternative D and other planned projects would be very similar but incrementally lower than Alternative B and incrementally higher than those from Alternative C.

4.7.7. Soundscape

Direct and Indirect Impacts

The duration of work and the number of truck trips required to complete Alternative D would be lower than Alternative B and higher than Alternative C. Thus, the impacts on the soundscape would be incrementally lower than those from Alternative D and incrementally higher than those from Alternative C.

Cumulative Impacts

Cumulative impacts on soundscape from Alternative D and other planned projects would be virtually the same as those from the other alternatives combined with other planned projects.

4.7.8. Greenhouse Gases

Direct and Indirect Impacts

Potential impacts on greenhouse gases likewise are tied to the duration needed to complete the alternative. Consequently, Alternative D would result in incrementally lower GHG emissions than those from Alternative B and incrementally higher emissions than those from Alternative C. Like the other alternatives, Alternative D would have minor, short-term, and adverse impacts on GHG emissions.

Cumulative Impacts

Similar to the level of direct and indirect impacts, Alternative D and other planned projects would be expected to have minor short-term, adverse impacts on GHG emissions compared to the other alternatives together with other planned projects.

4.7.9. Hydroelectric Operations

Direct and Indirect Impacts

The duration and intensity of beneficial impacts on hydropower operations would depend upon the degree of head recovery, which directly relates to power production. Alternative D would provide incrementally lower head recovery compared to Alternative B and incrementally higher head recovery compared to Alternative C. The beneficial effects on anticipated design life (46-92 years) and power generation ($4,302,000 to $8,512,000) also would be incrementally lower from this alternative compared to Alternative B and incrementally higher than those from Alternative C.

Cumulative Impacts

Cumulative impacts from this alternative and other planned projects are the same as those for the other alternatives and planned projects.

5. Consultation and Coordination

5.1. History of the Planning and Scoping Process

SCL identified the rock bar at the mouth of Stetattle Creek as the primary source of head loss at the Diablo Powerhouse Tailrace in 2003. Following the landslide in Stetattle Creek in 2003, SCL noticed a sharp jump in the tailwater elevation and began to investigate how to recover the lost generating capacity. During this process SCL noticed that the tailwater has increased over time. This conclusion was drawn by comparing the conditions at the beginning of the Diablo Project (a tailwater rating curve developed in 1946 for the design of the project) and data analyzed over the last 14 years that shows how the relationship between the tailwater elevation and flow has changed.

On June 27, 2007 SCL released 33,000 cfs of water from Diablo Dam in an attempt to reduce the size of the bar and restore some of the lost generation capacity at Diablo Powerhouse. This effort was partially successful, resulting an improvement of hydraulic head by about 0.5 ft. In the following years SCL contracted with Seattle University and R2 Resources to conduct studies to determine the source, composition, depth, and size of the rock material comprising the Stetattle Creek bar and to identify methods for removing the bar. Results of these studies and engineering assessment were used to develop the alternatives for the Diablo Powerhouse Tailrace Restoration. Five alternatives for excavation and disposal were identified and summarized in a report that was provided to the NPS, WDFW, ACOE, and USFWS for review and comment. Two of the alternatives from that report are addressed in this EA as Alternatives B and C. In addition to the work done by R2 Resources, SCL and the NPS conducted fish surveys in Stetattle Creek. These surveys coupled with NPS concerns for potential impacts to fish habitat and riparian conditions led to development of Alternative D.

5.2. Agency Consultation

SCL held a pre-application meeting with the NPS, WDFW, ACOE, and USFWS on August 14, 2013. In addition, the NPS has consulted independently with the USFWS to address potential concerns pertaining to bull trout, further clarify the alluvial processes causing the cobble bar to expand, and to explore options other than dredging.

5.3.List of Preparers and Contributors

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5.4. Distribution List

A summary of the contents of this EA will be distributed via regular mail to the NPS' parkwide mailing list, and also electronically to the e-mail list.

Full copies of the document will be sent to:

- The Federal Energy Regulatory Commission
- The Army Corps of Engineers, Seattle District
- U.S. fish and Wildlife Service
- Sauk-Suiattle Indian Tribe
- Swinomish Indian Tribal Community
- Upper Skagit Indian Tribe
- Nlaka'pamux Nation
- Washington Department of Ecology
- Washington Department of Fish and Wildlife
- Washington Department of Archaeology and Historic Preservation
- Whatcom County
- Skagit County

Hard copies of the EA will be available for public review at the park's visitor center in Newhalem, NPS headquarters office in Sedro-Woolley, the Seattle Public Library and at Seattle City Light headquarters office in Seattle and at the Skagit Project office in Newhalem.

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7. Glossary

Boulder. Using the Wentworth scale, sediment with a size greater than 256 millimeters.

Clay. Using the Wentworth scale, sediment with a size less than about 0.003 millimeters.

Cobble. Using the Wentworth scale, sediment with a grain size greater than 64 millimeters and up to 256 millimeters; second to boulders in largest sediment size.

Coffer dam. A watertight enclosure from which water is pumped to expose the bottom of a body of water and permit construction.

Dissolved oxygen. The concentration of oxygen dissolved in water, expressed in milligrams per liter (mg/l) or as a percent saturation, where saturation is the maximum amount of oxygen that can theoretically be dissolved in water at a given altitude and temperature.

Gravel. Using the Wentworth scale, sediment with a grain size > 2 to 64 millimeters.

Head loss. In the case of the Diablo Powerhouse Tailrace restoration project, head loss is caused by the backwater created by the cobble bar, which has raised the water surface elevation at the tailrace approximately 2.8 feet, thereby reducing the hydraulic head.

Hydraulic head. The hydraulic head for the Diablo Powerhouse is the difference in the water surface elevation at the Diablo Dam intake and the Diablo Powerhouse tailrace water surface elevation.

Hydraulic residence time. The amount of time it takes a molecule of water to pass through a body of water.

Hypolimnion. The layer of water in a thermally stratified lake that lies below the thermocline, in noncirculating, and remains perpetually cold.

NephＯlometric Turbidity Unit (NTU). A standard unit of measure used for quantifying turbidity levels in water.

Secchi depth. A measurement that is made with a Sechi disk and used to identify relative water clarity or transparency. The larger the value, the greater the water clarity or transparency.

Sand. Using the Wentworth scale, sediment with a size less than 2 millimeters to 0.0625 millimeter.

Silt. Using the Wentworth scale, sediment with a size less than 0.0625 millimeter and down to about 0.003 millimeter.

