RECLAMATION

Managing Water in the West

Draft Environmental Assessment

Middle Entiat River Habitat Restoration Project

Chelan County, Washington

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Boise, Idaho

August 2017

U.S. DEPARTMENT OF THE INTERIOR

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Acronyms and Abbreviations

Action Agencies	Reclamation, Bonneville Power Administration, and the U.S. Army Corps of Engineers
BiOp	2008 FCRPS Biological Opinion
BMP	best management practice
BPA	Bonneville Power Administration
CCC	Civilian Conservation Corps
CCD	Cascadia Conservation District
CCCD	Chelan County Conservation District
CCFEG	Cascade Columbia Fisheries Enhancement Group
CCNRD	Chelan County Natural Resources Department
CCT	Confederated Tribes of the Colville Reservation
CDLT	Chelan-Douglas Land Trust
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CRC	Cultural Resource Consultants, Inc.
CSRO	Columbia/Snake Salmon Recovery Office
dBA	A-weighted decibels
dbh	diameter at breast height
DOI	Department of the Interior
DPS	Distinct Population Segment
EA	Environmental Assessment
EIS	Environmental Impact Statement
ENFH	Entiat National Fish Hatchery
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System

FCRPS BiOp	2014 Supplemental FCRPS Biological Opinion
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
FWCA	Fish and Wildlife Coordination Act
GHG	greenhouse gas
HIP III	Habitat Improvement Program III
ITAs	Indian Trust Asset(s)
JARPA	Joint Aquatic Resources Permit Application
LWM	large woody material
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA Fisheries	National Oceanic and Atmospheric Administration Marine Fisheries Service
NPCC	Northwest Power and Conservation Council
NRHP	National Register of Historic Places
NWP	nationwide permit process
OHWM	ordinary high water mark
OWNF	Okanogan-Wenatchee National Forest
PHS	Priority Habitat and Species
Project	Middle Entiat Habitat Improvement Project
RCNM	Roadway Construction Noise Model
RCW	Revised Code of Washington
Reclamation	U.S. Bureau of Reclamation
RHS	Relative Habitat Suitability
RM	river mile
RPA	reasonable and prudent alternative
RTT	Regional Technical Team
TCP	Traditional Cultural Properties
UCR	Upper Columbia River
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

USGS	U.S. Geological Survey
VS	valley segments
WDAHP	Washington State Department of Archaeology and Historic Preservation
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WDOE	Washington Department of Ecology
WQI	Water Quality Index
WSHPO	Washington State Historic Preservation Officer
YN	Yakama Nation

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Chapter 1 PURPOSE AND NEED

1.1 Introduction

The U.S. Department of Interior, Bureau of Reclamation (Reclamation) proposes to fund three local project sponsors, Cascadia Conservation District (CCD), Cascade Columbia Fisheries Enhancement Group (CCFEG), and Chelan County Natural Resource Department (CCNRD) to improve habitat for Endangered Species Act (ESA)-listed species on portions of the Entiat River in Chelan County, Washington (Figure 1-1). Reclamation has developed a design for the proposed Middle Entiat Habitat Improvement Project (Project) that is comprised of four separate project areas, each of which would be implemented by one of the three project sponsors.

The Project would enhance fish habitat along the Entiat River between river mile (RM) 16.2 and RM 20.1 through the construction of large woody material (LWM) structures and re-establishment of side channels. The Project is intended to increase the amount of suitable habitat for fish and wildlife species that utilize the Entiat River with specific focus on the needs of Upper Columbia River steelhead (UCR Steelhead) (i) and Upper Columbia River spring-run Chinook (UCR Spring Chinook salmon) (*O. tshawytscha*) which are listed as threatened and endangered, under the ESA (16 U.S.C. 1531 et seq.). These efforts would complement other habitat improvement activities already occurring throughout the Columbia River Basin that are funded through Reclamation's Habitat Program and would help mitigate for the operation of the Federal Columbia River Power System (FCRPS).

Reclamation prepared this Draft Environmental Assessment (EA) to comply with the National Environmental Policy Act (NEPA) (42 U.S. Code [U.S.C.] 4321 et seq.), which requires federal agencies to assess the effects their actions may have on the environment. This Draft EA was prepared to determine if the Project is likely to significantly affect the environment and warrant preparing an Environmental Impact Statement (EIS), or whether it is appropriate to prepare a Finding of No Significant Impact (FONSI).

This chapter provides the following information regarding the Project:

- Purpose and need of the Proposed Action.
- Background information on the Project.
- Role of entities associated with the Project.
- Summary of the public involvement process and comments received.

Figure 1-1. Middle Entiat River Habitat Restoration Project Area.

1.2 Background

Bonneville Power Administration (BPA), U.S. Army Corps of Engineers (USACE), and Reclamation (collectively referred to as the Action Agencies) consulted with the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) on effects of the FCRPS on salmon and steelhead listed under the ESA.[1] The 2014 Supplemental FCRPS Biological Opinion (FCRPS BiOp) includes hydrosystem, harvest, hatchery, predator control, and tributary and estuary habitat actions to avoid jeopardy and aid recovery of these species. Each action agency fills different roles for meeting FCRPS BiOp commitments. Reclamation works primarily, but not exclusively with BPA to meet tributary habitat commitments for the FCRPS BiOp by designing habitat complexity and floodplain connectivity projects that are constructed on tributaries of the Upper Columbia, like the Entiat River. Specific to the FCRPS, Reclamation operates and maintains water storage facilities in the Upper Columbia River system such as Grand Coulee and Hungry Horse.

Reclamation and BPA contribute to the implementation of salmonid tributary habitat improvement actions in the Columbia River Basin to help meet commitments from the 2008 FCRPS BiOp, as amended by Supplemental FCRPS BiOps in 2010 and 2014 (NOAA Fisheries 2008; 2010; 2014).[2] The FCRPS BiOp includes a Reasonable and Prudent Alternative (RPA), or a suite of actions, to protect ESA-listed salmon and steelhead across their life cycle. Habitat improvement actions in various Columbia River tributaries are one aspect of this and can be found in RPA Actions 34 and 35. Reclamation provides technical assistance to states, tribes, federal agencies, and other local partners for identifying, designing, permitting, coordinating, and providing other technical services for stream habitat improvement actions. These primarily address streamflow, habitat access, entrainment, and channel complexity limiting factors. The Department of Interior (DOI), Departmental Manual, Section 255 DM 1 grants the authority for the Habitat Program.[3]

Reclamation generally does not provide construction funding but works with project sponsors to implement habitat improvement actions. Reclamation's goal for the Columbia/Snake Salmon Recovery Office (CSRO) Tributary Habitat Program supports meeting the Action Agency's commitments in the FCRPS BiOp with special attention to RPA Action 35.[4]

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[1] The full title for the 2008 FCRPS BiOp is Consultation on Remand for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(1)(A) Permit for Juvenile Fish Transportation Program (Revised and Reissued Pursuant to Court Order, NWF V. NMFS, CIV. NO CV01-640-RE (D. OREGON).

[2] These biological opinions are available at http://www.westcoast.fisheries.noaa.gov/fish_passage/fcrps_opinion/federal_columbia_river_power_system.html

[3] See http://www.usbr.gov/recman/delegations/Delegations.pdf

[4] See http://www.usbr.gov/pn/fcrps/habitat/panels/reference/1A-RPA35Table5.pdf

Reclamation works with project sponsors and watershed partners through the local scientifically-based planning, prioritizing, and implementing processes for each subbasin.

1.3 Purpose and Need

The purpose of the Project is to restore hydraulic connectivity between the Middle Entiat River and its floodplain and improve connectivity of flows with adjacent floodplain wetlands. To fulfill this purpose, the Project seeks to re-establish connection of historic side channels and alcoves along the river and through the strategic placement of LWM along the Middle Entiat's bends and bars to direct flow into the restored side channels and alcoves and onto the floodplain. Reclamation needs to meet its obligations under the ESA (16 U.S.C. 1531 et seq.) and fulfill actions associated with RPA Action 35 of the FCRPS BiOp, as follows, "The Action Agencies will identify additional habitat projects for implementation based on the population specific overall habitat quality improvements still remaining in Table 5". The Entiat River is identified in Table 5 of RPA Action 35 as part of both the UCR Spring Chinook and UCR Steelhead Ecologically Significant Units (NOAA Fisheries 2008; 2010; 2014). RPA Action 35 also states that, "Habitat quality improvements associated with projects will be estimated in advance of project selection by expert panelist." An expert panel evaluated and provided input on habitat projects in the Columbia River Basin, including the Entiat River under the Regional Recovery Board and Regional Technical Teams (NOAA Fisheries 2008; 2010; 2014).

Relative to the Entiat River, the decline in salmonid habitat is associated with anthropogenic changes that are generally localized and have included floodplain fill, levee construction, residential development, agriculture (e.g., orchards), and timber harvesting (Andonaegui 1999; Reclamation 2009, Reclamation 2013a; 2013b). The importance of floodplain habitat for juvenile salmonids (Martens and Connolly 2014; Bellmore et al. 2012; Opperman et al. 2010) and off channel spawning habitats for adults (Roni et al. 2014) on the Entiat and other systems is important biologically for salmonid species (UCR spring Chinook salmon, UCR steelhead, and Bull Trout) as well as other native fish and floodplain-associated wildlife in the Entiat River basin. Re-establishment of natural riverine processes and a properly functioning and self-sustaining riverine floodplain ecosystem would aim to provide critical spawning, rearing, and off-channel refuge habitat for these fish species, thereby partially fulfilling RPAs associated with RPA Action 35.

1.4 Supporting Technical Studies

Previous technical studies were conducted to analyze the condition and characteristics of the Middle Entiat River and are summarized in this section. These studies were conducted as part of Reclamation's process to identify restoration opportunities throughout the Upper Columbia River Basin where habitat for UCR steelhead and UCR spring Chinook salmon could be

improved. The studies identify existing physical and biological conditions of the Entiat River that limit habitat conditions supporting UCR spring Chinook salmon and UCR steelhead, and recommend conceptual restoration actions to improve habitat. The proposed Project furthers these conceptual ideas into the 80 percent habitat restoration engineering design plans and specifications as described in Chapter 2 (Reclamation 2016a).

1.4.1 Entiat Tributary Assessment

Reclamation established its Tributary Habitat Program under authorities contained in the ESA, Fish and Wildlife Coordination Act (FWCA), and Fish and Wildlife Act as delegated from the Secretary of the Interior in Secretarial Order No. 3274 (dated September 11, 2007). Reclamation's objective for the Tributary Habitat Program is to identify projects that will improve the survival of UCR salmon and steelhead listed under the ESA, which is required as part of the tributary habitat improvement commitments under RPA Action 35 in the FCRPS BiOp. Through this program, Reclamation evaluates fish screens to make sure they meet current criteria, identifies artificial fish passage barriers that need to be replaced or removed to allow fish access to spawning and rearing areas, and looks for opportunities where instream flows can be increased and spawning and rearing habitat can be improved in selected Columbia River tributaries. Reclamation works closely with local organizations and willing private landowners and provides engineering and related technical assistance where needed to meet the Tributary Habitat Program objectives.

This Entiat Tributary Assessment (Reclamation 2009) is intended to be a summary document containing the pertinent scientific information necessary for habitat improvement planning and decision making. Reclamation's assessment focused on the lower 26 river miles of the Entiat subbasin (the upper part of the basin, managed by the Okanogan-Wenatchee National Forest was not included) with the intention of both providing the context for developing habitat improvement projects by describing the historical natural and human-induced disturbances in the basin and identifying the locations where protection and/or habitat improvement should be implemented to address the limiting factors of ESA-listed UCR steelhead and spring Chinook salmon throughout the Entiat River basin.

1.4.2 Gray and Stormy Reach Assessments

Following the completion of the Entiat Tributary Assessment, Reclamation conducted a reach-scale refinement of the information contained in that document that was intended to provide a summary of pertinent larger-scale background information and to expand upon that information at the reach scale. The Gray and Stormy Reach Assessments evaluated the two reaches of the Entiat River that comprise the proposed project area. These assessments documented the current condition of the river and how conditions have changed over time. This was then used to identify suitable habitat improvement actions necessary to address the limiting factors for

UCR spring Chinook salmon and UCR steelhead within the reach. This reach level analysis was then used to guide the early concepts for restoration activities in the Middle Entiat River. Several existing reports have documented the limiting factors for these two species and they were summarized in the order of most limiting factor to least limiting factor based on interpreted findings from those reports as they pertain to the assessment area:

1. Lack of overwintering juvenile rearing habitat attributed to losses in floodplain connection and depleted riparian zone conditions (Andonaegui 1999; CCCD 2004; Reclamation 2009).
2. Lack of instream structure, especially poor size and distribution of LWM (CCCD 2004; Andonaegui 1999; Reclamation 2009).
3. Loss of well-established riparian vegetation/buffer and lack of cover (Andonaegui 1999; Reclamation 2009).
4. Excess fine sediment has been identified as a minor limiting factor within the Entiat River as a whole (Andonaegui 1999; CCCD 2004; Reclamation 2009). This report shows that fine sediment levels fluctuate in accordance with natural conditions and do not represent a consistent or long-term concern.

1.4.3 Project Map Book

Following the development of the Entiat Tributary Assessment and the Gray and Stormy Reach Assessments that included the documentation of historical, existing, and target conditions, and potential habitat improvement actions, Reclamation led the development of Project Map Books that took the next step towards identifying appropriate habitat actions for the project area based on the cumulative information developed in the previous studies.

A small group of habitat project designers (physical scientists and engineers) familiar with the Entiat subbasin were selected to participate in the development of the Project Map Books. The early concepts illustrated in the Project Map Books were identified based primarily on geomorphic appropriateness, engineering feasibility, and risk as assessed at a reach scale. Biological benefit and priority were evaluated by a subcommittee of the Upper Columbia Regional Technical Team (RTT) also at a reach scale. In the Project Map Books, the Gray and Stormy reaches were broken into six specific project areas. Maps of each project area were used to display the locations of potential restoration actions that would be necessary to achieve the objectives identified in the Gray and Stormy Reach Assessments. The early concepts shown in the Project Map Books were the starting place for the current designs for the Project.

1.5 Roles of Other Entities

Multiple entities have been associated with the Project. Local sponsors that participated in the design process and would implement the projects include the CCD, CCFEG, and the CCNRD. Representatives from these entities are part of the project team that worked with Reclamation to develop the Project's restoration plans. Although not a local sponsor, the Chelan-Douglas Land Trust (CDLT) is part of the project team as a primary land owner where the Project would be constructed.

1.5.1 Cascadia Conservation District

The CCD is a non-regulatory political subdivision of the State of Washington that serves all of Chelan County. CCD works cooperatively with local landowners and communities to provide technical and financial assistance for soil, water, forest, fish, and wildlife conservation efforts.

1.5.2 Cascade Columbia Fisheries Enhancement Group

In 1990, the Washington State Legislature created fourteen Regional Fisheries Enhancement Group Programs intended to involve local communities, citizen volunteers, and landowners in the state's salmon recovery efforts. The CCFEG works within Chelan, Douglas, Okanogan, and Ferry counties to cooperatively facilitate fisheries enhancement projects.

1.5.3 Chelan County Natural Resource Department

The CCNRD works to addresses federal, state, and local natural resource mandates and issues. Areas of focus include water resources and timber, fish, wildlife, and agricultural activities within Chelan County and North Central Washington. The Department responds to the general policy direction of the Board of County Commissioners.

1.5.4 Chelan Douglas Land Trust

The CDLT works with local organizations, businesses, and individuals to protect natural areas, a strong economy, clean air and water, abundant wildlife, and the ability for the public to enjoy it all. CDLT is a primary land owner where many of the proposed actions for the Project would be constructed, therefore, CDLT has been an interested and active participant during the Project's design process. As a landowner, CDLT has developed an agreement with the CCNRD on the roles and responsibilities to oversee the Project actions after construction.

1.5.5 Bonneville Power Administration

As an Action Agency in the 2008 BiOp (and supplements in 2010 and 2014), BPA participated in the development of the Middle Entiat project as a project team member through the 80 percent design process. That participation included issuance of a Scoping Letter for this project on February 2, 2016, in which BPA assumed Lead Agency status for federal environmental compliance. BPA contributed to the development of the Project Map Books (see Section 1.4.3), and engaged with Reclamation and local sponsors during planning and development of the Project, including funding a portion of the engineering design, until the fall of 2016. At that point, BPA made the decision to reallocate their funding to other projects in the Upper Columbia Region. This reallocation of funding necessitated BPA's change in status from Lead Agency to no longer a participant in the Project. Due to the BiOp commitments for the Entiat River for UCR spring Chinook salmon and UCR steelhead, Reclamation decided to allocate funding to complete the planning and design for the Project along with the intent to add construction funds. This assumption of primary responsibility for funding resulted in Reclamation's becoming the Lead Agency for environmental compliance, including compliance with the NEPA, the ESA, and National Historic Preservation Act (NHPA).

1.6 Public Involvement and Issue Summary

The purpose of public involvement is to provide an opportunity for the public to learn about the Project and invite them to comment on the Project or ask questions. Input from the public is used by Reclamation to identify potential issues that would be addressed during the NEPA process. This section summarizes the public involvement process and the issues that have been identified through the process.

The project team began public involvement for the proposed Project with two Entiat Watershed Outreach meetings in Entiat, Washington that were hosted by the CCD. The first outreach meeting was held on November 20, 2014, and the second was August 26, 2015. The team also hosted a landowner meeting and Barbeque at the Stormy Preserve on June 20, 2015, where residents with property adjacent to the project area were invited to learn about the proposed Project and were given a presentation by Reclamation on the Project background and desired outcomes. At each of these meetings, information was made available to the public regarding the restoration actions being planned in the valley. The Entiat Watershed Outreach meetings were advertised in the Entiat Valley Lookout, a free newsletter distributed by the Entiat Valley Chamber of Commerce and via post cards mailed to residents of the Entiat Valley. Four landowners attended the November 2014 meeting, and 30 landowners attended the August 2015 meeting. Additionally, several meetings with individual landowners took place in the field or at CCD offices to discuss the Project.

Several people who attended the Watershed Outreach Meetings commented on the potential for the Project to affect boating in the project area. As a result, in October 2015 Reclamation led a field trip to look at the project area and evaluate potential recreation risks. Six landowners attended the field trip and provided input on structure locations.

The NEPA public scoping outreach for the Project was initiated on February 2, 2016, when a letter was sent to the public potentially interested in or affected by the Project, including adjacent landowners, public interest groups, local governments, tribes, and state and federal agencies. The letter explained the proposal, the environmental process, and how to participate. Additionally, ads were placed announcing the public scoping period in the Wenatchee World, the Lake Chelan Mirror, and in the Entiat Valley Lookout.

Two tribes were identified that have a potential interest in the Project on their historic or current use of the land in the project area: Confederated Tribes of the Colville Reservation and the Confederated Tribes (CCT) and Bands of the Yakama Nation (YN). Project information was provided to the two tribes and requested information from the consulting tribes, including information on potential cultural resources in the project area.

Eighteen entities, which included individual landowners, CCCT, and Icicle Valley Trout, responded with comments during the scoping comment period. Reclamation considered the comments in preparing this EA.

The comments are summarized below.

Project Description

There was public confusion regarding the project area map that was sent with the public scoping letters about where project implementation would occur. These comments are addressed in Section 2.2.

Alternatives

Comments were made regarding the number, size, and location of structures, the efficacy of structures to create fish habitat, and the need for restoration in the project area. There were also concerns regarding potential risks from man-made structures in the river, particularly to downstream property. This topic is addressed in Sections 2.2, 3.5, and 3.10.

Water Resources

Several comments requested evaluation of the effects from the LWM structures on bank erosion, flooding, and water temperature. There were comments expressing concern around the recent fires in the upper Entiat watershed and the potential for sediment to be transported and deposited in the project area. A comment was received during public scoping asking that the

Project comply with Chelan County's Shoreline Master Plan that regulates development within the 100-year floodplain (Chelan County Code, Flood Hazard Development, Chapter 3.20). This topic is addressed in Section 3.4.

Recreation

There were several comments requesting evaluation of potential effects to recreational boaters posed by the LWM structures. In particular, the potential of additional logs being caught on the manmade log jams and blocking the entire river. This topic is addressed in Section 3.10.

Public Safety

Comments were also received expressing concern for the potential of the LWM structures installed as part of the Proposed Action becoming loose and causing damage to people and property.

Several people commented about the potential for the side channels installed as part of the Project increasing mosquito habitat. This topic is addressed in Section 3.11.2.

Wildlife

One comment expressed concern that the excavation necessary for the side channels would affect habitat for other species. This topic is addressed in Section 3.5.2.