Suspended sediment. Particles such as sands, silts, and clays that become suspended in the water column are suspended sediments or suspended solids. Whether a particle becomes suspended and how long it stays in suspension varies by the size of the particle and settling velocities. Sands settle most rapidly (a few minutes) followed by silts (minutes to hours) and lastly by clays (days to weeks).

Total Maximum Daily Load (TMDL). A total maximum daily load (TMDL) is a numerical value representing the highest amount of pollutant a surface water body can receive and still meet water quality standards. TMDL is a science-based approach for setting limits on how much of a pollutant can be discharged to a water to clean it up so that it meets the state water quality standards for that parameter.

Turbidity. Not clear or transparent because of stirred-up sediment or the like; clouded; opaque; obscured. According to Washington Annotated Code 173-201A-020 definitions, “turbidity” means the clarity of water expressed as nephelometric turbidity units (NTU) and measured with a calibrated turbidimeter.

Appendix A. Biological Evaluation

Attached as separate document.

Appendix B. Estimated Greenhouse Gas Emissions

Attached as separate document.

Appendix C. Erosion Control Measures for Shoreline of Diablo Campground

Description of Gorge Lake Campground Slope Stabilization Project

Site: The proposed project is on the north (right) bank of the Skagit River just below the town of Diablo. The site is also below the lower hydraulic control point for the Diablo Powerhouse backwater, and is in a landscape that has been heavily manipulated by construction of the Skagit Hydro Project.

Approximately 250 ft of the stream bank below Gorge Campground slopes steeply down a raveling slope ~20 ft. vertically from Gorge Campground to the Skagit River(Figures 1 and 2). Erosion at the toe of the slope by Gorge Lake and the Skagit River, depending on lake level, has prevented a stable slope from developing adjacent to the campground. The unstable slope is approximately 35 degrees and consists of sand and gravel, with remnants of an old stairway.

Conceptual Elements:

1-Remove existing concrete bulkhead and wire gabion baskets.

2-Stabilize the toe of the slope for about 300 ft below hydraulic pinch point by installing native rock and large woody debris as shown in Figures 2, 3 and 4.

3-Regrade the slope to 1.5H:1V (30 degrees) by cutting brow back 2 ft. into campground and using fill below. If necessary bring in clean fill (Figure 4).

4- Construct a new trail along the stabilized slope for camper access to river (Figure 2).

5-Revegetate slope with native trees, shrubs and ground cover. Use willow-layering technique at top of rock and wood along lower 10 ft of slope (Figure 5).

Material Sources:

NPS has a stockpile of large wood in Marblemount. Large rock for toe protection/regrading would come from gravel bar excavation. Native plants (willow, red osier dogwood) would possibly come from Stetattle Creek, or lower Babcock Creek (west of Newhalem).

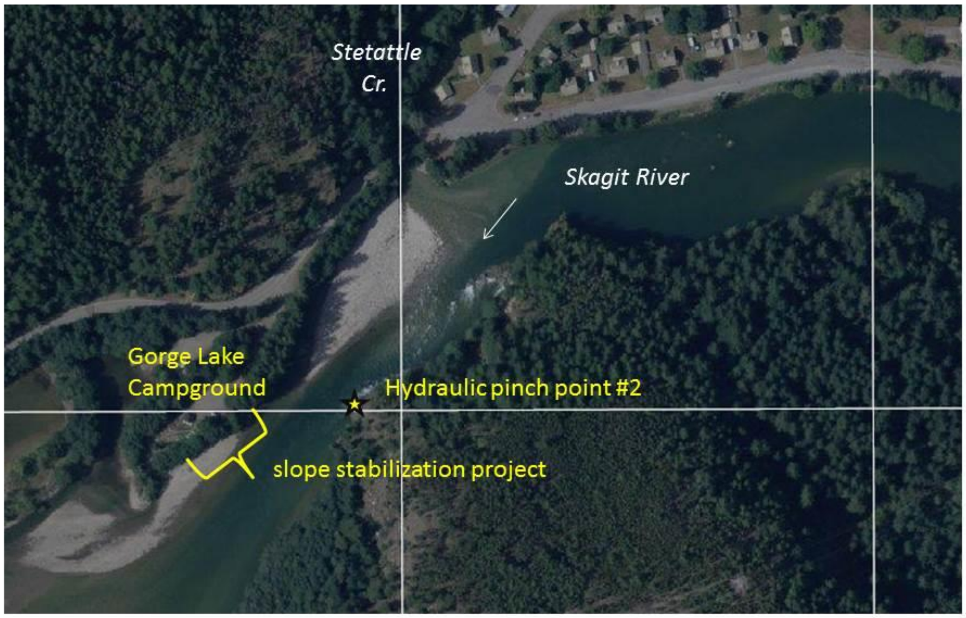


Figure 1.