Fishing Rights

One comment expressed concerns about the differences in fishing rights in the Entiat River and a request to consider impacts to tribal fishing rights. This topic is addressed in Section 3.9.

Cultural Resources

The CCT requested consultation on the cultural resource process under the NHPA and expressed its concern over project impacts to cultural resources. Reclamation will be adopting the Section 106 NHPA consultation process completed by BPA; consultation is addressed in Section 3.7.

Chapter 2 PROPOSED ACTION AND ALTERNATIVES

2.1 Introduction

This chapter describes the Proposed Action and the No Action alternative. This chapter also compares the Proposed Action and the No Action alternative by the project purposes and potential environmental effects.

2.2 Proposed Action

Under the Proposed Action, Reclamation would fund and design the Project, which includes installing constructed LWM structures to enhance fish habitat, reconnecting abandoned side channels to enhance floodplain connection, and removal of a levee. Reclamation's funding of the Project would be consistent with RPA Action 35 that states Action Agencies (such as Reclamation) provide funding to implement specific habitat projects in the Upper Columbia Basin, including the Entiat River (NOAA Fisheries 2008). Once constructed, Reclamation and CCNRD would inspect and adaptively manage the LWM structures in accordance with a cooperative agreement signed by both agencies.

The proposed project is detailed in the 80 percent habitat restoration engineering design plans prepared in August 2016. The 80 percent plans were prepared through a collaborative design process that included the project team (see Section 1.5) and a design team. The design team consisted of representatives from each of the project sponsors, the CDLT, Reclamation technical staff, BPA technical staff (before the subsequent withdrawal from the project as noted in Chapter 1), the Upper Columbia Salmon Recovery Board, the U.S. Forest Service (USFS), the U.S. Fish and Wildlife Service (USFWS), NOAA Fisheries, the Washington Department of Fish and Wildlife (WDFW), and the Washington Department of Natural Resources (WDNR). The YN was also a member of the design team before Project Area A was removed from the Project as discussed in the following paragraphs. The design team provided review and comment throughout the project team's design process.

The design process followed methods for design and review as established in BPA's Habitat Improvement Program III (HIP III) BiOps (NOAA Fisheries 2013; USFWS 2013). This requires the critical review of designs at the conceptual, 15 percent, 30 percent, and 80

percent design junctures. This also requires the application of General Aquatic Conservation Measures (BPA 2016) to ensure that design and construction result in predictable and minimal short-term effects. The design also followed Reclamation's Large Woody Material Risk Based Design Guidelines (Reclamation 2014). This methodology is used to evaluate watershed-level, reach-level, and site-level characteristics in a risk-based design approach for the placement and design of LWM. Risk was evaluated for public safety and property damage and the resulting level of risk and risk tolerance then informed the stringency of the planning and design. The design team utilized the HIP III and Risk Based Design Guidelines in the design process to develop a post-project condition that improves access to spawning and rearing habitat and improve habitat quantity and quality for the UCR spring Chinook salmon and UCR steelhead. These post project benefits are considered an element of the Proposed Action and would be accomplished through the construction of the habitat improvement elements described in this Chapter. The Proposed Action includes construction observation and post-construction inspection (Section 2.2.3) as measures to support the intended habitat benefits of the project. Projects are scheduled to be constructed in 2019 (Areas B and E) and 2020 (Areas C and F) based on Reclamation's current known funding structure.

The proposed project would be implemented at four proximate project areas (B, C, E, and F) between RM 16.2 and RM 20.1 (Figure 2-1 through 2-4). The most downstream location would occur approximately 16.2 river miles from the town of Entiat, Washington and the Columbia River. In Reclamation's Reach Assessments this stretch of the Entiat River was divided into two reaches: the Stormy Reach and the Gray Reach. In the Project Map Books, each reach was divided into three project areas: Project Areas A, B, and C in the Stormy Reach and Project Areas D, E, and F in the Gray Reach. During project planning, Project Areas A and D were dropped from inclusion in this project, resulting in only four current project areas (B, C, E, F). Project Area A is being pursued by a separate entity (YN) using a separate design process, schedule, separate environmental compliance process and lead agency, and would utilize construction funding from a different source. Project Area D encountered landowner issues, and has been halted for the foreseeable future. If and when the landowner issues are resolved, Project Area D may become active again. Any future construction of Project Area D would occur after completion of the current project. Each of the project areas and the actions that would occur there are described in Section 2.2.1.

The proposed project is comprised of both habitat improvement actions and actions that are necessary to facilitate construction. Habitat improvement actions would include installation of LWM structures and side channel logs, enhancement of side channels, and levee removal, as described in Section 2.2.2. Construction elements would include staging areas, helicopter flights, access routes, river crossings, vibratory pile driving, side channel excavation, construction observation, and post-construction inspection, as described in Section 2.2.3.

2.2.1 Project Areas

Project Area B is located between RM 20.0 and RM 19.4 (Figure 2-1). The Chelan County Department of Natural Resources would implement this project on land owned by the Chelan Douglas Land Trust. Project features proposed for Area B are summarized in Table 2-1 and shown on Figure 2-1. The main focus of work in this project area is the removal of a levee at RM 19.8, known locally as the Bremmer Levee. The levee was constructed from on site material in the early 1970s by the local landowner to protect the adjacent hay field from river erosion. The growing of hay has been abandoned and the levee is no longer maintained.

Twenty-four LWM structures would be constructed to provide habitat complexity and encourage channel migration and erosion of the area currently occupied by the levee within the project reach. The open field in Project Area B would be used as a large wood staging area. Logs would be transported to the staging area using trucks and then would be lifted and delivered to the individual LWM structure construction sites using a helicopter. (Helicopters would be used to deliver all logs to the LWM structure sites, however, once delivered to the construction site, the LWM structures would either be constructed by ground-based equipment, or by the helicopter, as described in Sections 2.2.2 and 2.2.3.)

Side channel enhancement on river right would include 71 linear feet of excavation of an inlet and outlet to introduce seasonal flows into an existing side channel. This action would improve low-flow winter connectivity and would allow for the migration of the main channel through this area in response to the removal of the levee from river left. Dump trucks would haul the excavated material to legal disposal or placement at offsite locations. The number of dump truck trips would depend on the size and type of equipment the contractor decides to use to complete the project (see Section 3.13 for analysis of expected number of truck trips).

Nineteen of the 24 LWM structures are considered primary and secondary structures and would be constructed by ground-based equipment. Five structures would be constructed using helicopters to reduce impacts associated with ground equipment. One wet crossing would be needed at the upstream end of the project area to allow two pieces of equipment to cross the river and install a LWM structure on river right. One temporary bridge would be installed to allow four to six pieces of construction equipment to cross the river to install two LWM structures and excavate the side channel enhancement inlet/outlet. Temporary access routes would be used to allow machines and equipment to access the river. Revegetation would occur within the temporary access and staging areas, and within the greater floodplain area that had been cleared by humans for the relict hay field.

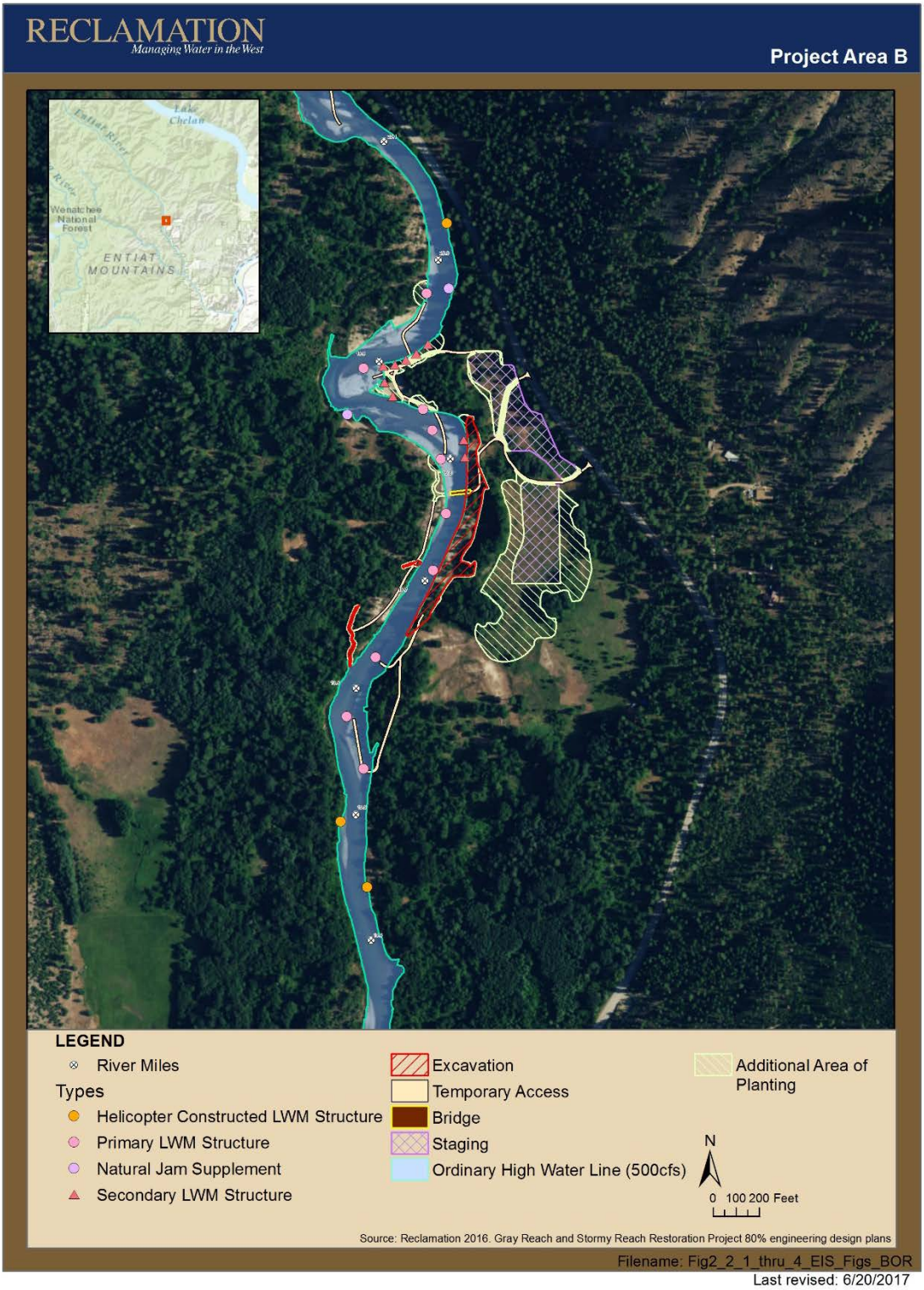

Figure 2-1. Project Area B.

Table 2-1. Project Area B summary of activities.

Activities*	River Mile/River Bank	Quantities:
Levee removal/spoil transportation	RM 19.8-19.65/left	1,000 linear feet of levee removal; 9,530 cubic yards of off-haul.
Side channel enhancement	RM 19.7 – 19.6/right	71 linear feet of excavation; 110 cubic yards of off-haul; 600 linear feet of side channel development;
Primary LWM structures (apex, deflector, and meander)	RM 19.9 – 19.45/right and left	10
Secondary LWM structures (bank enhancement and side channel structures)	RM 19.9 – 19.8/left	9
Natural jam LWM supplement	RM 20.0 and RM 19.9/right and left	2
Helicopter-constructed structures	RM 20.0/left	3
River crossing/temporary bridge	RM 19.7/NA	1
River crossing/wet crossing	RM 19.9/NA	1
Riparian plantings	Throughout	13,931 individual plants
Temporary access and staging	Throughout	4.8 acres
*See Sections 2.2.2 and 2.2.3 for a description of habitat improvement actions and construction elements.		

Project Area C is located between RM 18.6 and RM 18.2 (Figure 2-2). The CCFEG would implement the work in Project Area C on land owned by the CCLT known as the Stormy Preserve. Project features proposed for Area C are summarized in Table 2-2 and shown on Figure 2-2. In Project Area C, 15 LWM structures would be constructed by ground-based equipment to enhance habitat complexity and encourage geomorphic response, and an additional 10 individual logs would be placed by helicopter in an existing alcove and at the confluence of Stormy Creek to provide cover for aquatic and terrestrial species. An alcove is a natural off-channel aquatic habitat that can be seasonally or permanently connected by water to the Entiat River. Alcoves are “dead end” channels that do not have an outlet and therefore are not considered channels with water that flows through and inlet and outlet from the river.

A new channel would be excavated to encourage the Entiat River to flow away from the Entiat River Road and towards river right. The channel would be excavated across an exposed gravel bar and would be approximately 300 feet long and 30- to 60-feet wide. The excavated gravel would be placed on the adjacent gravel bar and incorporated into two proposed LWM structures.

Three river crossings would be needed to allow equipment to cross the river and install LWM structures. One temporary bridge would be installed to allow construction equipment to cross to the gravel bar where the new channel would be excavated. Two wet crossings would occur to facilitate construction of LWM structures on river right. Two staging areas for construction equipment would be sited within Area C. One staging area would be at a pullout along Entiat River Road and a second staging area would be located at the Stormy Preserve. Temporary access routes would be used to allow machines and equipment to access the river. The staging area within Project Area B would be used to stage large wood and helicopters to deliver the wood directly to structure sites in Area C. Revegetation would occur within the temporary access and staging areas, and within the greater Stormy Preserve floodplain area that had been cleared by humans for the relict hay field following construction.

Figure 2-2. Project Area C.

Table 2-2. Project Area C summary of activities.

Activities	River Mile/River Bank	Quantities
New channel construction	RM 18.55/left	300 linear feet of excavation; 225 cubic yards spoiled onsite.
Primary LWM structures (apex, deflector, and meander)	RM 18.65 – 18.35/right and left	8
Secondary LWM structures (bank enhancement and side channel structures)	RM 18.75 – 18.35/right and left	7
Alcove logs	RM 18.3/right	10
River crossing/temporary bridge	RM 18.55/NA	1
River crossing/wet crossing	RM 18.50 and 18.35/NA	2
Riparian plantings	Throughout	4,083 individual plantings
Temporary access and staging	Throughout	0.9 acres
*See Sections 2.2.2 and 2.2.3 for a description of habitat improvement actions and construction elements.		

Project Area E is located between RM 17.4 and RM 16.9 (Figure 2-3). The CCD would implement the work at Project Area E on privately-owned land. Project features proposed for Area C are summarized in Table 2-3 and shown on Figure 2-3. Eight LWM structures would be installed to encourage geomorphic response and enhance habitat complexity. The majority of these structures would be constructed using ground-based equipment, with one constructed using a helicopter to reduce impacts associated with ground equipment. An additional 18 individual logs would be placed by helicopter in an existing alcove to provide cover for aquatic and terrestrial species. An existing bermed access road that enters the site from the Entiat River Road would be excavated to create a vehicle ford. This action would remove soil that acts as a barrier to flows and fish within an existing side channel while allowing continued vehicle access to the private property.

A staging area would be located in a non-vegetated area between the river and Entiat River Road, and a temporary access route would be used to allow machines and equipment to access the river. Wood staging for helicopter delivery would occur offsite. Revegetation would occur within the temporary access and staging areas.

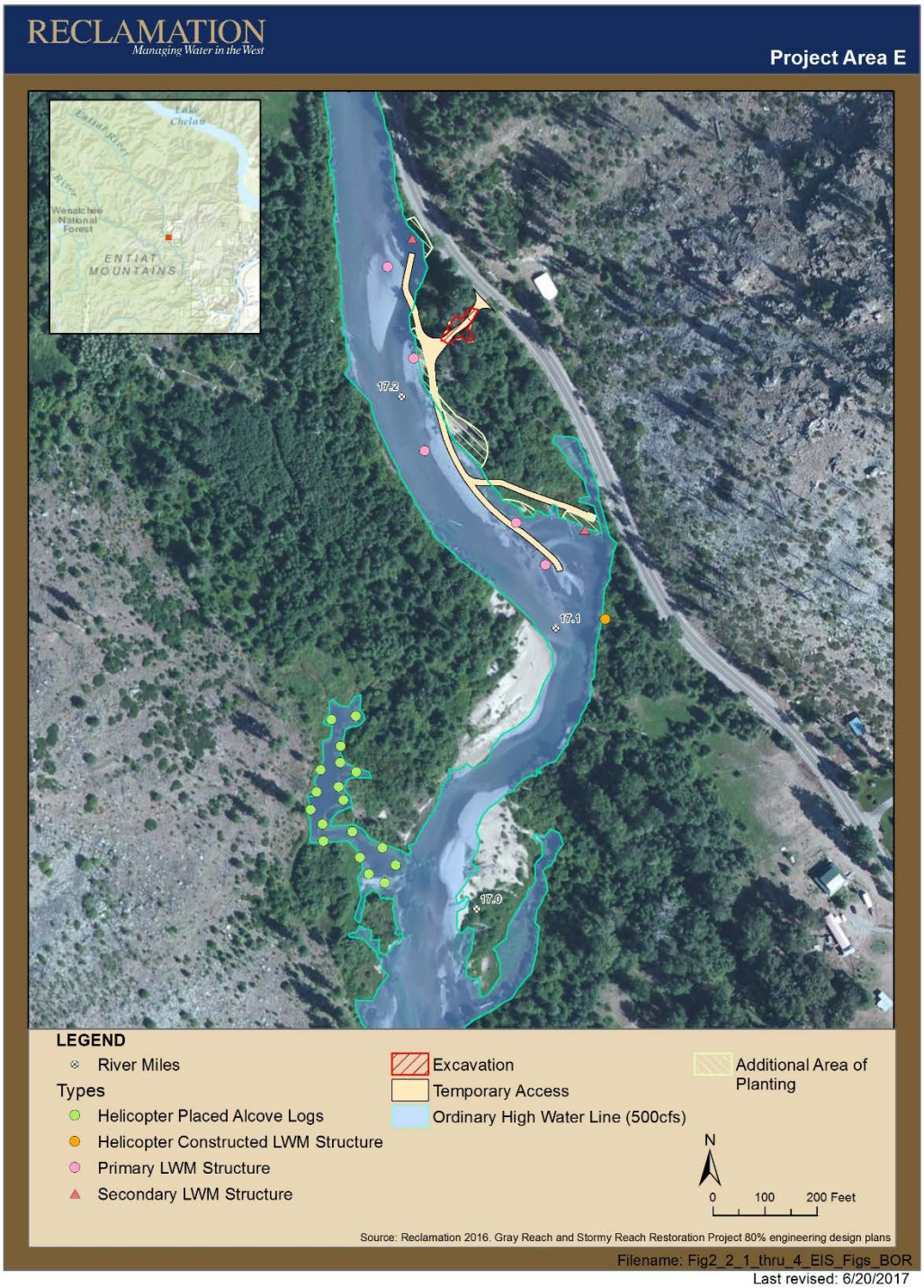

Figure 2-3. Project Area E.

Table 2-3. Project Area E Summary of Activities.

Activities	River Mile/River Bank	Quantities
Side channel enhancement/ford installation	RM 17.2/left	76 linear feet of excavation; 96 cubic yards of material spoiled offsite; 335 linear feet of side channel development;
Primary LWM structures (apex, deflector, and meander)	RM17.25 – 17.1/left	5
Secondary LWM structures (bank enhancement and side channel structures)	RM17.25 – 17.1/left	2
Alcove logs	RM 17.0/right	18
Helicopter-constructed structures	RM 17.1/left	1
Riparian plantings	Throughout	431 individual plantings
Temporary access and staging	Throughout	0.5 acres
*See Sections 2.2.2 and 2.2.3 for a description of habitat improvement actions and construction elements.		

Project Area F is located between RM 16.7 and RM 16.15 (Figure 2-4). The CCD would implement the work at Project Area F on both privately-owned land and land owned by CDLT. Project features proposed for Area F are summarized in Table 2-4 and shown on Figure 2-4. Nine primary and 30 secondary LWM structures would be installed throughout the reach to enhance habitat complexity. Of the 30 secondary LWM structures, 12 side channel LWM structures and an additional 9 side channel logs would be installed within the proposed side channel elements. At the upstream end of the project area, two inlets would be excavated on river right to improve floodplain connectivity to an existing complex of side channels, to provide high-flow refuge habitat for juvenile salmon and steelhead. An existing outlet would be excavated to allow surface water that has entered in the upstream inlets to return to the river. The excavated material at one inlet area would remain on site and placed on a nearby upland area. Material from the second inlet area and the outlet would be transported off site.

Farther downstream, also on river right, a side channel excavation would establish a perennial side channel, which is a side channel that would have water flowing through it year-round. At the downstream end of Project Area F on river left, a parcel of land recently purchased by CDLT would be converted, through removal of fill, from a property that was once a private residence with maintained lawn, into an excavated network of side channels and alcoves that would provide approximately five acres of low-velocity, year-round, temperature-regulated rearing habitat for juvenile salmon and steelhead. Habitat logs would be placed to enhance juvenile-rearing habitat and habitat for terrestrial species.

One wet crossing would be needed to allow equipment to cross the river and excavate the most upstream inlet. Two temporary bridges would be installed. One temporary bridge would allow equipment to access river right to excavate the second inlet and the outlet and allow haul trucks to carry material back to river left and off site. A second temporary bridge would allow equipment to access river right to construct the year-round side channel and allow haul trucks to carry material back to river left and off site. One staging area would be located at the recently purchased CDLT property. Wood staging would occur offsite. Temporary access routes would be used to allow machines and equipment to access the river. Revegetation would occur within the temporary access and staging areas and would occur throughout the side channel enhancement areas. Revegetation would also occur within the greater floodplain areas directly adjacent to the side channel enhancement areas that were cleared by humans in the past.

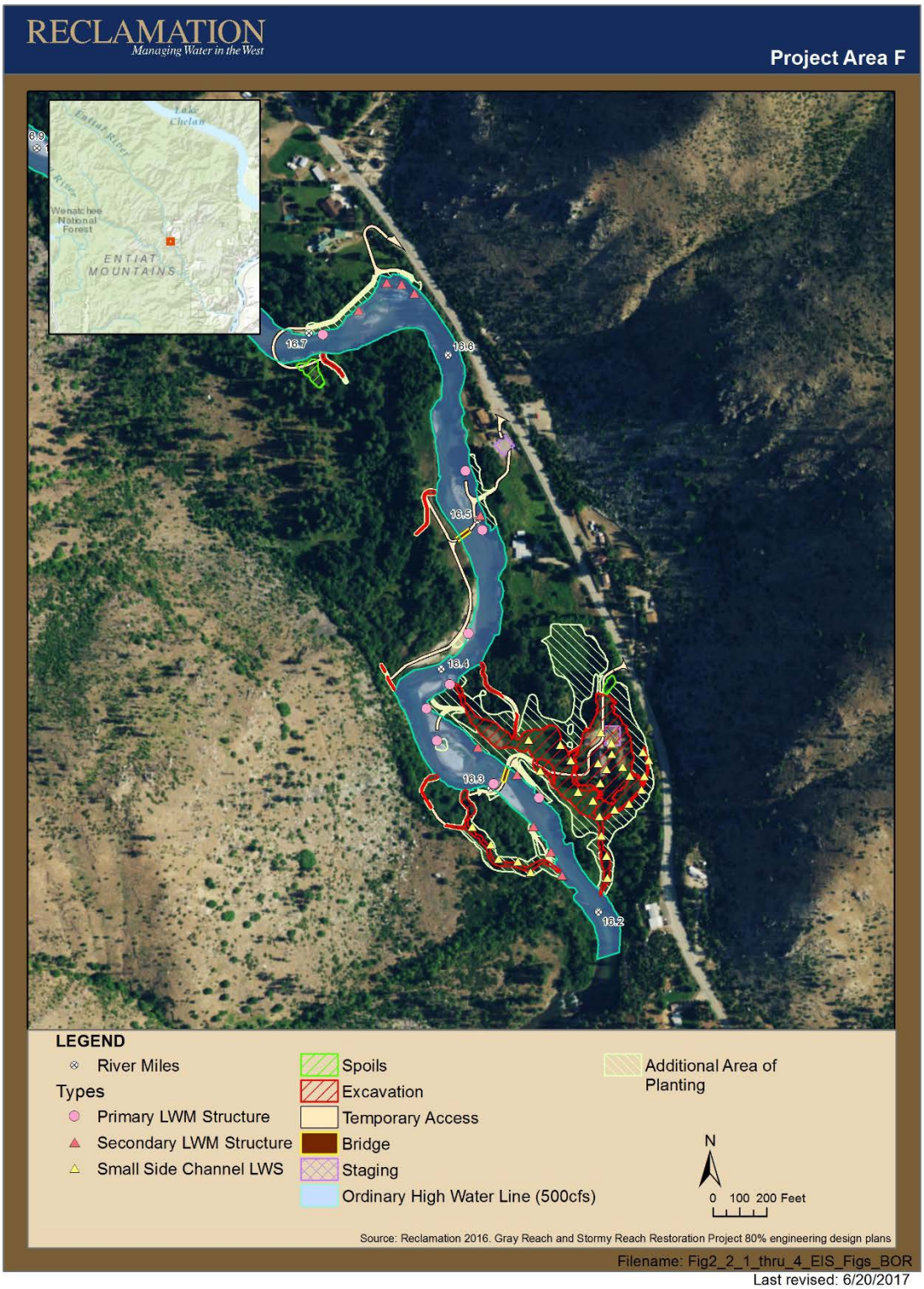

Figure 2-4. Project Area F.

Table 2-4. Project Area F summary of activities.

Activities	River Mile/River Bank	Quantities
Side channel enhancement	RM16.7 – 16.2/left and right	4,245 linear feet of side channel development, 4,541 cubic yards of material spoiled offsite; 100 cubic yards spoiled onsite.
Fill and floodplain bench removal	RM 16.2/left	6,260 cubic yards of material spoiled offsite.
Primary LWM structures (apex, deflector, and meander)	RM 16.7-16.25/left and right	9
Secondary LWM structures (bank enhancement and side channel structures)	RM 16.6 – 16.25/left and Right	30
Side channel logs	Rm 16.3 – 16.2	9
River crossing/temporary bridge	RM 16.5 and RM 16.3/NA	2
River crossing/wet crossing	RM 16.7	1
Riparian plantings	Throughout.	13,848 individual plantings
Temporary access and staging	Throughout	2.3 acres.
*See Sections 2.2.2 and 2.2.3 for a description of habitat improvement actions and construction elements.		

2.2.2 Habitat Improvement Actions

LWM Structure Types

A total of 86 LWM structures would be installed to provide biological benefits to native fish either by directly creating suitable habitat or through the geomorphic processes that would result from the Entiat River and the LWM structures interaction. The LWM structures consist of multiple logs placed together. Different types of structures would be installed in each project area, each with specific hydraulic and biological objectives depending on the structure type and location. Structures are designed to be "low-profile" to reduce visual impact and would be overtopped by flood waters during large flood events. All of the LWM structures would be wetted during seasonally high flows to direct flows into side channels, split flows, and encourage lateral channel migration (see text below for description of the different type of structures). As flows recede during summer and into fall months, portions of the structures would be above water line. In some cases, during lowest flows, entire structures may become unwetted, similar to natural conditions.

The only structural connections used to secure logs used in LWM structures would be threaded bolts that "pin" logs to one another. For helicopter constructed LWM Structures, short lengths of chain would be used to create "rock collars" used to create ballast intended to secure logs. In addition to the LWM structures, a total of 37 individual logs would be placed within side channel areas to enhance cover for aquatic and terrestrial species. No anchoring or pinning of these logs would occur. Logs for the wood structures would be commercially procured prior to construction by contractors hired by the project sponsors and would follow the necessary permits and approvals for this activity.

Primary LWM structures (Figure 2-5 and Figure 2-6) are the largest type of LWM structures and have different purposes based on where they are located. When installed mid-channel they would split river flows to either side of the structure and increase scour on the river bottom adjacent to and immediately upstream of the structure. The size of the structure would create areas of slow moving water, or eddies, behind it that would allow for the deposition of material just downstream. When Primary LWM structures are placed nearby or opposite of side channel enhancements (see text below for a description of side channel enhancement), they would force river flows into those areas and out onto the adjacent floodplain during floods. Primary LWM structures placed on the edge of the river would create natural resistance to erosion intended to narrow the river channel, induce scour, and encourage lateral channel migration.

There are three types of primary LWM structures: apex, deflector, and meander, all which would provide in-stream habitat complexity and habitat for fish. Apex structures are located in the middle of the river and intended to develop pools and bars in the river; deflector structures are located generally along banks to deflect flow away from the bank and create habitat pools or direct stream flow into side channels; and meander structures are placed to direct flow in lateral directions to create increased channel meanders. Primary LWM structure dimensions would be between 45- to 55-feet long by 50- to 75-feet wide. They would be constructed with approximately 12 piles driven into the river bed and then interlaced with 15 to 30 logs. Piles are 25-foot long logs that are driven into the ground using an excavator-mounted vibratory pile driver. When feasible, a scour pool may be excavated in front of a structure to encourage pool formation. The excavated materials would be incorporated into the downstream side of the structure. Other smaller logs and branches, called slash, would be incorporated in front of the structure by hand or with track equipment depending on size and volume of material.

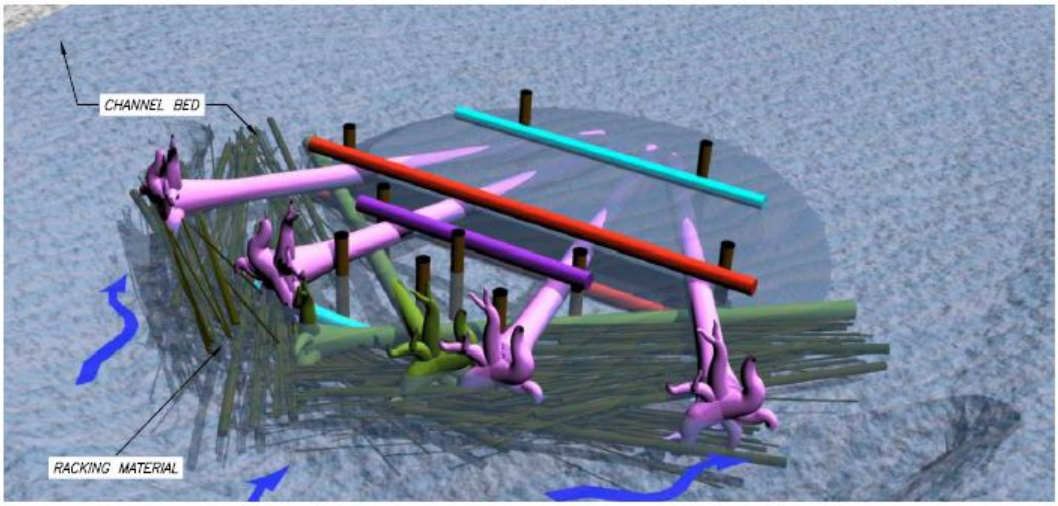

Figure 2-5. Primary LWM structures mid channel.

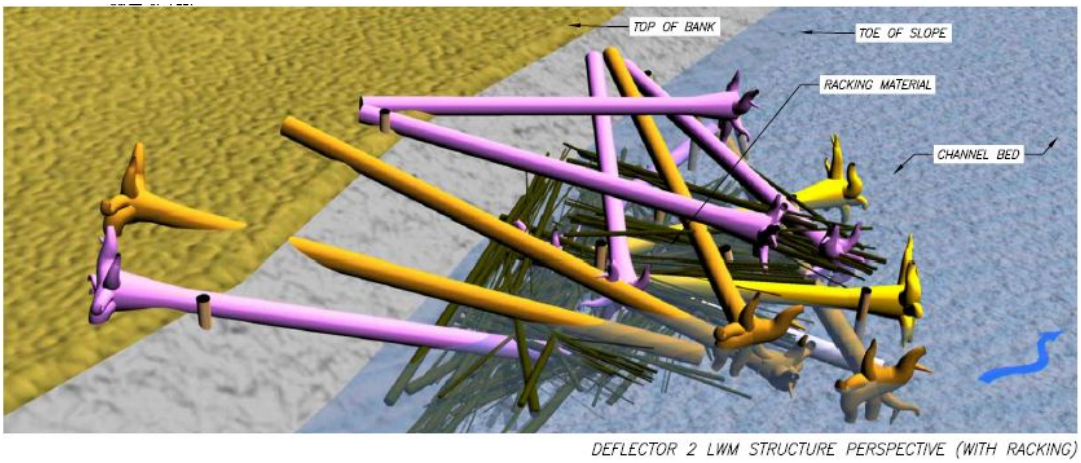

Figure 2-6. Primary LWM structures along river bank.

Secondary LWM structures (Figure 2-7and Figure 2-8) would be installed along the river's edge at the outside of bends and pool edges to provide cover and complexity for juvenile fish. The secondary LWM structures would also be placed in off-channel areas to slow floodwaters across the floodplain, provide stability, and cover in side channel habitats.

There are several types of secondary LWM structure including bank enhancement, and side channel LWM. The secondary LWM structures would range from 20-feet to 50-feet long and between 10- and 55-feet wide. The bank enhancement structures would be constructed around four to six driven piles using a vibratory pile driver. As with the primary LWM structures, logs would be laced in between the piles and secured with threaded bolts. Slash would be added on top of the structure. The side channel structures would be driven into the bank or woven within existing standing vegetation.

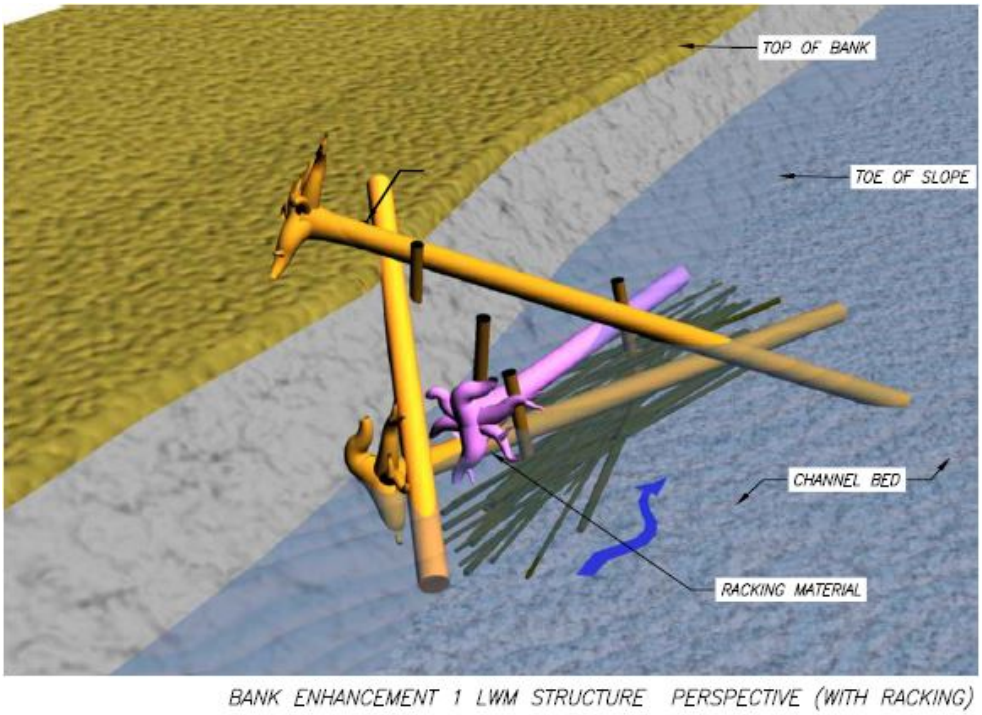

Figure 2-7. Secondary LWM structures along river bank.

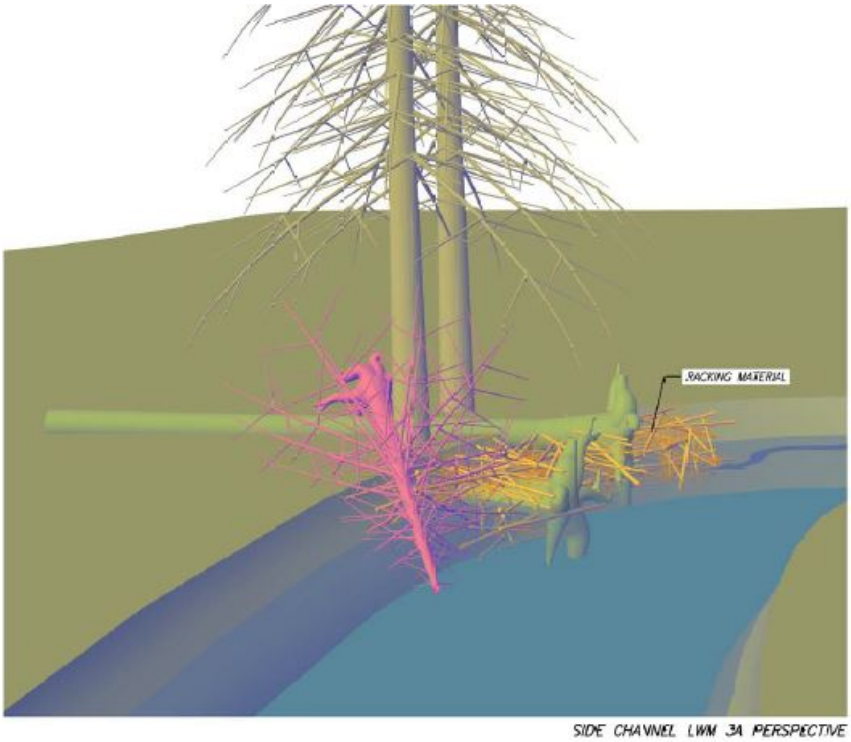

Figure 2-8. Secondary LWM structures side channel.

Helicopter-constructed LWM structures (Figure 2-9) would be installed to create habitat complexity in areas where the river is uniform and lacks structure. They are intended to produce scour needed to create pools and initiate channel migration. Some helicopter structures would also be placed along channel and pool edges to provide refuge and cover for juvenile fish similar to the secondary LWM Structures. Unlike the primary and secondary LWM structures, which would be installed using a vibratory pile driver, a helicopter would be used to place the wood, and a ground-based crew would then install pinning with rebar stakes to ensure structural stability. Rock collars would be used to anchor helicopter structures. A rock collar consists of two boulders connected by chain that are placed by the helicopter to hold the logs in place. Two rock collars would be placed on each log. Structures would consist of eight logs and be approximately 45 feet long by 30 feet wide. Additional smaller logs and branches would be layered on top to provide cover habitat. A total of four helicopter-constructed LWM structures would be constructed; three in Project Area B and one in Project Area E.

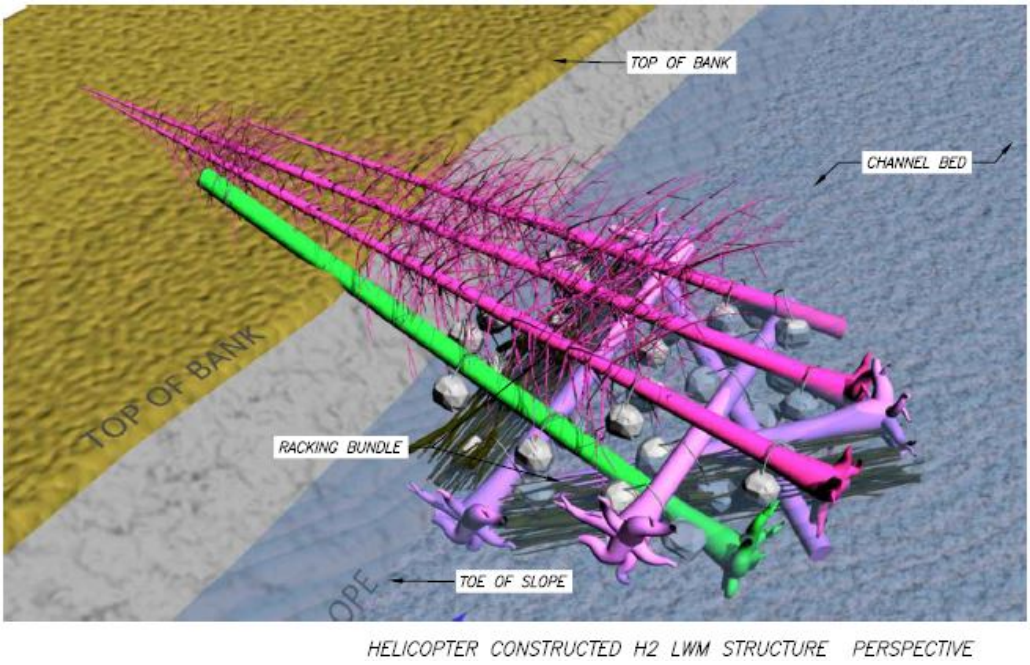

Figure 2-9. Helicopter-constructed LWM structures.