Figure 2. Gorge Campground Slope Stabilization

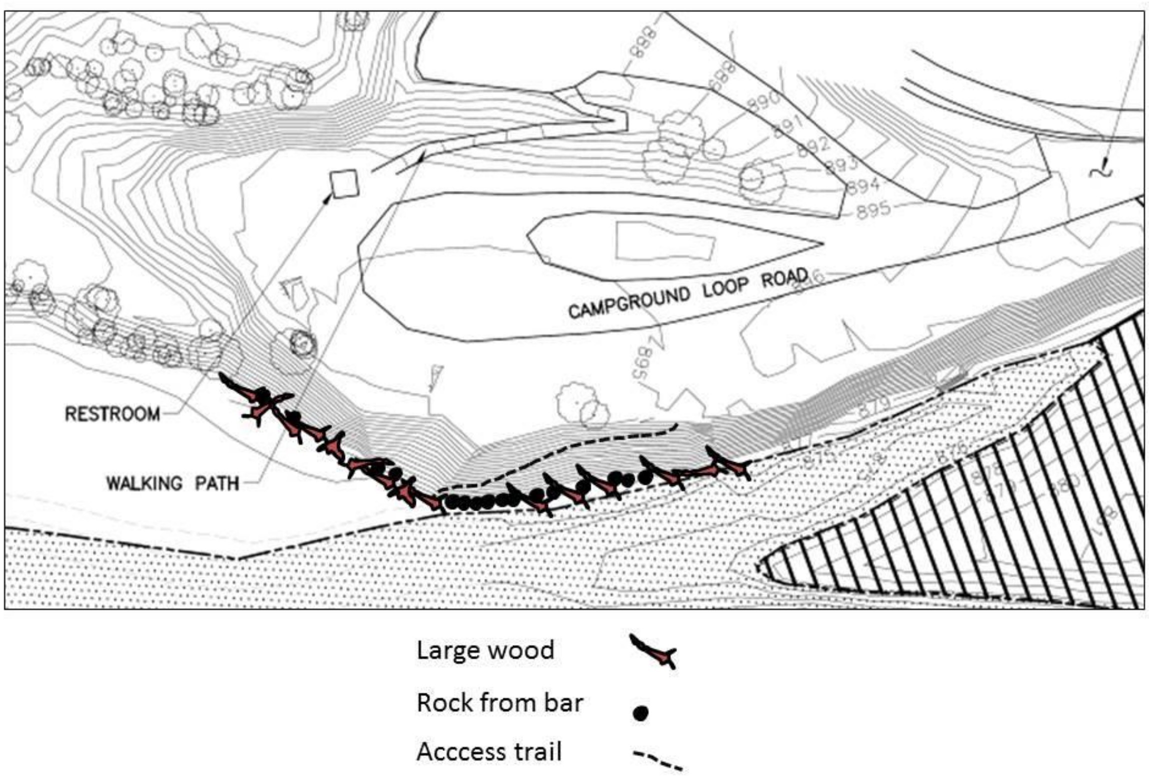


Figure 3 Existing Slopes

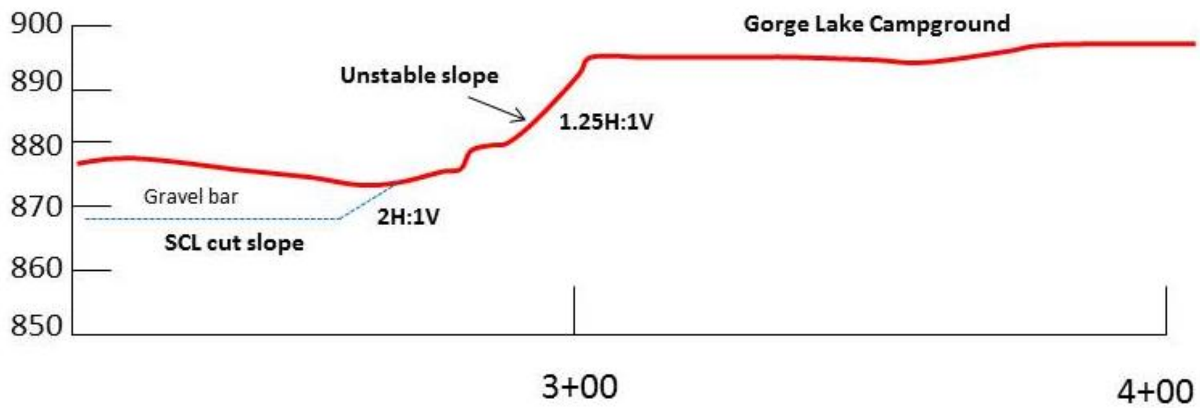


Figure 4 Proposed Restoration

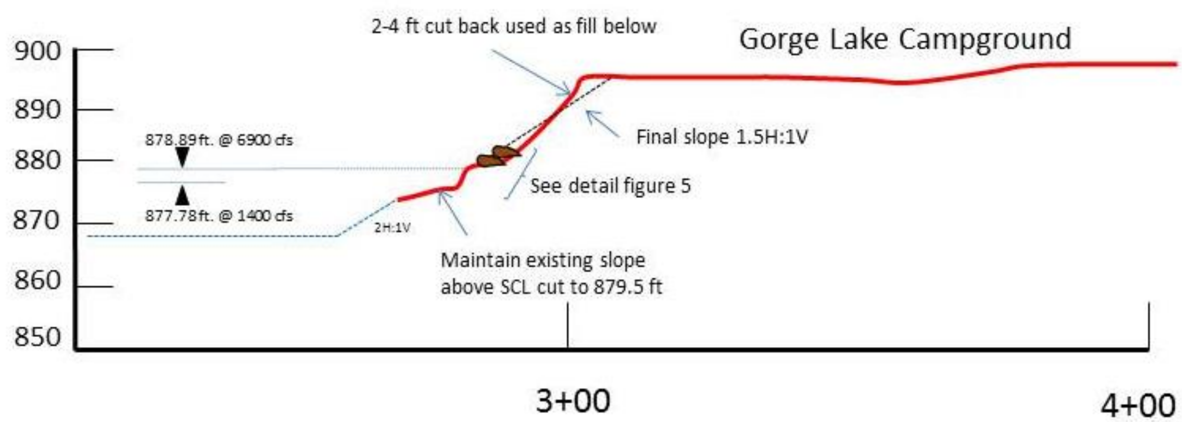
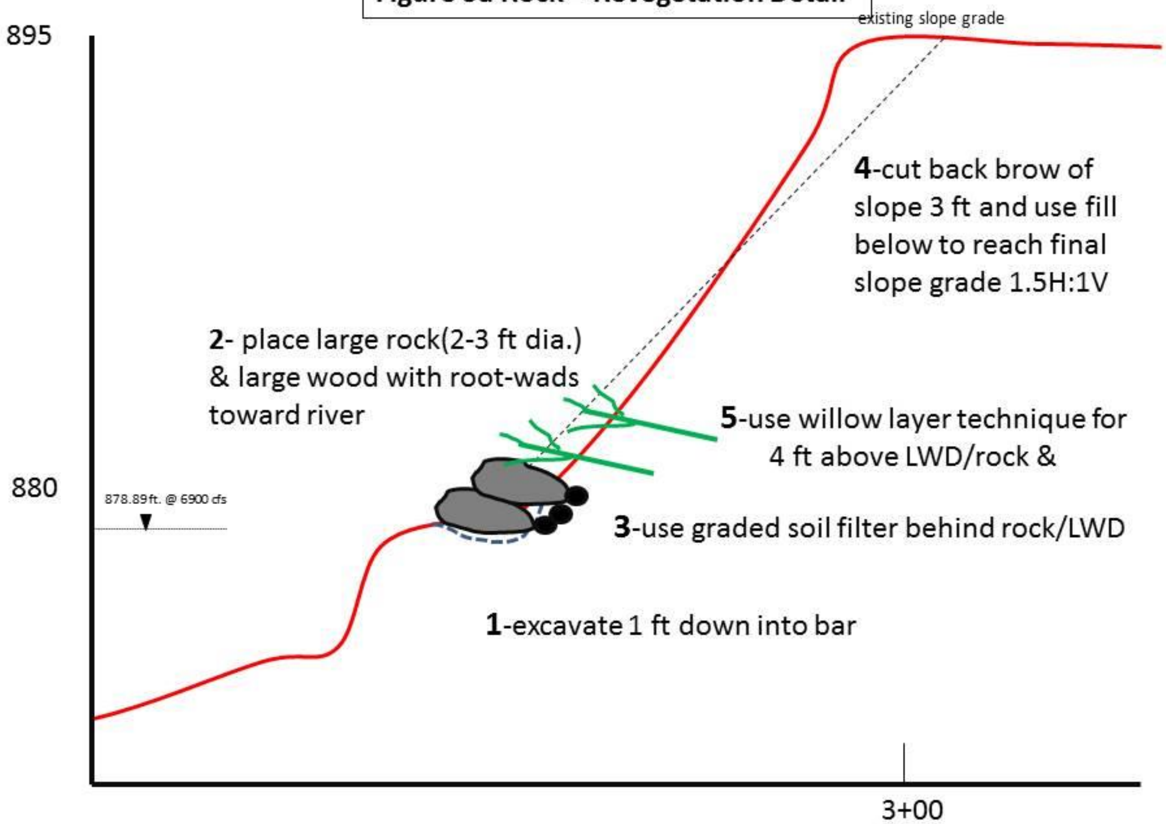