Natural jam LWM supplement (Figure 2-10) would use helicopters to supplement existing/natural large wood or boulder elements (jams) by adding large wood to increase habitat and hydraulic effectiveness. Wood and rock collar elements would be added by helicopter to avoid impacts associated with ground based equipment. Structures would vary in size and the quantity of materials based on the individual site conditions. Two natural jam LWM supplement sites would be constructed by helicopter in Project Area B.

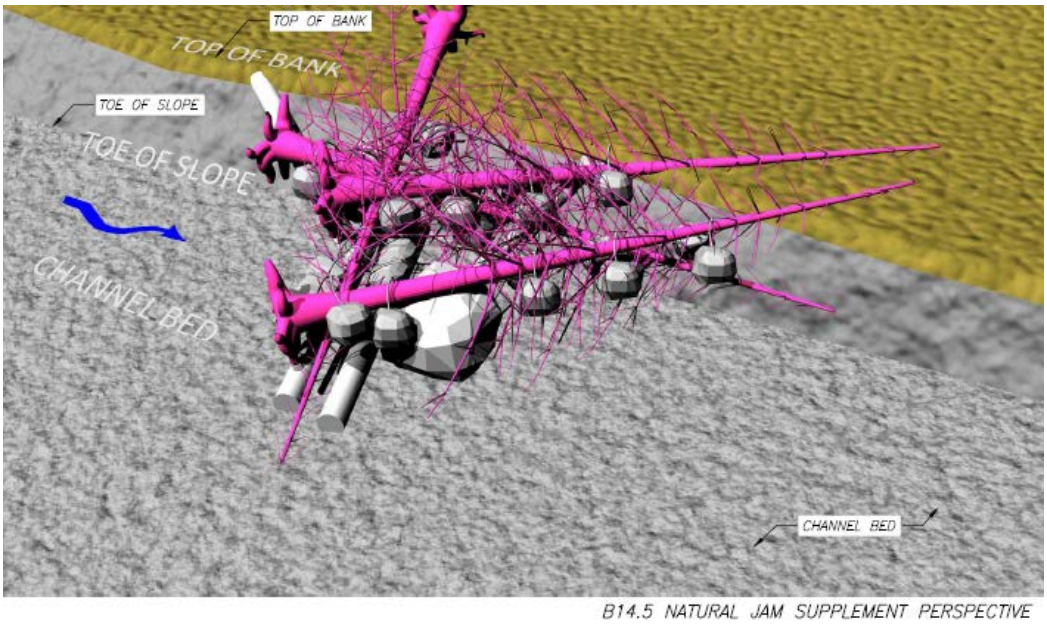

Figure 2-10. Helicopter-constructed natural jam LWM supplement.

Side Channel and Alcove Logs

The proposed project would include the placement of 37 individual logs in existing alcoves and constructed side channel habitats. The placement of the logs within existing alcoves would be achieved using helicopters. The placement of single logs within constructed side channels would be achieved by using both helicopters and ground-based equipment based on access. The logs themselves would range in length from 30 to 50 feet and would include branches to improve the effectiveness of providing cover to aquatic and terrestrial species. Existing vegetation would be used to hold the logs in place; no anchoring or pinning would occur.

Side Channel Enhancements

The proposed project would include the construction of a variety of side channel features that would increase flow interactions between the main stem river and adjacent floodplain, and increase the quality and quantity of juvenile salmon and steelhead-rearing habitat. See Figures 2-2 through Figure 2-4 for location of side channels enhancement actions. Side channel enhancements include excavation of native floodplain material to increase flow connectivity, fish access, wetland and floodplain hydraulic function, and water quality function. Side channel enhancements would include excavation of inlets or outlets to existing side channels on the floodplain, to reconnect the channel to the river (e.g., Area B and Area F on river right). Side channel excavation also includes excavation of entirely new side channels to increase floodplain reconnection and side channel habitat (e.g., Area F, river left). A total of 5,240 linear feet of newly inundated side channels would result from the project.

This includes 4,634 linear feet of newly constructed side channels and an additional 606 linear feet of existing side channel that would be reconnected to flows from the Entiat River through project construction.

Side channel enhancement areas include helicopter-placed and ground-based installation of individual habitat logs and secondary LWM structures to provide habitat complexity and cover for juvenile fish. Some of the structures would be placed to increase habitat availability for other reptile and amphibian species. Figure 2-11 shows a typical side channel cross section.

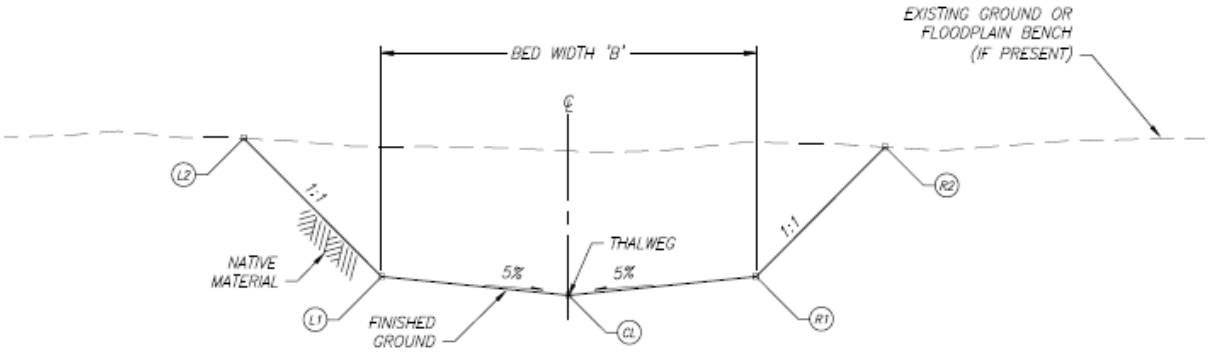

Figure 2-11. Typical side channel cross section.

At Project Area B, side channel enhancements would be used to establish floodplain connections to remnant side channels that would activate during high flows and provide off-channel-rearing habitat for juvenile salmon and steelhead. A total of 71 linear feet of excavation (110 cubic yards) would establish a flow-through connection to an existing alcove when flows in the Entiat River exceed 600 cfs. The 600 cfs is a design feature intended to wet this side channel to provide high-flow refuge habitat for juvenile salmonids. The excavated material would be hauled offsite across the temporary bridge.

At Project Area E, an existing access road that currently blocks a side channel would be removed and a ford would be installed to allow continued vehicle access while removing the impediment to side channel flows. This action would require the excavation of 76 linear feet of road bed (96 cubic yards). Materials would be spoiled offsite. The construction would allow flows through the existing 335-foot long side channel.

At Project Area F, side channel enhancements similar to Project Area B would occur as well as the creation of a perennial side channel (a side channel that receives flowing water all year long) and a network of new side channels would be constructed in a former residential property. In all, 4,245 linear feet of side channel construction would occur in five separate locations. This would require a total of 4,541 cubic yards of excavation and off-haul. A total of 100 cubic yards of material would be spoiled onsite. Excavated and spoiled material would

consist of native floodplain soils. To establish a high-water connection to a remnant side channel would require excavation in three areas: two inlets would be excavated, 110 feet in one area; and 220 feet and 91 feet of excavation at the downstream end. Water from the Entiat River would be able to enter this area when flows exceed 1,400 cfs. The 100 cubic yards of material excavated at the most upstream inlet and downstream outlet would be left onsite, and the 100 cubic yards of material excavated at the second inlet and the downstream outlet would be hauled offsite across a temporary bridge.

A new perennial side channel on river right would require 780 feet of excavation. This side channel would have water from the Entiat River year-round, though would be cut off if river flows dropped below 120 cfs. Material from the excavation (1,665 cubic yards) of the perennial side channel would be hauled offsite via a temporary bridge.

At Project Area F on river left, on the former residential property with a grass lawn, a network of side channel and alcoves would be constructed. In 2016, the CDLT removed the structures from this property. In total, 3,045 linear feet of side channels and open water alcoves would be excavated totaling 2,676 cubic yards. Excavated material is primarily a sandy loam floodplain soil. Water would come into the side channel network via two excavations. Both inlets would be seasonal with one activated at 500 cfs and one activated at less than 120 cfs. Other channels and deep pools would be excavated to a depth that would intercept groundwater that would create a cold water refuge for juvenile fish during periods of high water temperatures in the Entiat River. An outflow channel would be excavated to connect with an existing alcove area at the downstream end of the property. This alcove would be excavated and enhanced with wood cover to improve and increase the habitat refuge for juvenile salmon and steelhead along with terrestrial animals.

New Channel Construction

In Project Area C, a new channel would be excavated (225 cubic yards) into an existing gravel bar as a way to encourage a new channel alignment directed away from the Entiat River Road. Currently, the main channel abuts the Entiat River Road which does not allow for the development of floodplain vegetation or water storage on river left. The new channel would be approximately 300 feet in length and 30- to 60-feet in width to redirect flows away from the road prism. This would allow the abandoned main channel to function as perennial off-channel habitat. The gravel material excavated to create the channel would be spoiled on the adjacent gravel bar and incorporated into the proposed large wood structures.

Revegetation

Revegetation includes the restoration of access and staging areas temporarily disturbed during construction to restore construction areas to their pre-project condition and minimize the potential for erosion to occur in the first few years following construction. Revegetation also

includes, seeding, mulch, and plantings associated with habitat elements (e.g., side channels, and LWM structures), and within floodplain areas that were previously cleared for hay fields (Project Areas B and C) and human residence (Project Area F). These plantings would improve soil stability following construction and would enhance long-term regrowth of riparian vegetation communities adjacent to the Entiat River.

Seeding would include a mix of native grasses, rushes and flowering plans such as bentgrass (*Agrostis scabra*), slender rush (*Juncus tenuis*), lupine (*Lupinus sericeus*), bluebunch wheatgrass (*Agropyron spicatum*), and a mix of sterile grasses to increase soil stability such as sterile triticale (*Triticium aestivum*). All seeding would be followed by the application of certified weed-free straw mulch to improve seed germination.

Plantings would include native, locally collected or grown shrub, tree, and herbaceous species. Plantings would be sorted into ecological communities to match the environments that they would be planted within. This would result in species that can grow in frequently flooded conditions, such as willows (*Salix* sp.), being planted along stream banks, and species better adapted to dry soils such as Ponderosa pine (*Pinus ponderosa*) being planted in dry floodplain areas. Typical shrub and tree species that would be planted include coyote willow (*Salix exigua*), Sitka willow (*Salix sitchensis*), speckled alder (*Alnus incana*), water birch (*Betula occidentalis*), black cottonwood (*Populus balsamifera*), Douglas spiraea (*Spiraea douglasii*), chokecherry (*Prunus virginiana*), Nootka rose (*Rosa nutkana*), and serviceberry (*Amelanchiar alnifolia*). Plant materials would consist of container-grown, long-rooted stock and live cuttings. Live cuttings would be harvested onsite and planted immediately. Wood chip mulch would be added in a ring around each of the container plantings to improve soil moisture and planting survival. In addition to the planting of wood species, sprouted sedge and rush plugs would be planted by hand in wet areas. These species include Kellog's sedge (*Carex lenticularis*), lateral sedge (*Carex unilateralis*), and panicled bulrush (*Scirpis microcarpus*). Table 2-5 summarizes the quantity of revegetation materials required for each area.

Table 2-5. Revegetation quantities of materials by project area.

Project Area	Seed (acre)	Straw (ton)	Wood Chip Mulch (cubic yard)	Live Stake (each)	Container Plant (each)	Live Plug (each)
B	10.5	21	504	1,223	9,107	3,601
C	5.7	11.4	161	319	3,190	574
E	0.4	0.8	0	24	232	175
F	7.5	15	233	3,520	6,807	3,521
Total	24.1	48.2	898	5,086	19,336	7,871

Levee Removal

The proposed project would include the removal of the Bremmer Levee, located on land owned by CDLT at RM 19.8 (Figure 2-12; Project Area B). The levee is being removed to re-introduce flood flows to the adjacent floodplain and to induce future channel migration processes. Levee removal would include the removal of all the rock used to create the levee. The levee is 950-feet long, 70-feet wide, and 9-feet deep. Construction equipment would work along the top of the levee to remove material to the low-flow water level. Some additional large pieces of non-native rip rap would be removed from below the surface of the water if they can be removed without disturbing the native material. Approximately 900 cubic yards of rip rap and 8,600 cubic yards of native soil and gravel/cobble material that was originally used to create the levee would be removed. The material would be transported off site, requiring approximately 600 dump trucks (16 cubic yards per load).

Figure 2-12. Bremmer Levee.

2.2.3 Construction Elements

Staging Area

Temporary staging areas have been located where the disturbance to existing vegetation would be avoided or minimized. Areas would be cleared of woody vegetation as necessary for construction materials storage; office and equipment trailer(s); contractor parking; portable toilets; refuse and recycling; and equipment fueling and maintenance. Stored materials might include erosion and sediment control materials, piles, root wads, tree stems, live cuttings, and plant stock. Fueling and hazardous materials storage would occur within applicable spill containment measures. Staging areas would be protected with a stabilized construction entrance and the access drive would be secured with a temporary gate, as selected by the contractor, as a security measure. Each of the project areas would have equipment staging areas, and there would also be three wood storage staging areas where logs would be sorted, and stacked. A total of six temporary staging areas would be constructed covering 4 acres. Staging areas would be restored by ripping the soil to decompact the soil, then seeded and revegetated after they are no longer in use.

Helicopter Flights

Helicopters would be used to transport logs from the wood storage areas to the locations of the majority of the primary and secondary LWM structures. LWM structures that are located immediately adjacent to a log staging area and that have direct access between the staging area and the construction site may have logs transported by ground equipment. It is anticipated that helicopters would require 2 to 3 days of flight time per project area to complete the wood placement. The flights would deliver the specific logs for each structure. Helicopters would also be used to construct four helicopter-constructed LWM structures, two natural jam LWM supplements, and to place 28 individual logs in alcove areas in Areas C and E (as opposed to on ground track equipment used to construct the remaining 86 LWM structures and 9 side channel logs).

Access Routes

A total of approximately 9,600 linear feet of temporary access routes would be constructed to allow equipment to access the locations where LWM structures and side channels would be constructed. Access routes would be approximately 12 to 15-feet wide and have been selected to minimize impacts to existing vegetation and sensitive aquatic resources (i.e., wetlands). Due to the staging of wood by helicopters, access routes would require minimal use by ground-based equipment to construct LWM structures. Access routes would also be used to haul excavated materials associated with side channel construction and levee removal. Wood chips or mats would be required where access routes cross wetlands to minimize

impacts to soils. These routes would be temporary and at project completion, all temporary access routes would be obliterated, and the soil would be stabilized and revegetated. Route obliteration involves decompacting the surface, leveling the soil surface, reshaping to match the original contour, and revegetating with native grass/forb seed mix and planting native shrubs and trees if any are removed or damaged.

River Crossings

Both temporary bridge crossings and wet crossings would be used to construct project elements on the river bank opposite from the Entiat River Road. Temporary bridge crossing locations would be in Project Areas B (1), C (1), and F (2). Temporary bridges would be constructed using a commercial structure, old railcar, or similar that would be placed on a temporary footing and span the river (Figure 2-13). Approach ramps would be clean angular 3- to 6-inch rock. The lowest portion of the bridge would be a minimum of 1-foot above the water at time of installation and would be required to remove bridge in the event of a rise in water that would hit or cover the bridge. Exact locations, elevation and configuration of approach ramps would be determined in the field with the aid of the local sponsor's contracting officer associated with the project.

A wet crossing refers to construction equipment crossing through the river during the allowed period when work can occur in water. Wet crossings would occur where a maximum of two machines would be able to complete the work by making an average across the project area of six or less crossings of the river.

Figure 2-13. An example of a temporary bridge using an old railcar.

Work Windows, Work Area Isolation, and Dewatering

In-water work windows are established by WDFW, NOAA Fisheries, and USFWS and would be part of the permit conditions for construction. Typical in-water work is allowed on the Entiat River between July15 and July 31 each year. Each year there is the potential that the window can be extended to August 10, to be determined by WDFW and based on the presence/absence of adult UCR spring Chinook salmon in the project area. No work would be allowed from the end of the July/August in-water work window to mid-September as determined by WDFW, NOAA Fisheries, and the USFWS in relation to UCR spring Chinook salmon egg "eye-up." Once the eggs reach this stage of maturity they are less susceptible to disturbance from nearby construction activities and work may proceed in isolation of flowing waters up to October 31.

The primary LWM structures and excavation that would occur within the channel associated with side channel enhancement would require isolation from flowing waters to prevent sediment-laden water from entering the river and to prevent fish from entering the work area. In-water work would be isolated by constructing cofferdams with bulk bags and/or floating turbidity curtains. Biologists would remove fish from the isolation area and approve the area prior to construction. A record of all salvaged fish would be kept and reported to the interested agencies. The secondary, helicopter-constructed, and natural jam LWM supplement structures would not require machinery to enter the wetted channel, and, therefore, not require site isolation.

Construction of the side channels and LWM structures would not require excavation of the channel bed below water and therefore are not expected to require dewatering of the work area.

Vibratory Pile-Driving

Piles used to construct the primary and secondary LWM structures would be installed with a vibratory pile driver attached to the arm of a tracked excavator. The pile-driving machine is lifted and positioned over the pile by means of an excavator or crane, and is then fastened to the pile by a clamp and/or bolts. Figure 2-14 shows a vibratory driver attached to the arm of an excavator. Helicopter-constructed structures would not use vibratory drivers.

Figure 2-14. Vibratory pile driver.

Side Channel and Floodplain Excavation

The creation, enhancement, and reconnection to floodplain habitats for juvenile salmonids would be accomplished by the excavation of material from floodplain areas. In Project Areas B, C, E, and F, an excavator would excavate small areas to a depth that would increase river flows onto the adjacent floodplain and in existing and newly-created side channel areas. Figure 2-15 shows a typical side channel excavation by a small excavator.

Figure 2-15. Typical side channel excavation by a small tracked excavator.

Construction Observation

The Proposed Action includes Reclamation providing construction observation services. Reclamation would require engineers from the project team to be on site during construction. Engineers would observe work done by construction contractors hired by the local sponsors and report to Reclamation and the sponsors whether the work is being constructed to meet the intent of the design. Daily observation reports would be prepared and submitted to local sponsors and Reclamation describing work that was completed and report any changes to the design plans that were agreed to by the contractor, local sponsor, and Reclamation.

Post Construction Inspection

The Proposed Action includes a post construction inspection plan (Reclamation 2016b). This plan would evaluate the performance of habitat improvement actions implemented on the Project. Restoration actions refer to the different habitat features designed for the project such as LWM structures, side channels, Bremmer Levee removal (Area B), and a side channel ford at Area E (Section 2.2.2). The inspection plan provides metrics for determining success of the individual project restoration actions, outlines methods to measure the metrics of that success, identifies factors to review relative to structural stability of the restoration actions, and describes an adaptive management program. This plan focuses on the physical structures proposed to be built as presented in the 80 percent plans, and also includes qualitative assessment of biological benefits as measured by presence or absence of salmon species.

Inspection is intended to provide sufficient data to determine how the restoration actions are functioning in the river system. Field inspection would determine if the river's response is meeting the intended result of the restoration action. An adaptive management plan is intended to be part of the inspection program if the field inspection has identified a potential situation where the restoration action is trending outside its expected range of function or structural stability. The adaptive management plan would identify a "chain of command" to alert Reclamation and local sponsors of the site conditions, and ultimately whether an action should be taken to address the site condition. The adaptive management program allows local sponsors and Reclamation to take actions to enable the project to maintain features that provide post project habitat benefits and ensure safety for recreational users.

2.3 Environmental Design Features and Best Management Practices

Environmental design features and Best Management Practices (BMPs) measures are incorporated into the project to help avoid and minimize construction effects (see Table 2-6). The BMPs are prescribed through the General Aquatic Conservation Measures within the HIP

III process, expected permit conditions, and through Reclamation's Risk Based Design Guidelines. Table 2-6 lists the environmental design features and BMP measures that apply directly to the resource elements described in Chapter 3. Additional BMPs may be applied to the project through permit conditions and consultations with state and federal permit agencies that are not listed here.

Table 2-6. Environmental design features and BMPs.

Resource	Environmental Design Feature/BMP Measure
Soils and Geology	• Use sediment barriers such as fences, silt curtains, weed-free straw matting/bales, or fiber wattles, as necessary, in all work areas to minimize soil loss. • Use water trucks to apply water where needed daily to the construction area to minimize air-borne soil loss. • Cover stockpiled excess excavated materials to minimize loss of soil from stockpiles. • Reseed and plant disturbed areas with appropriate native species, and control weeds, following construction. • Minimize the size of the disturbance area, to the extent practicable. • Temporary access roads and paths would not be built on slopes where grade, soil, or other features suggest a likelihood of excessive erosion or failure. • Seven percent (355 cubic yards) of the total 5,102 cubic yards of material excavated for side channels would be placed on site in upland areas, reducing and minimizing the potential of soil erosion or turbidity caused by storage of excess soil materials.
Vegetation and Wetlands	• Minimize the removal of riparian vegetation during construction of temporary access roads • Mark wetland habitats as avoidance areas on construction drawings and flag as no-work areas in the field prior to construction. • Reseed disturbed banks with native herbaceous grasses to prevent the spread of noxious weeds. • Wash all construction equipment prior to leaving the site to prevent the spread of noxious weeds. • Inspect all watercraft, waders, boots, and any other gear to be used in or near water for aquatic invasive species. • Wading boots with felt soles are not to be used due to their propensity for aiding in the transfer of invasive species.
Water Resources	• Use sediment barriers such as fences, silt curtains, weed-free straw matting/bales, or fiber wattles, as necessary, in all work areas to minimize soil loss. • Locate staging areas whenever possible, (used for construction equipment storage, vehicle storage, fueling, servicing, and hazardous material storage) 150 feet or more from any natural water body or wetland, or on an adjacent, established road area in a location and manner that would preclude erosion into or contamination of the stream or floodplain. • Operate machinery, to the extent feasible, from the top of the bank

Resource	Environmental Design Feature/BMP Measure
	along adjacent uplands and previously cleared areas. • Operate refueling areas using BMPs and equip these areas with appropriate spill containment systems. • Biodegradable lubricants and fluids shall be used on equipment operating in and adjacent to the stream channel and live water. • Inspect machinery daily for fuel or lubricant leaks. • Cover and stockpile excess excavated materials away from water bodies and flank with sediment fencing to minimize opportunity for fine sediment to be transported into water bodies. • Dewatering would occur if work isolation is too wet and work cannot be done. Pumped water would be discharged and detained or filtered to allow removal of fine sediments prior to the waters re-entering the river. A fish screen would also be used on the pump intake to prevent harm to any fish that may remain within the isolated area being pumped dry. • Construction contractor must adhere to all spill prevention, containment/ and counter measures described in the construction plans • Construction contractor must monitor water quality as required by any permits issued by local, state, or federal agencies and stop work if water quality standards as identified in the Section 401 water quality certification. If at any time during turbidity monitoring, inspections or observation, water sampling shows that turbidity controls are not effective, work crews would immediately be mobilized to repair, replace, or reinforce water quality control measures as needed.
Fish and Wildlife	• No construction activities would occur during nighttime hours and prior to 30 minutes after dawn or continue any later than 30 minutes before dusk. • Conduct work below the ordinary high water mark (OHWM) from approximately July 15- August 10, as approved by WDFW and NOAA Fisheries. No work would be allowed from the end of the July/August in-water work window to mid-September as determined by WDFW, NOAA Fisheries, and the USFWS in relation to spring Chinook salmon egg “eye-up.” Once the eggs reach this stage of maturity they are less susceptible to disturbance from nearby construction activities and work may proceed in isolation of flowing waters up to October 31. • Use biodegradable lubricants and fluids on equipment operating in and adjacent to the stream channel and live water. • Require any work area where machines would be operating within the wetted channel be isolated from the Entiat River. • Construction contractor must isolate any work site along the Entiat River from river flows to keep fish from entering the active construction area. Contractor must contact contracting officer for local sponsor to remove any fish in the work isolation area.
Visual Resources	• Retain existing vegetation, when possible, to visually screen new disturbances, during construction. • Reseed and plant disturbed areas with appropriate native species, and

Resource	Environmental Design Feature/BMP Measure
	control weeds, following construction.
Cultural Resources	• Implement an Inadvertent Discovery Plan developed by Reclamation if unanticipated archaeological or historical resources are encountered during construction. As required by the plan, halt all ground-disturbing activity in the vicinity of the find and immediately notify Reclamation cultural resource staff.
Land Use and Recreation	• Post public notifications as needed to inform the public of the potential effects of construction activities. • Install permanent signs near usual river access points requesting that boaters and tubers stay clear of the project area in order to protect the habitat improvement work. Signs would also contain an educational element to describe the different project locations, the types of structures, and the benefits they provide for fish.
Noise, Air Quality, and Public Health and Safety	• Limit construction noise to normal daytime working hours. If construction is necessary during other times, such as at night, limit activities generating noise to those absolutely necessary.
Transportation	• Keep construction activities and equipment clear of residential driveways, to the greatest extent possible. • Employ traffic control flaggers and post signs along roads warning of construction activity and merging traffic for temporary interruptions of traffic, where needed.
Socioeconomics	• Use local labor and materials, to the extent practicable.

2.4 No Action Alternative

Under the No Action alternative, Reclamation would not provide funding to sponsors for construction of the Project and would not use the project to help satisfy its ESA obligations identified in the FCRPS BiOp (RPA Action 35). Under the No Action alternative, Reclamation would not fund or implement habitat improvement actions. Project sponsors could pursue small-scale habitat improvement actions with non-federal funding, but the extent of those activities would be dependent on the ability to find additional funding or funding partners.

2.5 Comparison of Alternatives

Table 2-7 compares how well the alternatives meet the project purpose as defined in Section 1.3. Table 2-8 summarizes and compares the potential environmental consequences of the alternatives. See Chapter 3, Affected Environment and Environmental Consequences, for a full discussion of environmental consequences.

Table 2-7. Comparison of the Proposed Action and No Action alternative by project purposes.

Purpose	Proposed Action	No Action Alternative
Restore hydraulic connectivity between the Middle Entiat River and its floodplain and improve connectivity of flows with adjacent floodplain wetlands. Support Reclamation's efforts to meet its obligations under the Endangered Species Act by fulfilling commitments to implement RPA Action 35, which calls for identifying tributary habitat improvement projects in the 2008 FCRPS BiOp, as amended by a Supplemental FCRPS BiOp in 2010 and 2014 (NOAA Fisheries 2008; 2010; 2014).	Would partially implement RPA Action 35 in the 2008 FCRPS BiOp by increasing the quality and quantity of tributary habitat to benefit and improve the survival of ESA-listed salmon and steelhead. Would create additional wood structures, pools, and floodplain side channels to improve floodplain connectivity and rearing and refuge habitat for UCR spring Chinook salmon and UCR steelhead.	Would not contribute to Reclamation's efforts to implement RPA Action 35 or improve habitat complexity or floodplain connectivity on the Middle Entiat River.

Table 2-8. Summary of potential environmental effects of actions.

Resource	Proposed Action	No Action Alternative
Soils and Geology	• Approximately 12 acres of soil resources would be temporarily affected by construction of LWM structures (4 acres) and access roads and staging areas (8 acres). Localized soil and compaction would occur. Upon completion of LWM installation and roads and staging area usage, soil would be replaced and revegetated with native seed mix, and roads would be rehabilitated. No soil erosion is expected to occur after site is revegetated. • Approximately 5,102 cubic yards of soil would be removed to excavate side channels. BMPs would contain temporary soil erosion during construction. Post-construction, soil erosion and deposition would likely occur after channels are constructed and flow enters channels, similar to natural processes. Banks of side channels, and the onsite spoil locations would be revegetated. • Removal of 8,600 cubic yards of levee material consisting of native soil and gravel and cobble sized material would occur. An additional 895 cubic yards of imported riprap would be removed. • Placement of wood structures is expected to direct flows toward river banks as part of the natural lateral migration associated with rivers in floodplains. This could cause localized soil erosion as banks lose sediment from river flows	• Construction-related impacts on soils would not occur from the project. • Soil resources would be affected by ongoing natural processes (e.g., bank erosion) or activities related to human disturbance to soil (e.g., vehicle use on dirt roads).
Vegetation and Wetlands	• Permanent removal of approximately 5 acres of grasses, trees, or shrubs would result where LWM structures or areas excavated for side channels would occur in vegetated areas. • Temporary disturbance of approximately 23 acres of grass and shrubs from access roads, staging areas, spoil piles, and new side channel banks. These areas would be revegetated with native grasses, shrubs, and trees for the site to establish native plant cover after construction. • Project would permanently impact 0.55 acre of wetland and temporarily impact 1.98 acres of wetland. Post construction impacts would be 0.48 acre where existing	• There would be no effect to vegetation or wetlands associated with construction. • Wetland enhancements from side channel enhancements would not occur. • Potential loss of vegetation or wetlands could occur if other development or restoration activities occur in along the project area.

Resource	Proposed Action	No Action Alternative
	wetlands would be converted to open water channels. • Wetlands temporarily affected during construction (i.e., access road use) would be recontoured as necessary to pre-project conditions and then revegetated with native grasses, forbs, shrubs, and trees. • Once completed the project would rehabilitate 17.73 acres and create 1.1 acres of wetlands and 0.7 acre of new side channel. The area of wetland benefit (i.e., rehabilitated or created wetlands) would vary by project area.	
Water Resources	• Construction would generate localized turbidity within the site due to new channel excavation, modifications to existing channels, and fill placement. Design features and BMP's such as isolation of work area to construct structures and side channels, in-water construction only during allowed work windows, silt fencing, would minimize and reduce the amount of sediment entering water bodies. • Water quality impacts would be reduced and minimized by turbidity monitoring, inspections or observation of water quality samples during construction. • LWM structure placement would cause stream channel migration and erosion. • LWM structures and new side channels would allow for increase inundation of the floodplain. Flooding of buildings/structures is not expected to occur based on analysis of 100-year flood event. • Approximately 5,240 linear feet of reconnected side channels would occur from the project providing a benefit to aquatic habitat and habitat for rearing and refuge of juvenile and adult UCR spring Chinook salmon and UCR steelhead.	• Construction effects to water resources would not occur.
Fish and Wildlife	• Construction equipment and activities would create temporary sediment and turbidity that would temporarily degrade aquatic habitat. Limiting construction to NOAA Fisheries and WDFW approved in-water work windows would reduce and minimize impacts. • Removal of 5 acres of vegetation and temporary disturbance to 23 acres of	• The Entiat River would continue to lack large wood within the stream channel. • There would be no increase in the amount of reading habitat available to juvenile salmon and steelhead. • There would not be

Resource	Proposed Action	No Action Alternative
	vegetation would reduce wildlife habitat for migratory and resident birds and mammals. Revegetation with native species would replace habitat that is temporarily or permanently affected by the Project. • Construction impacts on federally-listed terrestrial species (wolverine, grizzly bear, lynx, wolf) are unlikely as these species are not be expected to be in the area based on the current level of human activity, and would likely avoid the area during construction. • Construction impacts on bald eagle or golden eagle are unlikely as no known nests occur in the project area and construction would occur in July after majority of nesting occurs and fledglings would likely be starting to fly and be mobile. • Construction related impacts on salmonids would be avoided, minimized, or reduced because of the HIP III General Aquatic Conservation Measures incorporated into the design. These measures are also used to facilitate Project's ongoing ESA consultation. • An increase in overall UCR spring Chinook and UCR steelhead habitat for spawning, rearing, cover, foraging would increase in post-construction condition. Installation of LWM structures and side channels would increase rearing, cover, and foraging habitat. • Helicopter noise could impact northern spotted owls nesting in close proximity to the project area but effects would be low because of the lack of suitable quality habitat and no nests have been recorded in the project area. • Project effects on migratory birds would be low because planting of native trees in the disturbed areas would increase and enhance the riparian areas and habitat along the Entiat River. • Construction could result in temporary effects on other wildlife due to noise and presence of humans which may disturb feeding/breeding activities of wildlife within the immediate vicinity.	construction associated wildlife species.
Visual Resources	• Construction vehicles, construction materials, and disturbed areas would be	• There would not be visual effects during construction

Resource	Proposed Action	No Action Alternative
	visible during July-October 2019 and 2020. • After construction, wood structures would be visible from the floodplain and from the Entiat River Road in Project Area C.	or post construction from the Project. • Visual resources could change as other activities could occur in the area.
Cultural Resources	• No archaeological resources were identified in the project area so no known impacts would occur on cultural resources. Reclamation would implement an Inadvertent Discovery Plan if a cultural resource was encountered during construction. Inadvertent Discovery Plans would be consistent with Washington's RCW's governing human remains, cemeteries, and graves and records.	• No new ground disturbance would occur in the project area; therefore, no potential effects to cultural resources would occur.
Sacred Sites	• No Sacred Sites occur that would be affected by the project.	• No Sacred Sites are present that would be affected by the No Action alternative.
Indian Trust Assets	• No ITAs occur that would be affected by the project.	• No ITAs are present that would be affected by the No Action alternative.
Land Use and Recreation	• Design and placement of wood structures utilized Reclamation's Risk Based Design Guidelines, and input from local recreationists to reduce, and minimize risk to recreationists. • Project is consistent with Chelan County Comprehensive Plan.	• Construction of LWM structures would not occur therefore, risks to recreationalists and would remain the same if no other projects are proposed in the area. • Natural recruitment of wood in the stream could create different conditions for river users compared to existing conditions.
Noise, Air Quality, and Public Health and Safety	• Noise from construction activities could be discernible from ambient noise from public that are within 2,000 feet of on-ground construction equipment. Duration of construction equipment would primarily occur during construction periods with heavy equipment July to October each year. • Noise from helicopter use would be heard from public in the Entiat subbasin. Noise associated with helicopter use would be 2 to 3 days each construction year. • Air and dust emissions would be temporary and localized at individual construction	• Temporary construction-related noise effects would not occur. • Construction-related emissions would not occur • Public safety would remain the same.

Resource	Proposed Action	No Action Alternative
	sites. Water trucks would be used to reduce dust. Construction at the four sites is scheduled to occur over 2 years to reduce and minimize pollutant and dust emissions. Greenhouse gas (GHG) emissions would be well below the Environmental Protection Agency (EPA) threshold for reporting GHG emissions • Impacts on work safety and public would be avoided, reduced, and minimized as construction contractors would be required to follow all local, state, and federal policies (including Reclamation safety work plans on land and in or near water). • See "Land Use and Recreation" for public safety associated with wood structures	
Transportation	• Increased truck and equipment traffic would occur on the Entiat River Road during years 2019 and 2020 for construction. • Based on the proposed construction occurring in 2019 and 2020, the number of round trips would be approximately 7 to 10 trips per day, each construction year.	• There would not be a construction-related increase in traffic or traffic delays from the Project. • Traffic patterns would reflect local and regional use in the Entiat watershed.
Socioeconomics	• Project construction costs are estimated to be $5.2 million. This cost would include expenditures on purchasing materials, equipment cost or rentals, and income to construction workers during the construction period. • Temporary increase in need for lodging and supplies would support local lodging and businesses. • Project would be an open bid process and would provide income for selected contractor and workforce. Some earned income would likely be spent Entiat and Wenatchee, Washington (approximately 18 and 35 miles from the Project).	• No socioeconomic effects associated with construction would occur.
Environmental Justice	• No individuals or residents would be removed from their property. • Construction of the Project would likely have no adverse or disproportionate effects on minority or low-income populations.	• No effects on environmental justice associated with construction would occur

Chapter 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

This chapter evaluates the potential effects of the Proposed Action, as well as the No Action alternative, on human and natural resources to determine whether either alternative has the potential to cause significant environmental effects. For each resource, the narrative describes the existing environment that could be affected by the alternatives and the potential environmental consequences of the alternatives. Environmental consequences on the human and natural resources described in this chapter are discussed for both: 1) construction-related impacts, and 2) construction impacts. Post construction impacts can include beneficial impacts that are related to habitat and river conditions after the project has been constructed. Construction impact mechanisms include:

- Construction of LWM structures that require track equipment and trucks,
- Construction of side channels that require track equipment and trucks,
- Placement of spoils material in upland floodplain locations,
- Construction of access roads and staging areas,
- Helicopter use to deliver logs to LWM structures, use of vibrator pile driving to install pilings at selected LWM structures, use of dump trucks to haul material, and
- River crossings that include bridges or limited number of "wet" crossings across the river channel.

Construction impacts include permanent impacts where vegetation or soil is permanently removed to install LWM structures or excavate new side channels, and temporary impacts include actions such as construction of access roads and staging areas.

Discussion of the cumulative effects (incremental effects of the action when added to other past, present, and reasonably foreseeable future actions) is at the end of this chapter.

3.2 Soils and Geology

The analysis area for soils and geology is limited to the areas directly affected by the proposed project.

3.2.1 Affected Environment

Soils

The project area is generally characterized as alluvium mixed with volcanic ash and are characterized as very deep, somewhat poorly drained soils in floodplains (Aho and Beieler 2007). Burnscreek stony sandy loam and Billyridge gravelly sandy loam occur along the higher edges of the floodplain. Burnscreek stony sandy loam is formed in alluvium and is characterized as very deep, well drained soils in alluvial fans and terraces (Aho and Beieler 2007). Billyridge gravelly sandy loam formed in alluvium and is characterized as very deep, well-drained soils in alluvial fans (Aho and Beieler 2007).

The soil inventory (Aho and Beieler 2007) indicates that the following soils underlie the majority of the floodplain within the six project areas:

- Aeric fluvaquents, nearly level, under the vast majority of the floodplain in all six project areas. This series is a very deep, somewhat poorly drained floodplain soil that formed in recent alluvium mixed with volcanic ash.
- Billyridge gravelly sandy loam, 0 to 8 percent slope occurs under the secondary floodplain terrace at the northern end of Project Area D.
- Burnscreek stony sandy loam series, nearly level occurs under the higher elevation areas of the floodplain on river left in portions of Project Areas B, D, and F and along river right in Project Areas D, E, and F.

Geology

The geology of the Entiat River valley consists of three distinct valley segments (Reclamation 2009). A valley segment is defined as a section of river that shows similar geomorphic characteristics such as channel gradient, form, and structure. The upper most valley segment upstream of the project area is considered the headwaters of the Entiat River and has a steep gradient with many water falls, rapids and pools. In the second valley segment between RM 24–16, which is where the proposed project is located, the river gradient flattens out, likely caused by deep glacial scour during the last glacial period and subsequent infilling of glacial and post-glacial sediment. In the third valley segment the slope increases again downstream of the project area from RM 16.1 to the river's mouth where it joins the Columbia River.

The dominant geomorphic factors affecting the river within the project area are the Potato Creek moraine located at the downstream end of Project Area F, tributary alluvial fans, and delivery of sediment and wood from debris flows and sources in the upper watershed and local tributaries. The river channel within the project area has sections of multi-thread meandering channels separated by short relatively straight reaches with a single-thread channel. The multi-thread sections snake back and forth, have a wide floodplain, and some side-channels and relict channels. The single-thread sections are located in areas where large amounts of sediment has been deposited in the Entiat River by its smaller tributary creeks. These deposits are called alluvial fans and constrict the river into a narrow channel where it cuts through the sediment deposit at the mouth of the creeks. Alluvial fans affecting the river include: (1) Dill Creek alluvial fan just upstream of the project area at RM 21.1 and alluvial fan of the two unnamed tributaries across from Dill Creek, (2) Tyee Creek alluvial fan in Project Area B, and (3) Stormy Creek and Shamel Creek alluvial fans spanning from RM 18.4 to 18.0 at the lower end of Project Area C, Gray Creek alluvial fan between Project Areas E and F, and (4) an unnamed tributary just downstream of Project Area F.

3.2.2 Environmental Consequences – Proposed Action

Soils and Geology

Construction Impacts

During construction, the movement of machines at staging areas and along temporary access routes would result in some soil compaction. Following construction, the access routes would be ripped as appropriate to reduce compaction and re-seeded and replanted to stabilize the soils. The project design has been developed to avoid and minimize effect to soils by finding the most direct routes to construction areas, avoiding routes on steep slopes, and reducing the size of access routes and staging areas to just the area that is needed. Also, the proposed project has incorporated helicopters to deliver logs to the LWM structures sites and would use helicopters to construct whole LWM structures to avoid the use of ground-based equipment where long access routes would have been necessary.

Construction of the LWM structures would result in some temporary erosion or soil loss, but erosion and sediment control measures would be used during construction to control and manage temporary soil loss and accelerated sediment delivery to the river. Soil erosion during construction would be temporary and mitigated through the BMPs discussed in Chapter 2 (Table 2-6).

In areas B, C, and F, side channel excavations would allow flows to enter existing side channels. For Project Areas B and C, excavated soil would be loaded into a dump truck and disposed of off-site so not to alter floodplain function. These excavations would affect soils

in Project Areas B and C but exposed soils would be replanted and seeded in order reduce the risk channel bank erosion.