Figure 5a Rock – Revegetation Detail



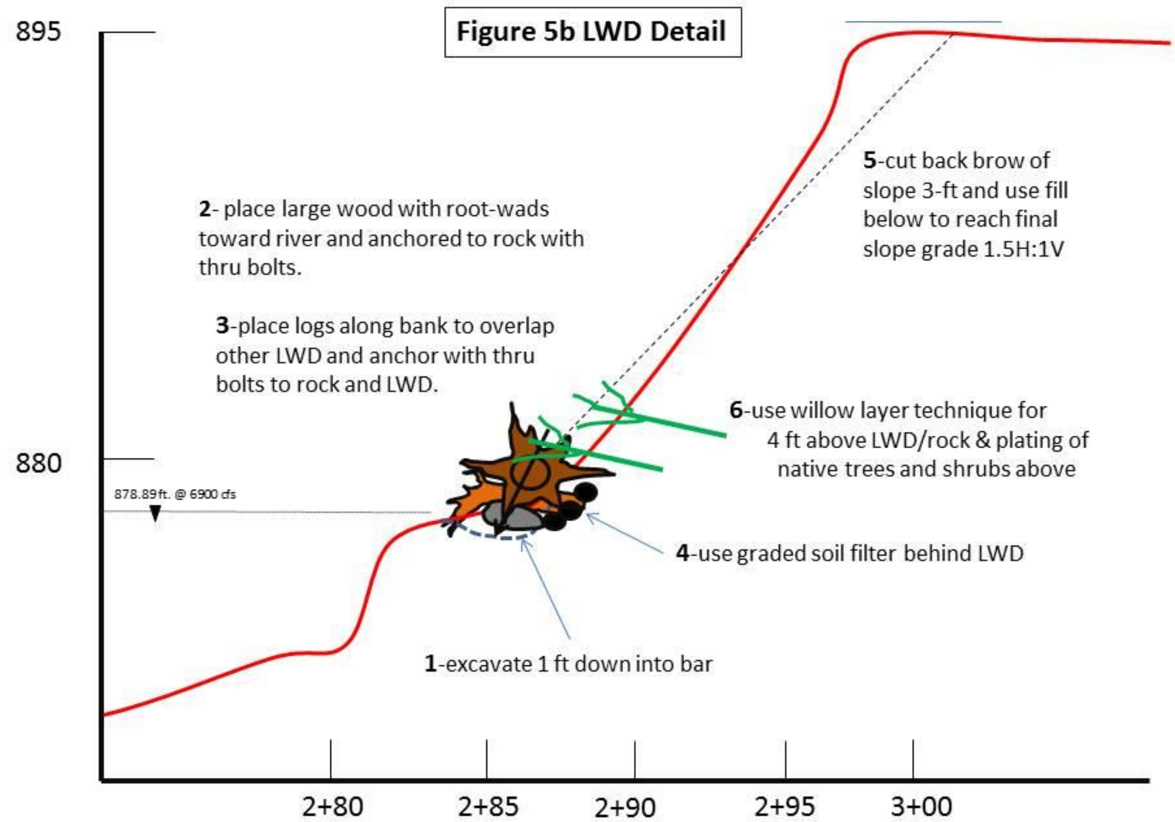


Figure 5b LWD Detail
895
880
878.89 ft. @ 6900 cfs
2- place large wood with root-wads toward river and anchored to rock with thru bolts.
3-place logs along bank to overlap other LWD and anchor with thru bolts to rock and LWD.
5-cut back brow of slope 3-ft and use fill below to reach final slope grade 1.5H:1V
6-use willow layer technique for 4 ft above LWD/rock & plating of native trees and shrubs above
4-use graded soil filter behind LWD
1-excavate 1 ft down into bar
2+80
2+85
2+90
2+95
3+00

Appendix D. Effects of Cobble Bar Removal on Aquatic Habitat Conditions and Macroinvertebrate Productivity

Ed Connor, Seattle City Light
May 6, 2014

During the March 12, 2014 project coordination meeting between the National Park Service (NPS) and Seattle City Light (SCL), the NPS expressed concern about the potential impacts of the cobble bar excavation project on macroinvertebrate productivity and diversity in the exiting aquatic habitats. Of particular concern is that alteration of the existing stream habitat in the mouth of Stetattle Creek below the bridge, which is regarded as a highly productive invertebrate production area, would substantially reduce the forage base of rainbow trout and juvenile bull trout in Gorge Lake immediately downstream of the mouth.

Seven distinct aquatic habitat zones were delineated in the vicinity of the cobble bar excavation site (Figure 1), including:

- Zone 1 - Mouth of Stetattle Creek
- Zone 2 – Ephemeral side channel located along right bank of cobble bar
- Zone 3 – Backwater side channel located along right bank of cobble bar
- Zone 4 – Exposed cobble bar proposed for excavation
- Zone 5 - Gravel bar in reservoir located immediately upstream of the Stetattle Creek confluence
- Zone 6 - Rapids located on the southeast side of the exposed cobble bar
- Zone 7 - Deep run habitat located below the rapids (Zone 6)

Current Habitat Conditions
Zone 1: The mouth of Stetattle Creek is about 220 ft in length under normal reservoir operating conditions, and has a total area of 0.48 acres, and a wetted channel area of 0.43 acres, under fall low flow conditions. The substrate at the mouth of Stetattle Creek consists of an alluvial fan composed mainly of cobble and large gravel bed materials. The alluvial fan extends out to the fast waters of the free-flowing section at the upper end of Gorge Reservoir, and also extends upriver along the right bank of the reservoir where some of the flow from Stetattle Creek runs counter-current to flows in the reservoir. The alluvial fan of this stream also extends well onto the exposed cobble bar that is proposed for excavation (Zone 4). The mouth of the creek was surveyed with three habitat cross-sections during the spring and fall of 2013 by SCL. Velocities, depths, and substrate composition were measured across the stream channel during these surveys.

The upper section of the stream mouth zone (Zone 1a) is a plunge pool tail-out that transitions into run habitat, which extends about approximately 120 ft below the bridge. This section of the channel has a very gradual water surface slope, dropping less than 0.1 ft in elevation over 120 ft distance (slope = 0.07%). Under low flow conditions in the fall (75 cfs), this section of the Stetattle Creek mouth has a wetted width of 70 ft, a mean depth of 1.4 ft, and mean velocity of

0.7 ft/sec. Under higher flow conditions in the spring (250 cfs), this section of the channel is 80 ft wide, and has a mean depth

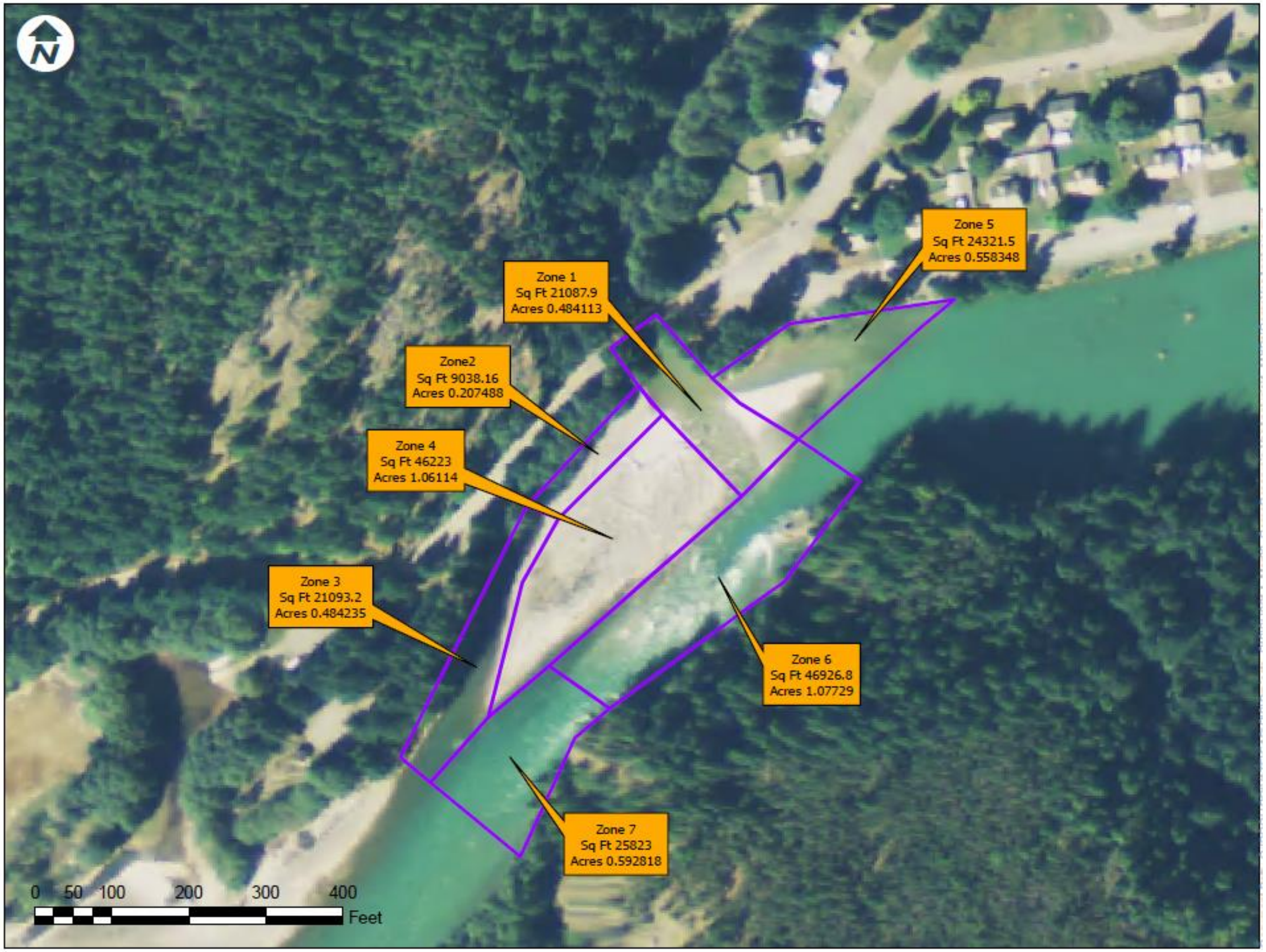


Figure 1. Map of habitat zones at Diablo tailwater cobble bar excavation site.

of 2.1 ft and mean velocity of 1.5 ft/sec. Substrates in this run habitat area are dominated by small cobbles and large gravels.

The lower section of the Stetattle Creek mouth (Zone 1b) is a riffle that is approximately 100 ft in length. Water surface elevations drop 1.5 ft from the top of the riffle to the confluence with the free-flowing section of the reservoir (slope = 1.7%). Under fall low flow conditions (75 cfs), this lower section of the mouth has a wetted width of 77 ft, and has a mean depth of 1.2 ft and average velocity of 1.2 ft/sec. Under higher flow conditions in the spring (250 cfs), this section of the mouth is 87 ft wide, and has a mean depth of 1.5 ft and mean velocity of 2.0 ft/sec. Substrates in this riffle habitat are dominated by small and large cobbles.

Zone 2 is side channel habitat that has surface water only under high outflow conditions from Stetattle Creek, typically in the spring and early summer. This habitat zone has a total area of 0.21 acres, but most of this area is dry during normal and low flow conditions.

Zone 3, which is just downstream of Zone 2, is also side channel habitat, but is connected to the reservoir and is a zero-velocity backwater area except when Stetattle Creek is running high during the spring and early summer and flows into this side channel. This habitat zone has a total area of 0.48 acres, with a wetted channel area of 0.38 acres at normal reservoir operating elevations. The average depth of this backwater habitat is 1.9 ft (NPS 2013). Juvenile rainbow trout and bull trout were observed in Zone 3 during surveys conducted by the NPS in 2013.