In Project Area F, soil excavated for side channel enhancement would be hauled by small machine and would be deposited within 50 feet of the excavation on nearby upland areas so to not alter floodplain function. Soil excavated from the second inlet and at the downstream outlet would be transported off site via a temporary bridge. Also, new side channels would be created and a remnant side channel would be enhanced for its entire length. Soils from all three of these areas would also be transported off-site. Much of the excavation would occur in river left, which was formerly a residential property. Much of the material that would be removed had been brought to the site to elevate and protect the home so it would be out of the floodplain. On river left, a historical side channel would be excavated to create a side channel with year-round flow. These side channel excavations would result in the removal of 10,000 cubic yards of native soils from the area

Post construction Impacts

Primary LWM structures installed throughout the project areas would increase scour of the river bottom to create "holes" which provide habitat for fish. The material that is displaced from these areas would be moved downstream until it reached a depositional area where slower moving water would cause the material to settle back into the river bed so it would not leave the system. In addition, some of primary LWM structures would force flow towards the opposite bank, rather than straight downstream. The energy from this redirected flow would cause erosion of the river bank causing lateral channel migration. Soils would be carried away and moved downstream; materials would be deposited depends on the size of the material and how quickly the water is moving. Soil erosion occurs when a stream channel experiences lateral migration, which is a natural occurrence in rivers and has happened historically in the Entiat River. Larger rocks and cobbles would drop out and settle on the river bed fairly quickly. Finer materials such as gravels and soils could be carried for miles downstream. The historical channel scars visible in the floodplain are evidence of where the main channel was once located. Because of past human and natural disturbances within the riparian area (i.e., land clearing and fire), there are few large mature trees available for recruitment into the river that could both initiate channel migration and trap mobilized sediments. The addition of LWM structures within the project reach would not only initiate erosion and mobilization of soils but would create areas of slow water that would settle and trap soils as they move through the river system.

Mobilization of exposed soils would occur during the first flush of water through these newly excavated side channel areas. This would mobilize fine sediments into the Entiat River but would likely occur during the first spring high flow when high water volumes and sediment-laden water would reduce the effect on water quality. Once riparian plantings and seeding is allowed to take hold the annual effect of high flows on soil mobilization would be reduced.

Bremmer Levee in Project Area B prevents lateral channel migration and so the river moves straight down the valley rather than moving from side to side. The material being removed at the Bremmer Levee is anthropogenic (something done by a human that affects nature), and its removal would help restore the natural functions of the river, including allowing greater lateral channel migration and improved connectivity between the flood flows and the adjacent floodplain.

3.2.3 Environmental Consequences – No Action

Under the No Action alternative, Reclamation would not provide funding for the Project and the proposed habitat improvement efforts would not be implemented. The limited amount of lateral channel migration and connection to adjacent floodplains would continue.

3.3 Vegetation and Wetlands

The analysis area for vegetation and wetlands is limited to the Entiat River valley floodplains within the project area.

3.3.1 Affected Environment

The Entiat River subbasin lies generally within the lower elevation edge of the grand fir *(Abies grandis)* Vegetation Zone of the North Cascades Province. This vegetative complex occupies the midslope foothills of the eastern slope of the Cascade Mountains in Washington. This zone generally transitions to the Douglas-fir (*Pseudotsuga menziesii*) or ponderosa pine (*Pinus ponderosa)* zone at its lower limits (Franklin and Dyrness 1988). The landscape surrounding the project areas is a combination of undeveloped floodplain dominated by young deciduous tree and shrub species, and upland forests, and intermixed with rural residential properties.

Vegetation

The tree species found within the project area are grand fir, western white pine (*Pinus monticola*), Ponderosa pine, western larch (*Larix occidentalis*), and Douglas-fir (*Pseudotsuga menziesii*), with one species often dominating forest stands. The understory is composed of a mixture of grasses including pinegrass (*Calamagrostis rubencens*), Geyer's sedge (*Carex geyeri*), northwestern sedge (*Carex concinnoides*), heartleaf arnica (*Arnica cordifolia*), tailcup lupine (*Luppinus caudatus* or *laxiflorus*), and white hawkweed (*Hieracium albiflorum*) (Franklin and Dyrness 1988). Shrub species include birch-leaved spirea (*Spiraea betulifera*), various rose and willow species (*Rosa* and *Salix* sp.), and snowberry (*Symphoricarpos albus*) (Franklin and Dyrness 1988). Scouler's willow (*Salix scouleriana*),

snowbrush (*Ceanothus velutinus*), serviceberry (*Amelanchier alnifolia*), and both blue and red elderberry (*Sambucus cerulean* and *S. racemosa*) are also common shrub dominated areas in this zone (Franklin and Dyrness 1988).

Riparian and wetland vegetation is a mixture of trees, shrubs, and grasses that include Sitka alder (*Alnus viridis/sinuata*), black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), trembling aspen (*P. tremuloides*), western red cedar (*Thuja plicata*), red-osier dogwood (*Cornus sericea*), snowberry (*Symphoricarpos albus*), and various species of rose (*Rosa* spp.) and willows (*Salix* spp.), and a variety of sedges (*Carex* spp.).

Wetlands

Reclamation conducted wetland delineation for each project area to determine where wetlands currently exist in an effort to limit effects to wetlands. It was estimated, based on the delineation that there are 116.2 acres of wetlands within the Project area (ICF International 2015). Table 3-1 presents the area of delineated wetland within each project area.

Table 3-1. Delineated wetland area by project area.

Project Area	Acres of Wetland
B	16.9
C	70.9
E	12.7
F	15.7
Total	116.2

These wetland areas were comprised of both riverine and depressional wetlands. Riverine forested/scrub-shrub wetlands are the most common variety of wetland found within the project area and are characterized by dense trees and shrubs with sparse grassy or emergent vegetation underneath. Depressional wetlands generally support a diverse mixture of native emergent species but also have degraded components dominated by non-native reed canary grass (*Phalaris arundinacea*) and/or have been affected by development in the floodplain.

These riverine and depressional wetlands are generally found within the floodplain of the Entiat River in the project area as follows:

- Riverine wetlands, strongly influenced by beavers, where beavers have created diverse open water/emergent areas at the mouth of historic or active side channels. These wetlands typically extend back into the floodplain as scrub-shrub/forested wetlands.
- Riverine wetlands, in which beavers have created small open water/emergent areas back in the floodplain within larger scrub-shrub and forested wetlands.

- Riverine forested/scrub-shrub wetlands within the floodplain. These floodplain wetland/upland mosaic areas are the most common variety of wetland, with a dense tree and shrub overstory and a very sparse understory.
- Depressional, predominately emergent wetlands separated from the river by man-made features (e.g., Project Area B behind the Bremmer Levee on river left). These wetlands generally support a diverse mixture of native emergent species.
- Riverine wetlands with depressional, often emergent components. These wetlands typically support a mixture of native species, but also have degraded components dominated by reed canary grass and/or have been affected by floodplain development.
- Riverine wetlands where trembling aspen trees co-dominate with river birch and willow trees. Only one of the wetlands sampled during the field effort met this criterion, Project Area B, on river right. This wetland is considered a Category I wetland due to the 'special characteristic' of having an estimated 20 percent of forested community composed of trembling aspen.

Because there are differences in the type and amount of habitat functions that a wetland provides, they are broken into three category types. To determine the classification for the wetlands found within the project area, the Washington State Wetland Rating System for Eastern Washington (Hruby 2014) was used. Three wetland categories were identified within the project area:

- Category I wetlands are those that 1) represent a unique or rare wetland type; or 2) are more sensitive to disturbance than most wetlands; or 3) are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime; or 4) provide a high level of functions. Generally, these wetlands are not common and make up a small percentage of the wetlands in the region. Only two Category I wetlands were found within the entire project area: The aspen wetland in Project Area B (described above), and a wetland in Project Area C. The wetland in Area C is Category I because of the high scores it received for providing water quality and hydrologic functions and wildlife habitat characteristics.
- Category II wetlands are difficult, though not impossible, to replace, and provide high levels of some functions. These wetlands occur more commonly than Category I wetlands, but still need a relatively high level of protection. Category II wetlands are the predominant wetland type within found throughout the Entiat River floodplain areas within the four project areas.
- Category III wetlands are wetlands with a moderate level of functions, have usually been disturbed in some way, and are often less diverse or more isolated from other natural resources in the landscape than Category II wetlands. Few Category III wetlands were identified within the four project areas, and all of these wetlands were associated with past human disturbance.

3.3.2 Environmental Consequences – Proposed Action

The proposed project includes construction activities associated with LWM structures and new side channel habitats that would damage or destroy some plants and wetlands during construction, but would create conditions for establishing larger and more robust vegetated riparian areas and wetlands in the long term.

Vegetation

Construction Impacts

To install LWM structures, construction equipment would need to have access to the river bank in areas with existing vegetation. In the short term, these construction activities would result in a temporary loss of approximately 23.6 acres grasses, shrubs, and trees at specific spots in each project area. The excavation for side channels and the construction of LWM structures would result in a permanent loss of 5 acres of riparian vegetation. Construction access and staging areas were sited in areas to minimize and direct effect to vegetation (refer to Figures 2-1 through 2-4 in Chapter 2). While much of the Entiat River's riparian area is vegetated, due to fire and human activity the majority of vegetation consists of young deciduous trees and shrub vegetation. No mature trees would be removed to facilitate construction access or staging. Table 3-2 presents the acreage of vegetation that would be temporarily disturbed during construction.

Table 3-2. Temporary vegetation effects by project area (ICF International 2015).

Project Area	Acres of Disturbed Vegetation
B	9.6
C	3.3
E	1.7
F	9.0
Total	23.6

Vegetation cleared for access and staging areas would be cut but the roots would not be grubbed to allow rapid regrowth. Access and staging routes would also be replanted or re-seeded following construction (see Section 2.2.2).

Invasive species such as reed canary grass within Project Area F would decrease as a result of the vegetation clearing during construction. Controlling the introduction and spread of invasive species during construction would be achieved through BMPs described in Chapter 2 (Table 2-6).

Post construction Impacts

The restoration of flood waters and the increased wetting of the floodplain would increase the growth of native riparian plant species. In addition, floodplain plantings in Project Areas B, C, and F would restore floodplain areas that have been cleared by humans to native woody riparian complexes. The installation of the LWM structures would increase lateral channel migration, local bank erosion, and recruitment of shrubs and trees into the river. These effects are expected to be localized and are a normal process that is intended to be initiated.

Wetlands

Construction Impacts

Project elements and temporary access routes with impacts on wetlands that were avoidable or not balanced by benefits were revised or eliminated in efforts to minimize unavoidable impacts on wetlands and waters. Through the design process, several side channels, alcoves, and LWM structures were eliminated and work within wetlands to restore flow to relic side channels was substantially reduced. The project also incorporates construction of LWM structures by helicopter into areas too difficult to access without substantial impact on wetlands or waters in order to avoid temporary impacts and minimize the need for additional access routes and staging areas. All access routes and wet crossings of the river were similarly strategically oriented to minimize impacts on wetlands and waters. Placement of excavated material (where necessary to eliminate additional access routes and river crossings) was strategically oriented to occur only in upland areas lacking mature riparian vegetation; no side cast or placement of excavated material would occur in wetlands.

An analysis was done where the proposed habitat improvement actions were mapped along with the areas of existing wetland. Table 3-3 provides the results of this analysis showing the temporary construction impacts (staging areas and access roads), and more permanent construction impacts such as earthwork activities (e.g. cut, fill).

Table 3-3. Evaluation of potential construction impacts to wetlands (Stratten 2017).

Project Area	Temporary and Permanent Construction Impacts (acres)		
	Permanent	Temporary	Wetland Total
B	0.01	0.47	0.48
C	0.00	0.04	0.04
E	0. 00	0.07	0.07
F	0.54	1.40	1.94
Total	0.55	1.98	2.53

Post Construction Impacts

While some wetland areas would be affected by excavations needed to reconnect old side channels (direct construction impacts), allowing surface water to flow into these side channels would allow for more frequent inundation of these areas. More frequent inundations through these excavations or through the placement of LWM structures would convert some wetland areas into open water channels. This would reduce wetland functions related to vegetative structure and were considered a post construction impact. Table 3-4 lists the area of post construction impacts to wetland areas.

Table 3-4. Post construction impacts to wetlands (Stratten 2017).

Project Area	Impacts (acres)
B	0.14
C	0.14
E	0.03
F	0.17
Total	0.48

In addition to calculating the negative effects to wetlands, the beneficial effects were estimated by combining the proposed changes to the landscape as a result of the project with river hydrology data to show where new inundation levels would either enhance existing wetlands or create new wetland areas. The wetland benefits accrued across the floodplain are classified into two categories: wetland rehabilitation, and wetland creation. The definition of the benefit categories is consistent with the definitions of mitigation terms from the EPA and Corps regulations governing compensatory mitigation for losses of aquatic resources (Mitigation Rule, 33 CFR Parts 325 and 332, and 40 CFR Part 230) (79 FR 19594). Wetland rehabilitation is defined as manipulation of physical, chemical, or biological characteristics with the goal of repairing the natural or historic functions to a degraded aquatic resource. In this analysis, wetland rehabilitation is represented as the net area of existing floodplain wetlands—not currently, but that would be—flooded by the 2-year flows. In this analysis,

upland areas would become wetlands by the removal of fill. Fill to be removed would typically consist of material placed many years ago to create roads or residences (e.g., the house and fill pad in Project Area F) and the Bremmer levee in Project Area B, most likely in areas that were formerly wetland. Table 3-5 summarizes the anticipated area of benefits to wetlands.

Table 3-5. Evaluation of anticipated benefits to wetlands (Stratten 2017).

Project Area	Net Benefits (acres)		
	Wetland Rehabilitation	Wetland Creation	Total
B	5.25	0.17	5.42
C	6.78	0.00	6.78
E	1.73	0.01	1.74
F	3.97	0.92	4.89
Total	17.73	1.10	18.83

The proposed habitat improvement actions would result in 1.03 acres of impacts (permanent) for all four project areas, but once completed the project would rehabilitate or create 18.83 acres of wetlands. The amount of wetland benefit would vary by project area, but in all cases the proposed project design would improve the frequency of floodplain connectivity between the river's flow and the floodplain wetlands.

3.3.3 Environmental Consequences – No Action

Under the No Action alternative, Reclamation would not provide funding for the project. The current extent and condition of wetlands in the project area would remain the same because the Entiat River would remain disconnected from the floodplain. Riverine wetlands that are located adjacent to downcut or incised streams provide less flood attenuation than those adjacent to a stream with no incision (Hruby 2014). This current condition within the project area has led to a degradation of hydrologic functions and a decreased ability to store floodwaters to reduce the effects of flooding. The decreased storage of floodwaters also decreases the ability to provide late summer low-flow discharge as more water is held within the incised channel during flood events. While the wetlands that currently exist would continue to provide some ecological value, the increase in wetland area and improved hydraulic function proposed under the Proposed Action would not occur.

3.4 Water Resources

Water resources include hydrologic characteristics within the basin and project areas, water quality, and floodplain functions.

3.4.1 Affected Environment

The Entiat River originates on the eastern slopes of the Cascade Mountains. All runoff generated from the Entiat River drainage basin empties into the Columbia River just south of the city of Entiat, Washington. The Entiat River begins at about elevation 9200 feet and the elevation at the mouth of the Entiat River is approximately 710 feet. The Mad River is the only major tributary of the Entiat River and enters the Entiat six miles downstream of the proposed project area. Within the project area small seasonal tributaries enter the Entiat River, they include Shamel Creek and Stormy Creek (Project Area C), Gray Creek (between Areas E and F), and several unnamed seasonal tributaries.

Hydrologic Characteristics

The hydrologic regime in the Entiat watershed is predominantly controlled by spring and summer snow melt, with episodic rainfall at low to mid-elevations and rain-on-snow events in the upper watershed contributing to flow during the fall and winter months. Mean annual precipitation ranges from 90 inches in the moist alpine areas of the upper basin to less than 10 inches in the arid shrub steppe portions of the lower basin (Andonaegui 1999). Much of the precipitation falls as snow, accumulating through the winter as mountain snowpack and melting through the warmer spring and summer months. Snowmelt is the primary source of surface and groundwater in the valley. The permeable sands and gravels that comprise the valley bottom allow for groundwater movement between the stream channel and the surrounding floodplain (Andonaegui 1999). Peak flows are associated with late spring and early summer snow melt, with base flows receding throughout late summer and fall. Snow melt is the dominant control on the magnitude of peak flow events (Reclamation 2009). The flood of record occurred on May 29, 1948, with a discharge of 10,800 cfs (USGS gage #12453000, Entiat River near Entiat), and is approximated as a 500 year flood event (Reclamation 2009). Major flood events also occurred in 1894 (no gage record), 1972 (6,430 cfs, approximately 100-year event), and 1999 (5,600 cfs, approximately 10-year event) (Reclamation 2009).

A comprehensive hydrologic evaluation of the Entiat River basin was completed by Reclamation and is described in detail in Appendix B of the Entiat River Tributary Assessment (Reclamation 2009). This report calculated the peak flows for the 2- to 100-year events for each river mile from the mouth at the Columbia River to RM 32 (12 miles upstream from the proposed project). The 2009 analysis included the hydrologic response to

the large fires that occurred between 1957 through 2009. These peak and are summarized in Table 3-6.

Table 3-6. Entiat River hydrology at key locations.

Location	River Mile (RM)	Drainage Area (mi2)	2-year Peak (cfs)	25-year Peak (cfs)	100-year Peak (cfs)
Project Area B	32	108.66	2,350	4,490	5,540
Project Area C	20	187.73	2,640	5,040	6,220
USGS 12452800	19	192.02	2,650	5,070	6,250
Project Area E	18	203.35	2680	5,130	6,330
Project Area B	17	204.56	2680	5,130	6,330
Gray Reach Area F	16	208.01	2,690	5,150	6,360

In addition to evaluating the stability of LWM structures during the 100-year design flow, lesser high water events were also used to determine how, where, and why habitat improvement elements should be placed on the landscape. The hydrologic analysis in Reclamation's Entiat Tributary Assessment identified several limiting factors in this reach of the river related to its hydrology. By using the peak flows from more regularly occurring high-water events (flows that occur on average every two or five years), the analysis showed that areas that used to experience flooding (the active floodplain) had been disconnected from the river over time. This is largely due to a lack of mature trees in the riparian area, most of which have been harvested or destroyed during wildfires. Historically large trees would have regularly fallen into the river as the stream channel migrated across the floodplain and created large logjams that would force the water off onto the floodplain. The river's energy would have then created side channels. Because the Entiat River riparian area lacks large trees those logjams are not being created so the water does not get directed toward the flood plain but instead it stays in the main channel. In the river's current state the energy carried by the water is directed downward toward the river bed. This concentration of flow in the main channel causes "down-cutting" as the river's energy moves material along the river bed and downstream. Down-cutting ultimately deepens the channel and further disconnects the river from the floodplain.

Recent Fire Effects

In 2015, severe wildfires burned portions of the Entiat watershed upstream of the project area. These fires occurred relative to a long historic record of both fire and flood in the Entiat River Watershed (Reclamation 2016b). Specifically, the 2015 Wolverine fire complex included lands in the Entiat River Watershed above Entiat River Falls located at RM 32 approximately 12 miles upstream of the project area. In a November 25, 2015 letter

addressed to YN Fisheries (Whitehall 2015), the USFS expressed concerns that the burned watershed areas above the proposed Project could be at risk to experience increased runoff and debris during a three year period following the 2015 fire. The letter described the potential for an increased runoff response, rill and gully erosion, flash floods, debris flows and sediment deposition in the post fire condition for approximately three years while the watershed vegetation and soils recover. The Project is scheduled for construction in 2019 and 2020, past the period of concern (2015 through 2018) for increased flooding and debris flow as expressed in the USFS letter.

Climate Change

The warming of global surface temperatures over recent decades has already triggered a wide array of impacts to the environment that are projected to accelerate in the coming decades (Melillo et al. 2014). Recent work indicates that climate in the Cascade Mountain Range is changing (e.g., Mantua and Raymond 2014; Mantua et al. 2009). Mote and Salathé (2010) analyzed climate model simulations for two scenarios from the Intergovernmental Panel on Climate Change (IPCC) 2007 report (Randall et al. 2007) and projected an increase in mean annual temperature over the Pacific Northwest of 6.1° and 4.5°F, respectively, for the A1B (moderate emissions increase) and B1 (low emissions) scenarios over the next century.