Zone 4 is currently a large expanse of cobble bar that is mostly dry under typical flows from Diablo Powerhouse and Stetattle Creek. This dry cobble bar has an area of 1.06 acres.

Zone 5 is a gravel bar area of the reservoir that is located immediately upstream of the Stetattle Creek confluence that is relatively shallow under most flow conditions. Part of this gravel bar is dry during low generation flow conditions (1,400 cfs), but becomes completely submerged during high generation flows (6,900 cfs). The total area of this gravel bar is 0.56 acres, of which 0.45 acres are wetted under low (1,400 cfs) to average (3,400 cfs) generation flows. Depths are shallow within this habitat zone under low generation flow, having a mean depth of 0.7 ft and a mean velocity of 0.5 ft/sec. The gravel bar in Zone 5 has aggraded over the past two years, and an incised side channel that was formerly used by juvenile rainbow trout and bull trout is no longer present.

Zones 6 and 7 are free-flowing riverine habitats located along the left bank of the cobble bar at the upper end of Gorge Lake. Zone 6 is a rapids, with standing waves visible during average (3,400 cfs) and high (6,900 cfs) generation flows. Average velocities in the Zone 6 rapids exceed 10 ft/sec makes most this area, except for the edges, low quality fish habitat. Zone 6 has a total area of 1.07 acres.

Zone 7 is more reservoir-influenced than Zone 6, and is consequently deep and fast run habitat. Average velocities within Zone 6 are still high, exceeding 6 ft/sec. The dominant substrates in Zones 6 and 7 are small boulders and large cobbles. This habitat area was observed to be used by adult rainbow trout for foraging during snorkel surveys conducted by NPS biologists (NPS 2013).

Post-Project Habitat Conditions

Zone 1: The mouth of Stetattle Creek (Zone 1) would be moderately altered in terms of habitat conditions as a result of the cobble bar excavation. The upper end of the mouth below the bridge would be expected change from plunge-pool tail-out habitat to run habitat after the excavation of the cobble bar. Substrates in this upper section of the mouth (Zone 1a) would continue to be dominated by cobbles and large gravels. Depth and velocities would be expected to be similar to those observed under existing conditions. The lower end of the stream mouth (Zone 1b) would become a transition zone between the riverine riffle habitat formed in the reservoir above the confluence of Stetattle. The mean depth of Zone 1b is predicted to be 2.7 ft under low generation flows and 4.7 ft under high generation flows. A mean velocity of 1.6 ft/sec is predicted under low generation flows and a mean velocity of 4.9 ft/sec is predicted under high generation flows. Substrates at the mouth would be expected to remain similar to those observed under existing conditions, consisting of primarily cobbles and large gravels. Hence, the lower section of the mouth of Stetattle Creek would remain riffle habitat but would have riverine rather than stream characteristics.

Zones 2 and 3: Excavation of the cobble bar would convert the ephemeral side channel habitat found in Zone 2 and backwater side channel habitat currently found in Zone 3 to riverine riffle habitat. This area would become a mixing zone for water flowing out of Stetattle Creek with free-flowing reservoir water originating from the Diablo Powerhouse. For this reason, Zones 2 and 3 would be expected to possess both stream and riverine characteristics, resulting in heterogeneous aquatic habitats, a condition that is particularly valuable for fish and invertebrates. Zones 2 and 3 would become an aquatic habitat transition area that has ecological characteristics similar to those found at the confluence of Stetattle Creek and Gorge Lake under current conditions. Zone 2 would be expected to become riffle habitat, while Zone 3 would be expected to become run habitat. Mean depths in Zones 2 and 3 under low generation flows (1,400 cfs) would be expected to be 2.6 and 6.1 ft, respectively. Under high generation flows, average depths in Zones 2 and 3 would be expected to be 4.0 ft and 7.0 ft, respectively. Average velocities in Zone 2 would range from 1.7 to 4.9 ft/sec from low to high generation flows, with lower velocities (< 2 ft/sec) found along and within the woody structures that would be placed along the banks for habitat mitigation. Average velocities in Zone 3 would range from 1.0 to 4.3 ft/sec for low and high generation flows, respectively. Lower velocities would be found along the bank where habitat mitigation structures would be placed.

Zone 4: The newly formed channel at the former location of the dry cobble bar (Zone 4) would have an average depth of 3.0 ft and average velocity of 1.8 ft/sec under low generation flows of 1,400 cfs. Under high generation flows of 6,900 cfs, this newly formed channel section would have an average depth of 4.7 ft and average velocity of 5.2 ft/sec. Based upon substrates observed in similar habitat found at the lower end of the Stetattle Creek mouth, dominant substrates in the newly formed channel area would be cobbles and large gravels. Given the 1.1% channel gradient of this habitat zone following excavation, this newly formed habitat zone would be best classified as a deep riffle with an area of 1.06 acres.

Zone 5: The gravel bar area located along the right bank of the river immediately upstream of the confluence of Stetattle Creek (Zone 5) would be expected to downcut following excavation, becoming a riverine riffle. Under post-project conditions, average depths in this gravel bar habitat would be expected to 2.3 ft under low generation conditions (1,400 cfs) and 4.7 ft under high generation flows (6,900 cfs). Mean velocities in this Zone 5 would be 1.3 ft/sec under low generation flows and 4.5 ft/sec under high generation flows. Substrates in this zone would continue to be dominated by small cobbles and large gravels following excavation of the cobble bar.

Zones 6 and 7: Flows from Diablo Powerhouse and Stetattle Creek are currently confined to a narrow channel (Zones 6 and 7) located between to the cobble bar and a bedrock wall located along the left bank of the reservoir. Under normal operating conditions, this channel has an average width of about 135 ft. Following completion of proposed cobble bar excavation, the flows will spread out over a much wider channel area. This new channel would average 250 ft in width. Velocities would be substantially lower in the rapids habitat adjacent to the cobble bar (Zone 6) and the deep run located immediately downstream of the rapids (Zone 7) under post-project conditions. This reduction in velocities would result from the expansion of this free-flowing section of the river from an average width of 135 ft under current conditions to 250 ft under post-project conditions. Under post-project conditions, mean velocities in Zone 6 would be expected to be 2.2 ft/sec under low generation flows (1,400 cfs), and 5.8 ft/sec under high generation flows (6,900 cfs). Mean depths in Zone 6 would be 4.1 ft under low generation flows, and 5.6 ft under high generation flows. Rapids created by hydraulic jump (i.e., standing waves formed by supercritical velocities) would no longer be present in this zone following excavation of the cobble bar, since velocities throughout most of the Zone 6 would substantially lower than those occurring under existing conditions. Substrates would be expected to remain dominated by small boulders and large cobbles. For this reason, Zone 6 would be best characterized as riverine run habitat under post-construction conditions.

Mean velocities in the deep run (Zone 7) would be 1.3 ft/sec under low generation flows and 5.2 ft/sec under high generation flows. Mean depths in Zone 7 would be 8.4 and 9.3 ft under low and high generation flows, respectively. This zone would continue to provide deep run habitat under post-project conditions, but with velocities that were more suitable for rainbow trout and juvenile bull trout.

A comparison of aquatic habitat conditions within the cobble bar excavation project site for existing and post-project conditions shows that there will be a net gain in aquatic habitat following completion of the project (Table 1). The proposed excavation project (Alternatives B, C, and D) would increase total aquatic habitat at the project site from 2.93 acres to 4.46 acres, which represents a net increase of 1.53 acres of aquatic habitat from existing conditions. The greatest gain in aquatic habitat would occur from the inundation of the dry cobble bar (Zone 4) following excavation. This would result in a 1.08 acre gain in riverine riffle habitat. An additional 0.21 acres of aquatic habitat would be created by the proposed project by the excavation and subsequent year-round inundation of the ephemeral side channel (Zone 2), which is dry most of the year under existing conditions. Additional riffle habitat would be created by downcutting and inundation of the dry gravel bar located in Gorge Lake immediately upstream of the confluence of Stetattle Creek (see Figure 1). Downcutting of this cobble bar would increase riffle habitat in Zone 1 (lower section) by 0.03 acres and in Zone 5 by 0.11 acres. Finally, excavation of the backwater side channel area (Zone 3) would increase run habitat in this zone by 0.12 acres.

Table 1. Summary of aquatic habitat types under existing and post-project conditions for cobble bar excavation project site. Habitat areas provided below are for normal reservoir operating and average Stetattle Creek outflow conditions. Range and mean depths and velocities are based on low (1,400 cfs) and high (6,900 cfs) generating flows. Mean velocities and depths for Zones 2 through 7 calculated from HEC-RAS hydraulic model output data.

		Existing Conditions				***Post-Project Conditions***			
Zone	**Description**	**Habitat Type**	**Wetted Area (acres)**	**Mean Water Depth (ft)**	**Mean Velocity (ft/sec)**	**Habitat Type**	**Wetted Area (acres)**	**Mean Water Depth (ft)**	**Mean Velocity (ft/sec)**
1a	Stetattle Creek Mouth (upper section)	Tributary Mouth Pool Tail and Run	0.24	1.4-2.1[a]	0.7-1.5[a]	Tributary Mouth Run	0.24	No Data	No Data
1b	Stetattle Creek Mouth (lower section)	Tributary Mouth Riffle	0.19	1.2-1.5[a]	1.2-2.0[a]	Riverine Riffle	0.24	2.7-4.7	1.6-4.9
2	Ephemeral Side Channel	Ephemeral Stream Riffle	0.00	NA	NA	Tributary Confluence Riffle	0.21	4.0	1.7-4.9
3	Backwater Side Channel	Reservoir Backwater	0.38	1.9[b]	0.0[c]	Tributary Confluence Run	0.48	7.0	1.0-4.3
4	Cobble Bar	Dry alluvial bar	0.00	NA	NA	Riverine Riffle	1.06	3.0-4.7	1.8-5.2
5	Gravel Bar above Stetattle Creek	Riverine Riffle	0.45	0.7-1.1	0.5-2.3	Riverine Riffle	0.56	2.3-4.7	1.3-4.5
6	Rapids adjacent to Cobble Bar	Riverine Rapids	1.08	3.4-4.0	5.0-14.2	Riverine Run	1.08	4.1-5.6	2.2-5.8
7	Deep Run below Rapids	Riverine Run	0.59	9.7-10.2	2.0-9.1	Riverine Run	0.59	8.3-9.4	1.3-5.2
Total			***2.93***				***4.46***		

a – Range of depths and velocities for existing conditions collected in field from SCL cross sections during low (75 cfs) and high (265 cfs) streamflow conditions

b – Depth collected in field by NPS (2013) at normal reservoir elevation

c – Velocity determined to be 0.0 due to zero cfs flow though side channel under low to average Stetattle Creek outflow conditions

Expected Effects on Aquatic Invertebrate Habitat
In addition to increasing total aquatic habitat area from 2.93 to 4.46 acres (Table 1), the proposed excavation project (Alternatives B, C, and D) will change the composition of aquatic habitat present at the excavation project site. This change is expected to have a net beneficial effect on the aquatic invertebrate community within the project area. Several habitat types present within the excavation project area, including tributary confluence riffle and run habitat, and riverine riffle and run habitat, are expected to substantially increase in area following completion of the proposed project (Figure 2).
Riffle habitats are typically the most productive and diverse habitats for aquatic invertebrates in streams and rivers (Hynes 1970; Minshall 1984). Macroinvertebrates have been found to be most abundant and taxonomically diverse in gravel and cobble substrates which have moderate velocities and relatively shallow depths found in riffles and runs (Minshall 1984; Jowett 2003).

The greatest increase in riffle habitat would occur when the existing cobble bar (Zone 4), which is dry throughout most of the year under normal reservoir operating conditions, is converted into a large riverine riffle. The 1.06 acre riffle would be expected to support a diverse and productive invertebrate community based upon the small cobble and large gravel substrates that would remain in this area following construction and based upon the moderate velocities and depths predicted in this area under post-project conditions. Total riverine riffle habitat would increase by a factor of 4.3 under post-project conditions compared to existing conditions (Figure 2).