In watersheds with snowmelt dominated hydrology such as the Entiat, these changes in temperature are likely to equate to reductions in annual snowpack and a greater proportion of the watershed within rain-on-snow or rainfall dominated precipitation zones (Adam et al. 2009), thus resulting in the hydrologic regime of the Entiat shifting to lower spring and summer peak flow events and more frequent peak flow events associated with winter rain-on-snow storms. There is not yet sufficient data, however, to determine any long term climatic trends for peak flow magnitude or timing in the Entiat, however, four main sensitivities to predicted changes in climate are identified for rivers of the North Cascades: (1) higher flood frequency and magnitude of peak flows, (2) lower summer low flows, (3) warmer stream temperatures, and (4) higher sedimentation (Mantua et al. 2009; Mantua and Raymond 2014). For the Entiat basin in particular, a 10 percent reduction in summer low flows and an 88 percent increase in the 100-year flood magnitude are predicted by the end of the century (Hamlet et al. 2010). See Section 3.12 for more information on climate change.

Water Quality

The Entiat River is classified as a Class A (excellent) stream from the boundary of the Wenatchee National Forest at approximately RM 26 to its confluence with the Columbia River and as a Class AA (extraordinary) stream from the National Forest boundary to its headwaters (Cascadia Conservation District 2014). It supports beneficial uses including domestic, industrial and agricultural water supply and primary contact recreation. Overall water quality at the Washington Department of Ecology (WDOE) ambient water quality monitoring station 46A070 (Keystone) met or exceeded expectations in water year 2002, and

is of lowest concern according to Washington Department of Ecology's Water Quality Index (WQI).

Water quality in the Entiat River has been affected in the past by practices including flood control, logging and related road building, livestock grazing, and past hayfields practices. Substantial positive changes and reductions have been made in several of these land uses. Logging and grazing in the watershed has declined significantly, and agricultural practices have improved significantly with new technology. Watershed restoration emphasizing road rehabilitation has become a major focus of federal land managers. Furthermore, the amount and type of flood rehabilitation and control measures used and/or financed by federal agencies earlier in the century would probably not reoccur, due to a better understanding of the environmental sensitivity of the watershed.

No water quality issues have been identified in the Entiat River with respect to fecal coliform, dissolved oxygen, pH, or turbidity. Temperature exceedances in the summer months have been identified throughout the record, beginning in 1960. Occasional temperature exceedances may have occurred naturally prior to settlement of the Entiat Valley; however, it is likely that the number and frequency of exceedances has increased due to a combination of historic manipulation of channel geometry and removal of riparian vegetation.

Floodplains

The Entiat Tributary Assessment (Reclamation 2009) evaluated and estimated the size of the adjacent floodplain. The width of the river's active channel and active floodplain were averaged by reach in order to identify general patterns in channel complexity as well as any deviations in width measurements that might signal altered areas. In general, width-averaged measurements show that wider active channels correspond to wider or unconfined active floodplains. Where a river is wider it normally has more channel complexity because there is a wider range of depths, velocities, and substrate and a greater number or length of side-channels that provide off-channel habitat. Where a river is narrow or has confined floodplains it normally has less channel complexity because in-channel velocities, depths and substrates are more uniform and off-channel habitat is more limited.

Several manmade structures are within the active channel area and floodplain and are currently at risk of erosion or flooding during large magnitude events (Reclamation 2016c). These include Entiat River Road, the Bremmer Levee at RM 19.75, the utility line crossing at RM 18.75, the private dirt roads in the right bank floodplain at RM 19. 0 and along the right bank at RM 18.25, and two homes near RM 16.5. With the exception of the levee, no in-channel anthropogenic structures exist within the any of the project areas and no dwellings are within the 100-year floodplain shown on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) (FEMA 1982). The term 100-year flood

indicates that the area has a one-percent chance of flooding in any given year, not that a flood will occur every 100 years.

3.4.2 Environmental Consequences – Proposed Action

Hydrologic Characteristics

Future wildland fires can lead to increased peak flows following storm events and the mobilization of debris through the project area. In addition to these discrete events, long-term climate change forecasts increased peak flows and lower summer low flows. The addition of LWM structures would help dampen the expected increases to peak flows by increasing long-term channel stability through adding stable hard points in the floodplain to collect debris, slow flood flows, and increase flood inundation on adjacent floodplains. The LWM structures would also help to recharge local groundwater during flood events through the increased floodplain inundation which would lead to increased groundwater discharge to the main channel during low flows (Abbe and Montgomery 2003; Pollock et al. 2014). This would help augment low flows with additional cool-water discharge.

Water Quality

Construction Impacts

Impacts to water quality in the Entiat River could occur during construction of the LWM structures, the excavation of side channels, installation of temporary bridges, and potentially from leaks or spills of fuel, or oil from construction machinery.

The majority of LWM structures would be constructed using a pile-based design and so would require little-to-no excavation. A pile driver positioned on the stream bank would lift logs and drive them into the riverbed. The additional logs used to create the bulk of the structure would be laid/woven between the piles. Small amounts of sediment would be released in to the water when the piles are driven but the small amount of sediment would likely not be visible. For LWM structures where construction equipment would need to be in the river, the work area would be isolated from the main channel to prevent disturbed sediment from flowing into the river (see Section 2.2.3). Once the vertical piles are driven into the substrate of the river, the horizontal logs would be placed between the vertical piles with very minor, if any disturbance to river sediment. Only temporary effects of sediment on water quality during construction are expected due to the methods used to construct each of the LWM structures and the site isolation methods for in-water work.

Excavation to construct and connect historical side channels would occur when the areas are dry or disconnected from the Entiat River so little to no sediment would be released during side channel excavations. In some areas once the excavation is completed and water from

the river is allowed to enter the new channel, a pulse of sediment would be released into the river but the effect on water quality would be temporary and localized.

Several types of large machinery would be used during the construction of project. Leaks and spills from these machines could occur during construction but the potential effects on water quality would be reduced by construction BMPs described in Chapter 2 (Table 2-6).

Post Construction Impacts

The long-term effects of the Project would result in increased complexity within the river that would allow for more floodplain connection. This increased connection to the floodplain would slow the speed of water during high flows and encourage sediment and fine particles to settle out in depositional areas. The placement of LWM structures would encourage stream channel migration and cause erosion in certain areas but this represents the natural functions of a river system.

Floodplains

Construction Impacts

Construction impacts within the floodplain would be limited to those caused by construction equipment access and staging, and the construction of the LWM structures and side channels. These activities would result in temporary impacts to floodplain vegetation and soil stability which would be reduced in severity through the implementation of the BMPs listed in Chapter 2.

Post Construction Impacts

The changes in floodplain inundation resulting from these project actions were modeled across a range of flood flow events in order to assess the overall project effects to flood flows. The installation of the LWM structures typically results in local increases in surface waters adjacent to the structure and during higher flows (e.g., flood flows) this also results in greater floodplain inundation. The excavation of the side channel elements typically increases local floodplain capacity. The increase in the extent and frequency of flooding to vegetated floodplain areas is part of the intended outcome of the Project. The installation of the LWM structures and increase in floodplain capacity associated with the side channel construction would work to allow flood flows greater access to the vegetated floodplain thereby slowing and storing flood flows and reducing the peak and timing of the flood events downstream of the project area.

The floodplain analysis of the Project also looked at the extent of the 100-year floodplain based on the current Chelan County FIRM produced by the FEMA that went into effect on February 4, 1981 (FEMA 1982). The 100-year floodplain depicted on the 1981 FIRM was

determined with the data and hydraulic modeling available in 1981. Since that time, hydraulic modeling and data from aerial imagery and topography gathered using satellites now allows for a much more accurate assessment of where and how water moves and flows over the landscape during a high flow event. In accordance with Reclamation's risk-based design guidelines, the Project was evaluated to determine if the proposed project would affect the extent of the 100-year floodplain and result in increased risk to property throughout the project area. This analysis showed that the 100-year floodplain shown on the 1981 FIRM map underestimates the extent of the actual 100-year floodplain in some locations (Reclamation 2016c).

The assessment of effects on the 100-year floodplain is based on the assessment using current hydraulic modeling and topographic data and not the FIRM. The floodplain analysis of the project's effects relative to the 100-year floodplain shows that the proposed project would result in minor changes to the current extent of the actual 100-year floodplain. The only homes shown to be within the updated 100-year floodplain are in Project Area F. In the vicinity of these structures, frequent floods (e.g., less than the 100 year) have inundated large portions of the floodplain that extend beyond the 100-year floodplain boundary shown on the FIRM.

The County's Shoreline Master Plan regulates development within the 100-year floodplain. On June 3, 2016, project engineers met with staff from Chelan County's Community Development Department to discuss the effects of the project. The project designers showed Reclamation's hydraulic modeling and how it was used to develop the planned habitat improvement actions to create increases in the frequency of inundations to the existing 100-year floodplain while minimizing any effects to its extent, particularly in areas where structures or infrastructure existed. The County determined that because the project is intended to restore floodplain functions and, therefore, improve the quantity and quality of available fish habitat, they would allow changes to the 100-year floodplain on properties where those changes were agreed to by the affected land owner (Yanagimachi 2016). All areas affected by the Project must have landowner agreements.

Throughout the project areas, the proposed LWM structures would reduce future bank erosion in some areas but also increase the water surface that may increase the extent of floodplain inundation. While the proposed project would increase the extent and frequency of flooding in some areas, there are no structures that would be affected by increases to the 100-year flood event.

3.4.3 Environmental Consequences – No Action

Under the No Action alternative, Reclamation would not provide funding for the proposed project and the construction effects to water resources from Reclamation-funded work would not occur. During high flows, the Entiat River would continue to down cut, further

disconnecting from the floodplain. This would continue the trend of increasing peak flood flow quantities, and as the depth of the river increases, the velocity of flows would increase; increasing the potential for effects to infrastructure like downstream bridges and the Entiat Valley Road. These trends would continue to reduce the Entiat River's resiliency to the predicted effects of fire and climate change on hydrology, channel erosion, and floodplain function.

3.5 Fish and Wildlife

The project area is located on the Entiat River between RMs 16.2 and 18.7. The analysis area for this EA has been delineated based on the anticipated impacts and benefits to fish and wildlife and their habitats, extending 1,000 feet from the project area. This analysis area is based on the anticipated noise levels that would be generated during construction of the project. Construction-related impacts to the aquatic environment would extend approximately 1,000 feet from the project area, based on the use of vibratory pile drivers to install the LWM structures.

3.5.1 Affected Environment

Fish Habitat Conditions

The Entiat Tributary Assessment (Reclamation 2009) subdivided the lower 26 miles of the Entiat River into three valley segments (VS). The analysis area is within VS-2, which extends from the Potato Creek moraine at the downstream end to the Dill Creek alluvial fan at the upstream end. This unconfined valley segment has relatively good floodplain connectivity compared to the higher gradient segments up- and down-stream, which is a key factor in targeting reaches within VS-2 for habitat restoration.

Human impacts to the Entiat River watershed date back to the late 19th century, during which time logging and grazing by sheep and cattle acted as the primary anthropogenic disturbances (Andonaegui 1999; Reclamation 2009). Log drives down the river necessitated channel modifications to improve timber transport to mills near the mouth of the Entiat at its confluence with the Columbia River. Timber harvest throughout the watershed greatly reduced the quantity and size of trees available for recruitment to the channel, also reducing water storage capacity and increasing runoff and soil erosion (USFS 1996). As development of the valley increased, agricultural land use began to expand, with apple orchard tracts appearing in the early 20th century (Andonaegui 1999). Establishment of the Okanogan-Wenatchee National Forest (OWNF) occurred in 1908, initiating federal control over timber harvest and grazing practices in the watershed above RM 25.5. These land use practices continued throughout the watershed, however, and salvage timber harvest still occurs in

portions of the OWNF. The upper reaches of the watershed above RM 43 are within the Glacier Peaks Wilderness Area, which was established in 1964. As such, this portion of the watershed has restricted uses, with impacts limited to natural disturbances and trail maintenance (Reclamation 2016b). These elements have all contributed to the existing fish habitat conditions in the Entiat River subbasin, as well as the existing wildlife habitat conditions.

Downstream of the National Forest boundary (RM 25.5), higher road densities and encroachment of the riparian area by hayfields, grazing, and development negatively impact fish habitat through excess fine sediment delivery, compaction of soils leading to flashy runoff, changes in land cover, and reductions in riparian forest (Andonaegui 1999). Loss of floodplain connectivity and floodplain forests is identified as a limiting factor for fish and fish habitat in the Entiat subbasin (Andonaegui 1999). Twenty two bridge crossings span the Entiat in the reaches below the OWNF boundary, locally constricting the river (Reclamation 2009). Two such bridge crossings span the Entiat within Gray Reach (Reclamation 2016c). No bridges occur in the Stormy Reach.

Pool frequency in the Entiat has been reduced by 90 percent since the 1930s, which is likely associated with historic removal of beavers and large wood (Andonaegui 1999). Large wood was actively removed from the river by the U.S. Army Corps of Engineers (USACE) in 1971 (Reclamation 2009). Current wood loading in the Entiat is below that of undisturbed watersheds of similar size and geomorphic nature (Fox and Bolton 2007). The Gray Reach Assessment (Reclamation 2013a) estimated that historically, there were 5 to 10 logjams per mile (defined as 10 or more interconnected pieces of LWM) and at least 20 additional large wood pieces per mile (defined as greater than 12-inch diameter and 30-feet long). Existing logjams and individual large wood pieces were identified in the field during the May and July 2014 field assessments of the Gray Reach. It was determined that today, there are only 3.3 logjams per mile and 3.3 additional large wood pieces per mile in the Gray Reach. The nearby Chiwawa River has similar watershed and channel characteristics as the Entiat, but differs in that it has more intact forest, larger diameter trees, and higher wood loading. As such, geomorphic conditions in the Chiwawa are considered as somewhat of a reference for target conditions in the Entiat. The Chiwawa has more than double the amount of large wood accumulations as the Gray Reach with 6.8 jams per mile (Reclamation 2016c).

Fish Species

The Entiat River currently supports both federally protected and non-protected anadromous and resident fish, as listed in Table 3-7. The following discussion provides a brief overview of these species.

Table 3-7. Fish species present in the analysis area.

Species[a]	Federal/State Status	Comments
Federally-protected Anadromous Fish		
Chinook salmon (*Oncorhynchus tshawytscha*) Upper Columbia River Spring-Run ESU[b]	E/C	Spawning occurs August – September. Fry emerge from the redds February – mid-May Juvenile rearing occurs February – September
Steelhead (*O. mykiss*) Upper Columbia River DPS[b]	T	Spawning occurs late-February – early-June Fry emerge from the redds June – August Juvenile rearing occurs June – October
Federally-protected Resident Fish		
Bull Trout (*Salvelinus confluentus*) Columbia River DPS[b]	T	Spawning occurs August – mid-November Fry emerge from the redds March – June Juvenile rearing occurs year-round
Non-protected Anadromous Fish		
Chinook salmon (*O. tshawytscha*) Upper Columbia River Summer-Run ESU[b]	N/A	Spawning occurs late-September – early-November Fry emerge from redds January – April Juvenile rearing occurs January – March
Sockeye Salmon (*O. nerka*)	N/A	Sockeye salmon are not endemic to the Entiat subbasin. Those sockeye salmon that occur in the subbasin are assumed to be strays.
Coho Salmon (*O. kisutch*)	N/A	Coho Salmon are not endemic to the Entiat subbasin. Those Coho Salmon that occur in the subbasin are assumed to be stays.
Pacific Lamprey (*Entossphenus tridentatus*)	N/A	Spawning occurs March – July Embryos hatch after approximately 19 days Ammocoetes drift downstream to areas of low velocity and fine substrates where they may remain for 3-7 years.
Non-protected Resident Fish		
Westslope Cutthroat Trout (O. clarki lewisi)	N/A	Spawning occurs March – July Fry emerge from redds May – August Juvenile rearing occurs year-round
Rainbow Trout (*O. mykiss*)	N/A	Spawning occurs February – June Fry emerge from reds April – July Juvenile rearing occurs year-round
Brook Trout *(S. fontinalis*)	N/A	Nonnative to the Entiat subbasin.
Speckled Dace (*Rhinichthys osculus*)	N/A	Spawning occur June --August
Longnose Dace (*R. cataractae*)	N/A	Spawning occurs May – early-July
Sculpin (*Cottus* spp.)	N/A	Spawning typically occurs February – June
Largescale Sucker (*Catostomus macrocheilus*)	N/A	Spawning occurs April – June

Species[a]	Federal/State Status	Comments
Bridgelip Sucker (*C. columbianus*)	N/A	Spawning occurs April – June
Northern Pikeminnow (*Ptychocheilus oregonensis*)	N/A	Spawning occurs May – July
Chiselmouth (*Acrocheilus alutaceus*)	N/A	Spawning occurs May – July
Three-spined Stickleback (*Gasterosteus aculeatus*)	N/A	Spawning occurs May – July
Notes: [a] Species Presence based on USFWS 2017b Federal Status – E=Endangered, T=Threatened, N/A=Not Applicable; State Status – E=Endangered, T=Threatened, C= Candidate, N/A=Not Applicable [b] ESU=Evolutionarily Significant Unit. DPS=Distinct Population Segment.		

Federally-Protected Anadromous Fish

Spring-run Chinook salmon

The UCR spring-run Chinook salmon Evolutionarily Significant Unit (ESU) was listed as Endangered under the ESA on March 24, 1999. Critical Habitat was designated on September 2, 2005. Adult spring Chinook salmon (stream type) enter and ascend the Columbia River between March and June and reach the Entiat River (484 miles upriver) between May and August each year. Adult fish hold in deep pools within the Entiat River or Columbia River from May to August and then move upriver to spawn in the Entiat and Mad Rivers from late August to late September. Within the project analysis area approximately 68 spring-run Chinook salmon redds were identified during surveys by the USFWS in 2011 (Hamstreet 2012). The 2009 Tributary Assessment (Reclamation 2009) provides context and background information regarding the historical abundance and long-term population trend of spring-run Chinook salmon in the Entiat River subbasin. The 1999 listing of the UCR spring-run Chinook salmon was a direct response from the NOAA Fisheries to the diminishing population trend of this species.

Currently, in the Entiat River, spawning generally begins in August near RM 30, then progresses downriver as stream temperatures drop and is typically completed by the 3rd week of September. Adult Chinook salmon die within a short time after spawning and carcasses can often be observed in close proximity to newly constructed redds. Decomposition of carcasses contributes nutrients back to the stream where their eggs have just been deposited; thereby contributing to the growth of their offspring. Spring Chinook salmon eggs remain in the gravel until hatching in December and fry emergence occurs in January and/or February (LaVoy 1992, as cited in Reclamation 2009). Juveniles spend approximately one year in fresh water before smolting and migrating to the Pacific Ocean between April and June. Adult spring Chinook salmon returning to the Wenatchee River system, had remained in the

ocean from 2 to 3 years before they matured and returned to spawn (Mosey and Murphy 2000).

The Entiat National Fish Hatchery (ENFH) raised spring-run Chinook salmon from 1979 to 2008. Beginning in the fall of 2009, the ENFH began raising summer Chinook salmon. The goal of the program is to maintain a segregated harvest program for summer Chinook salmon. Fish from this program are not intended to spawn naturally and are not intended to establish, supplement, or support any summer Chinook salmon populations occurring in the natural environment (USFWS 2017a).

Steelhead

Steelhead of the Upper Columbia River Distinct Population Segment (DPS) were listed as Threatened under the ESA on August 18, 1997 (re-evaluated on January 1, 2006). Critical Habitat was designated on September 2, 2005. Steelhead exhibit one of the most complex suites of life history traits of any salmonid species. Entiat River steelhead enter and ascend the Columbia River in June and July, arriving near their tributary spawning grounds by November. However, some steelhead hold in the mainstem Columbia River until the following February or March before moving into natal streams to spawn (English et al. 2001). Unlike other anadromous salmonids that return from the ocean to spawn and subsequently die, steelhead have the ability to migrate back to the ocean after spawning and to return and spawn again.

The population of steelhead within the Entiat River is not known with certainty due to the inability to distinguish resident Rainbow Trout from steelhead juveniles and due to a short period of record for spawning surveys (2003 to 2008). Spawning survey data from the Mad River and Entiat River indicate that the Entiat/Mad steelhead population has ranged from 150 spawning adults (2007) to 550 spawning adults (2008), assuming 2 fish per redd. UCR steelhead spawning has been documented within the project area. Between 2005 and 2012 approximately 79 steelhead redds were documented in the project area (Reclamation 2014), an average of approximately 10 redds per year.