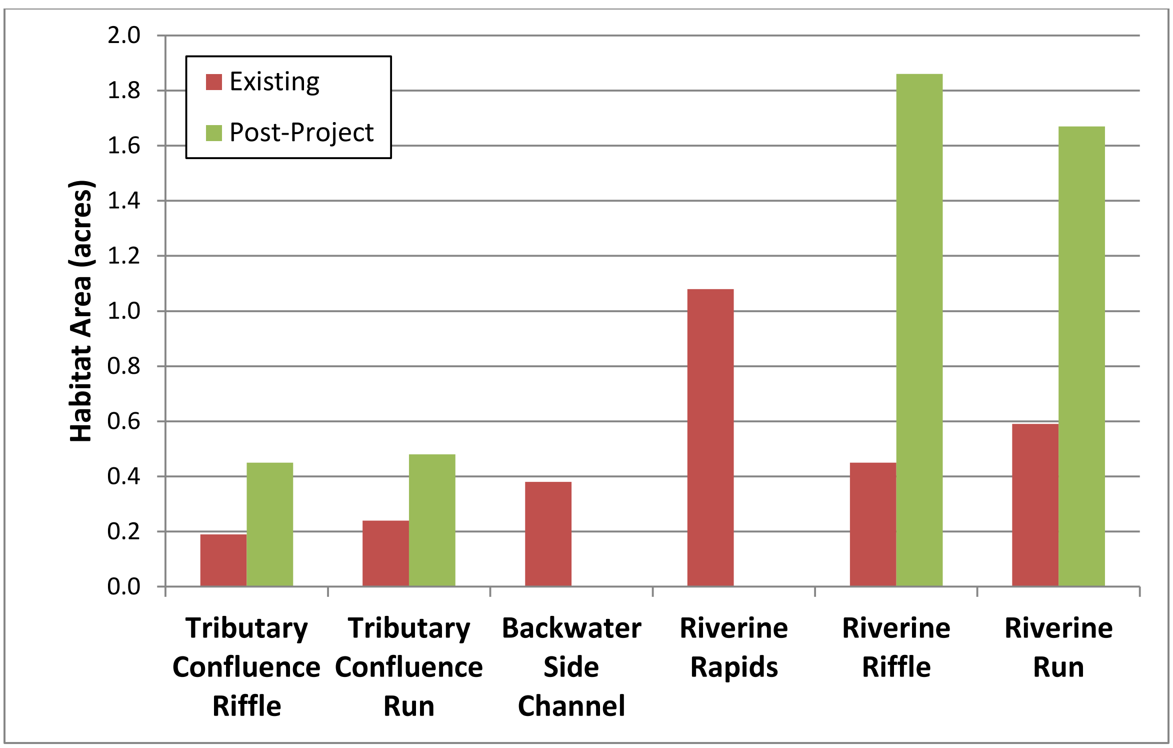


Figure 2. Comparison of aquatic habitat composition at cobble bar excavation project area under existing and post-project conditions.

The stream riffle and run habitat found at the mouth of Stetattle Creek is assumed to contain a highly productive and diverse aquatic invertebrate assemblage under existing conditions. While the upper section of this area (Zone 1a) would remain tributary mouth run habitat, the lower section (Zone 1b) would be converted to riverine riffle habitat following completion of the proposed project. This area would be still be expected to support a productive and diverse macroinvertebrate community following completion of the cobble bar excavation project but would be different in taxonomic composition since most flows in this zone would originate from the Diablo tailrace instead of Stetattle Creek.

The highly productive stream-river mixing zone found in Zone 1 under current conditions would occur in Zones 2 and 3 under post-project conditions. These areas would be converted to riffle and run habitat following completion of the proposed project with much of the flow in these two areas originating from Stetattle Creek. Thus, the most productive and diverse habitat area for aquatic macroinvertebrates within the project site (i.e., the tributary confluence where stream and reservoir waters mix) would shift from Zone 1 (Stetattle Creek mouth) under existing conditions to Zones 2 and 3 under post-project conditions. The productivity and diversity of the aquatic invertebrate assemblage in Zones 2 and 3 would be further improved by large wood structures and riparian vegetation placed along the banks of these habitat areas as mitigation measures. We are proposing to add large wood structures, including root wads, along the river bank in Zones 2 an 3 to provide complex cover habitat for juvenile bull trout, and to reduce velocities of the channel along the bank to those that suitable for these fish. These large wood structures would also provide a large surface area for aquatic invertebrates to inhabit.

Two aquatic habitat types – riverine rapids and reservoir backwater side channel habitat – will be greatly reduced in area by the cobble excavation project (Figure 2). The rapids habitat found in Zone 6 likely supports a less productive and diverse aquatic invertebrate assemblage than the run habitat that will be occur in this area after the project is completed. Aquatic invertebrate abundance and diversity is negatively correlated to areas having high shear velocities and turbulence (Brooks et al. 2005), which are evident in Zone 6 from the presence of hydraulic standing waves in this area. The run habitat formed in Zone 3 following excavation of the cobble bar would provide heterogeneous habitat conditions for aquatic invertebrates because of the presence of cobble and gravel substrates, the presence of complex wood structures, and the mixing of stream and river water. This area would be expected to support a considerably higher diversity and abundance of benthic invertebrates than the zero-velocity backwater habitat that is found within this zone under existing conditions. Consequently, the loss of the rapids and backwater habitat types within the cobble excavation area would be offset by the formation of new habitat types that support a more abundant and diverse aquatic invertebrate assemblage.

Waters in the Diablo tailrace remain cold throughout the year, and would therefore be expected to maintain a cold water dominated invertebrate community under post-project conditions. Because of the greater volumes of water originating from the Diablo tailrace in Zones 4 and 5, the forage for invertebrates would be dominated by fine particulate organic matter (FPOM) originating from Diablo Reservoir (allochthonous inputs) and periphyton (autochthonous inputs) growing on riffle substrates, rather than course particulate organic matter (CPOM) originating from leaf matter transported in Stetattle Creek. Consequently, the riverine riffle habitat created by the project would be expected to be more dominated by filter feeders, collector, and grazing macroinvertebrate feeding guilds, with reduced abundance of leaf shredding insects when compared to the macroinvertebrate community found in Stetattle Creek. Additional CPOM trapped by the habitat mitigation wood structures in Zones 2 and 3 would support a greater diversity of aquatic invertebrates, including leaf shredders and wood gougers.

Invertebrate drift densities would be expected increase in habitat zones adjacent to and downstream of Zone 4 due to the substantial increase in riffle and run habitat that would occur with the excavation project (under Alternatives B, C, and D). These increased drift densities would favor rainbow trout (>150 mm length) that are found in relatively high abundance along the low-velocity margins of Zones 6 and 7, and juvenile native char currently observed in the backwater habitat of Zone 3 by NPS (2014). Invertebrate drift produced by the stream riffle habitat in the Zone 1, the riverine riffle habitat in Zones 1 and 5, and the deep riffle habitat in Zone 4 would provide increased forage for the juvenile bull trout that would be expected to reside in Zones 2 and 3 under post-project conditions.

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