Non-protected Anadromous Fish

Summer/Fall-run Chinook salmon

Chinook salmon of the UCR Summer/Fall-run ESU are currently not warranted for protection under the ESA. Summer/Fall-run Chinook salmon in the Columbia River are defined as “ocean-type.” Ocean-type Chinook salmon juveniles migrate to the sea as sub-yearlings and return as adults to their natal stream from late summer to fall, and spawn almost immediately. They are also referred to as summer/fall, or ‘late-run’ Chinook salmon. The term summer will be used for discussion purposes in this section. UCR summer Chinook salmon return to the Entiat River primarily in July and August, but may enter the

river into early October. Virtually all summer Chinook salmon returning to the Entiat River spawn in 23 miles of the mainstem downstream of the Preston Creek confluence, although they have been observed above Box Canyon and as far upstream as Entiat Falls (USFWS and WNF 1996). No summer Chinook salmon spawn in the tributaries of the Entiat River. Data indicate the primary main stem spawning area is found in the Project Area between RM 16.2 to 18.7. Spawning begins in late September, peaks in late October, and ends in early November (Peven 1992). Spawning has been recorded in the project reach, with spawning recorded between late-September and early-November (USFWS 2004; Hamstreet 2012). Juveniles emerge from the gravel sometime between January and April and most travel downstream to the ocean in their first year of life.

Within the analysis area and between RMs 16.2 and 28.9, spawning surveys have occurred since 1994. Between 1994 and 1999, the number of redds recorded annually was below 50. Since 2001, the number of redds recorded annually has been at or above 100. In 2015, 212 Spring-run Chinook salmon redds were recorded. The number of redds appear to be relatively stable, but are certainly below historic levels that were observed before the completion of the construction of Grand Coulee dam in 1941.

Sockeye Salmon

Sockeye salmon were not originally found in the Entiat River (Craig and Suomela 1941). They were stocked only twice, in 1943 and 1944, from Lake Quinault and Lake Whatcom stocks. From that, a small run was observed spawning in the Entiat River from 1945 to 1955. Between 75 and 150 sockeye salmon were noted in the Entiat River during incidental counts over the period 1969 to 1981 (Mullan 1986). Little is known about sockeye salmon life history strategy in the Entiat River. Spawning occurs between mid-September and mid-October. Gravel emergence occurs from March through May, and juveniles are assumed to move downstream immediately afterward to the rear in the lower reach of the Entiat River and the Columbia River reservoir (Chapman 1995).

Coho Salmon

Although Coho Salmon were once present in the Entiat subbasin, only 475 Coho Salmon were counted at Rock Island Dam, located on the Columbia River downstream of the Entiat River, from 1933 to 1943. From 1942 to 1975, 46 million juveniles were released by hatcheries; however, this effort failed to re-establish populations, and mid- and upper Columbia River Coho Salmon are now considered an extirpated species under the ESA (Andonaegui 1999). In an effort to reintroduce Coho Salmon, the YN recently initiated a juvenile release program in the Wenatchee and Methow subbasins. Although no Coho Salmon were released in the Entiat subbasin, straying of returning adults has been documented. In October 2001, during their spring-run and summer-run Chinook salmon spawning ground surveys, the USFWS identified 12 Coho Salmon redds, three adults, and three carcasses. In 2002, one Coho Salmon carcass was noted near the confluence with the

Columbia River (Hamstreet and Carie 2002). In 2011, the USFWS documented 10 Coho Salmon redds, 15 adults and 8 carcasses (Hamstreet 2012). In subsequent years, the USFWS has noted the presence of Coho Salmon redds, adults and carcasses but has not quantified the amount observed.

Pacific Lamprey

Pacific lamprey are known to occur in the Entiat River, but little is known related to their abundance and distribution within the subbasin and their potential occurrence within the project study area. A petition to protect the Pacific lamprey under the ESA was received by the USFWS on January 27, 2003. In 2004, the USFWS found that the petition did not provide the required information to indicate that listed the species may be warranted and, therefore, a status review was not initiated. Pacific lamprey do have cultural importance to several Northwest Tribes within the Columbia River Basin. Pacific lamprey have commercial, subsistence and ceremonial significance for several Tribes, including the YN.

Spawning takes place in the spring in low-gradient sections of water with gravel and sandy bottoms, when water temperatures are between 50 and 60°F. Adults die within 3 to 36 days after spawning (Clemens et al. 2013).

The young (ammocoetes larvae) hatch in 2 to 3 weeks and are dispersed by currents to slack-water areas with soft substrates, where they settle in sediments, which are soft and rich in dead plant materials. They quickly burrow into the muddy bottom where they live for a period of 3 to 8 years as filter feeders consuming microscopic plants (mostly diatoms) and animals. Late in the ammocoetes life stage, unknown factors trigger a metamorphosis, from which lamprey juveniles emerge. During high water periods, in late winter or early spring, the juveniles migrate to the ocean where they mature (Moyle 2002).

Federally-Protected Non-Anadromous Fish

Bull Trout

Currently, Bull Trout found in the mainstem Entiat and Mad Rivers are considered to be two distinct local populations. Bull Trout are known to occur in the Entiat and Mad Rivers (located downstream of the analysis area), exhibiting both fluvial (residing in and migrating between rivers and streams) and resident (resides in natal stream) life history strategies. Bull trout spawning surveys conducted by the USFWS (Nelson 2014) between 2007 and 2013 recorded the number of Bull Trout redds between RM 11.18 and 18.7. The number of Bull Trout redds fluctuates considerably annually, with a peak of 29 redds recorded in 2007 and a low of 2 redds recorded in 2013 (Nelson 2014). Fluvial Bull Trout that spawn within the analysis area migrate between tributaries of the Columbia River. Bull trout use the habitat within the analysis rea for adult migration and spawning, egg incubation, and juvenile rearing and migration. Overall, the Mid-Columbia Recovery Unit is considered vulnerable, but

specific actions have been identified that would contribute toward Bull Trout recovery in the Mid-Columbia Recovery Unit, which includes implementing conservation actions (USFWS 2015).

Non-protected Non-anadromous Fish

Other Non-protected Non-anadromous Fishes

Several species of resident salmonids, including; Rainbow, Westslope Cutthroat, Brook, and Interior Redband Trout, as well as Mountain Whitefish utilize the Entiat River and tributary habitats year-round. In 2001, a petition was made to list Westslope Cutthroat Trout. The petition to list Westslope Cutthroat Trout as threatened under the ESA was found to be "not warranted" by the USFWS in April 2000 and again in August 2003. Westslope Cutthroat Trout continue to be a federal species of concern as their status is uncertain in the Entiat River. Other resident fish identified in Table 3-7 likely occur within the analysis area as well, with residence times lasting from weeks to year-round. Fish that may occur in the analysis area for spawning, such as suckers and northern pike minnow, may occur in the analysis area for weeks. Fish such as sculpins, dace and stickleback would be expected to occur within the analysis area year-round.

Wildlife

Habitat Conditions

Terrestrial habitat within the analysis area has been modified through human development such as hayfields, forest practices, infrastructure and residential development, much of which is located within the floodplain or valley bottom areas. Riparian vegetation is sparse and typically consists of narrow, fragmented patches of trees along either bank.

Overall terrestrial habitat conditions within the valley bottom and floodplain areas have been extensively modified by human activity. Upland areas within the analysis area have similarly been modified through grazing, road building, and logging activities. The analysis area is located at an elevation of approximately 1,500 to 1,600 feet. Current activities such as forest management, wildland fire fighting and military flights that occur within the Entiat River subbasin generate elevated noise levels from the use of heavy equipment (i.e., trucks, helicopters), hand-equipment (i.e., chain saws) and military jets. It is therefore expected that wildlife species that occur within the subbasin are acclimated to elevated noise levels similar to those that would be generated by the proposed project.

Species

Historically, the types and numbers of wildlife present in the Entiat subbasin have varied as much as the habitats on which they depend. Fluctuations in habitat conditions due to climate,

wildfires, and other natural events have been a common occurrence in the subbasin. Prior to European settlement, wildfires occurred frequently in the lower elevations, but were of low intensity and allowed for the maintenance of somewhat stable wildlife populations. Human activities such as development, hayfields, logging, roads, and fire suppression have exacerbated natural disturbances and now both natural and manmade changes have effected resulted in fragmented habitat for many species (NPCC 2004). Some of the more common species known to occur in the Entiat Valley are shown in Table 3-8 (NPCC 2004; WDFW 2017).

Table 3-8. Wildlife occurrence in the Entiat River subbasin.

Species	Federal/State Status	Comments
Federally-protected Wildlife Species		
Marbled Murrelet (*Crachyramphus marmoratus*)	T/T	May occur in Chelan County, but not expected in Entiat River subbasin.
Northern Spotted Owl (*Strix occidentalis caurina*)	T/E	Resident within the Entiat River subbasin.
Yellow-billed Cuckoo *(Coccyzus americanus*)	T/C	Rare in Washington with individual siting's, including Chelan County. Breeding no longer occurs in Washington. Only 8 siting's in eastern Washington between 2000 and 2012.
Gray wolf *(Canis lupus)*	E/E	There have been unconfirmed sightings in the past several years.
Grizzly bear *(Ursus arctos)*	T/E	Habitat exists and occurrence is suspected but not confirmed within the Entiat River subbasin. They are an extremely wide-ranging animal with individuals requiring several square miles of habitat.
Canada Lynx *(Lynx Canadensis)*	T/T	Sightings have been documented in the Entiat River subbasin, but occurrence is rare.
North American Wolverine (*Gulo luscus*)	PT/C	Rare in Washington with 10 wolverines captured in the state between 2006 and 2012. No sitings documented in the analysis area.
Non-protected Wildlife Species		
Black bear (*Ursus americanus*)	NA	Common throughout Washington.
Cougar (*Puma concolor*)	NA	Common throughout Washington.
Coyote (*Canis latrans*)	NA	Common throughout Washington

Species	Federal/State Status	Comments
Mule deer *(Odocoileus hemionus)*	NA	Mule deer are the most important big game animal in the Entiat River subbasin. Although populations are currently depressed after the 1994 wildfires. It would take 10 to 15 years for them to recover to post fire levels.
Great blue heron *(Ardea Herodias)*	NA	Great blue herons are commonly observed in the lower Entiat River subbasin.
Peregrine falcon *(Falco peregrinus)*	SC/S	Birds have been seen in the Entiat River subbasin.
Osprey *(Pandion haliaetus)* Prairie falcon *(Falco mexicanus)*	NA NA	Observations of both have been made in the Entiat River subbasin. Ospreys are common residents.
Northern goshawk *(Accipiter gentilis)*	SC/C	Both species have been observed in the Entiat River subbasin and are assumed year-round residents.
Swainson's hawk *Buteo swainsoni*	NA	Swainson's Hawks prefer open grassland habitat. Goshawks prefer forested habitat.
Black-backed woodpecker *Picoides arcticus*	NA/C	Nest and forage within the Entiat River subbasin.
Pileated woodpecker *Dryocopus pileatus*	NA/C	Nest and forage within the Entiat River subbasin.
Dunn's salamander *(Plehodon dunni)*	NA/C	Occurs within the Entiat River subbasin.
Western Toad *(Bufo boreas)*	NA/C	Occurs within the Entiat River subbasin.
Columbia spotted frog *(Rana luteiventris)*	NA/C	Occurs within the Entiat River subbasin.
Northern leopard frog *(Rana pipiens)*	NA/E	Occurs within the Entiat River subbasin.
Sharptail snake *(Contia tenuis)*	NA/C	Occurs within the Entiat River subbasin.
Striped whipsnake *(Masticophis taeniatus)*	NA/C	Occurs within the Entiat River subbasin.
Birds with Other Regulatory Protection [*Migratory Bird Treaty Act (MBTA) and Bald and Golden Eagle Protection Act (B&GEPA)]*		
Bald eagle *(Haliaeetus leucocephalus)*	MBTA and B&GEPA	Bald eagles are residents of the Entiat Subbasin.
Black Swift (*Cypseloides niger*)	MBTA	Breeding
Brewer's Sparrow (*Spizella breweri*)	MBTA	Breeding
Calliope Hummingbird (*Stellula calliope*)	MBTA	Breeding

Species	Federal/State Status	Comments
Cassin's Finch (*Carpodacus cassinii*)	MBTA	Year-round residents
Eared Grebe (*Podiceps nigicollis*)	MBTA	Breeding
Flammulated Owl (*Otus flammeolus*)	MBTA	Breeding
Fox Sparrow (*Passerella iliaca*)	MBTA	Breeding
Golden Eagle (*Aquila chrysaetos*)	B&GEPA	Golden eagles are residents of the Entiat Subbasin.
Greater Sage-grouse (*Centroceus urophasianus*)	MBTA	Year-round residents
Lewis's Woodpecker (*Melanerpes lewis*)	MBTA	Breeding
Loggerhead Shrike (*Lanius ludovicianus*)	MBTA	Breeding
Long-billed Curlew (*Numenius americanus*)	MBTA	Breeding
Peregrine Falcon (*Falco peregrinus*)	MBTA	Breeding
Rufous Hummingbird (*Selasphorus rufus*)	MBTA	Breeding
Sage Thrasher (*Oreoscoptes montanus*)	MBTA	Breeding
Short-eared Owl (*Asio flammeus*)	MBTA	Year-round residents
Swainson's Hawk (*Buteo swainsoni*)	MBTA	Breeding
Western Grebe (*Aechmophorus occidentalis*)	MBTA	Breeding
White Headed Woodpecker *(Picoides albolarvatus)*	MBTA	Year-round residents
Willow Flycatcher (Empidonax traillii)	MBTA	Breeding
Notes: Federal Status: E=Endangered; T=Threatened; PT=Proposed Threated; SC=Species of Concern MBTA=Protected under the Migratory Bird Treaty Act B&GEPA=Protected under the Bald & Golden Eagle Protection Act State Status: E=Endangered; T=Threatened; C=Candidate; S=Sensitive		

Federally-protected Wildlife Species

There are three mammals and one bird species listed under the ESA with the potential to be in the Entiat Valley: grey wolf, grizzly bear, Canada lynx, and northern spotted owl.

Grizzly Bear: There have been unconfirmed sightings of the grizzly bear in the Entiat subbasin. Denning occurs at the higher elevations in the alpine, subalpine fir and white bark pine forests. Grizzlies forage primarily on vegetation in wet/dry meadows, marshes, low gradient stream bottoms, riparian areas, berry-producing shrub fields, avalanche chutes, rivers, and streams. They also feed on winter-killed deer, ground squirrels, mice, grubs, and ants. There is the potential for grizzly bear to migrate through the project area en route to more suitable habitats. However, due to their solitary nature, they more likely would avoid this area.

Gray Wolf: The gray wolf population in the Entiat watershed has decreased significantly from historical figures. They are currently listed as endangered under the ESA, but numbers have grown slightly in this area over the last few years. Although there are no known den sites in the Entiat River subbasin, they usually occur in remote country with sources of ungulates and water nearby. Prey includes deer, elk, mountain goats, bighorn sheep and small mammals. The Wolf Conservation and Management Plan (Wiles et al. 2011) was developed as the first wolves were becoming reestablished in Washington. The Plan was developed to outline the conservation and management objectives for wolf reintroduction. Within the Entiat River subbasin, no Wolf Recovery Regions have been identified and no known Wolf Pack Territories are documented (WDFW 2013a). In 2013 a wolf siting was documented in the Entiat River subbasin of a female wolf that had been tagged by WDFW. The wolf was from the Teanaway pack and was dispersing north (WDFW 2013b).

Canada Lynx: Lynx are associated with habitat above 4,000 feet elevation and use a mosaic of forest types. Their primary food source, snowshoe hare (*Lepus americanus*), is found in early successional lodgepole pine thickets, and lynx locate their dens in piles of large downed wood in late successional stands of larger conifers. This type of habitat is not present in the analysis area. However, there is the potential for lynx to migrate through the project area en route to habitats.

North American Wolverine: Wolverines are rare in Washington State, and generally occur in alpine and sub-alpine habitats of the cascades. Wolverines are not expected to occur in the project analysis area, as they are typically associated with areas with persistent spring snow cover (WDFW 2013a). There is the potential for wolverine to migrate through the project area en route to more suitable habitats. However, due to their solitary nature, they likely would avoid this area to avoid interactions with humans and human activity.

Northern Spotted Owl: Spotted owls have been known to exist in the Entiat watershed since 1986 when the first inventories were completed. The analysis area has not been surveyed for northern spotted owls, however Priority Habitats and Species (PHS) data from WDFW

(2017) does not indicate the presence of any northern spotted owl nest sites within the analysis area. Logging and fires have destroyed or damaged spotted owl habitat in the watershed. Suitable habitat for spotted owls consists of stands of trees with sufficient structure (large trees, snags, and downed wood) to provide opportunities for owl nesting, roosting, and foraging. Generally, these conditions are associated with conifer-dominated stands, 80 years old or older, multi-storied in structure, have trees greater than or equal to 18 inches mean diameter at breast height (dbh), and the canopy closure generally exceeds 60 percent. Stands are defined at a larger scale (e.g., province) as suitable based just on age or size (i.e., 80 years, >18") alone (USFWS 2013)). Designated critical habitat does not occur within the project analysis area. The nearest designated critical habitat for the northern spotted owl is approximately three miles west of the project analysis area (77 FR 71875).

The USFWS critical habitat data rates areas in terms of Relative Habitat Suitability (RHS) for northern spotted owls. Habitat suitability ranges from 0 to 1. Habitats with RHS values below 0.35 have a low likelihood of occupancy by nesting spotted owls. The habitat that would be flown over by helicopters has an RHS value of 0.26 or less (Halupka 2017); this low RHS may indicate a lower chance that northern spotted owls would nest in the project area.

Marbled Murrelets: The USFWS species list obtained for the project indicates that marbled murrelets may occur in the project area. However, marbled murrelets typically occur within 50 miles of Puget Sound or coast waters, and it is unusual for them to occur on the east side of the Cascade Mountains. Marbled murrelets are not anticipated to occur within the Study Area, due to the distance from Puget Sound and lack of a clear migratory pathway along a river valley between the analysis area and Puget Sound.

Birds with Other Regulatory Protection (MBTA and B&GEPA)

Several species of birds are also federally-protected under the Bald and Golden Eagle Protection Act and/or the Migratory Bird Protection Act. These species are identified in Table 3-8, and discussed briefly below.

Bald Eagle: The USFWS species list obtained for the project indicates that bald eagles may occur in the project area. The WDFW PHS data (WDFW 2017) does not indicate the presence of any bald eagle nest sites or winter roost sites within the project analysis area. Bald eagles may occur within the analysis area year-round.

Golden Eagle: The USFWS species list obtained for the project indicates that golden eagles may occur in the project area. PHS data do indicate the presence of golden eagle breeding activity in the vicinity of the project analysis area (WDFW 2017). Golden eagles may occur within the analysis area during the breeding season, and could occur year-round.

Other birds that may occur in the analysis area year-round, according to the USFWS species list obtained for the project include Cassin's Finch, Greater Sage-grouse, Short-eared Owl and White-headed Woodpecker. PHS data does not document any occurrences of these species. Cassin's finch is typically associated with montane pine forests, and could occur in the project analysis area. Sage-Grouse are found almost exclusively in dry sagebrush plains, and thus would not be expected to occur in the project analysis area. Short-eared owl is typically found in open expanse, coursing low to the ground in search of prey, and could occur within the project analysis area. The white-headed woodpecker is associated with mountain conifers and could occur within the project analysis area.

Birds occurring in the subbasin during the breeding season are identified in Table 3-8. The breeding season, including nesting, rearing, fledging and dispersal, typically occurs in spring and summer. Specific times vary by species. While PHS data does not document the presence of any of these species in the project analysis area, many of these species are relatively common in Washington and are assumed to be present.

Non-protected Wildlife

Several species of wildlife are common in Washington and are expected to occur in the Entiat River subbasin, as identified in Table 3-8. These species include mammals and birds.

Mammals

Mammals such as black bear, cougar, coyote and mule deer are common throughout the area and could occur within the analysis area during project construction. These mammals are highly mobile and occur in a variety of habitat types as they migrate within their home range and forage and stalk prey.

Birds

Birds that are likely to occur in the Entiat River subbasin, as identified in Table 3-8 above, could occur during the construction period.

Amphibians

Amphibians such as salamanders and frogs may occur in the analysis area, and could be present in aquatic habitats during construction. WDFW (2017) PHS data does not indicate any documented observations or detections of the amphibians identified in Table 3-8 within the analysis area.

Reptiles

Reptiles such as snakes and lizards may occur in the analysis area, and could be present in terrestrial and aquatic habitats during construction. WDFW (2017) PHS data does not

indicate any documented observations or detections of any reptiles identified in Table 3-8 within the analysis area.

3.5.2 Environmental Consequences – Proposed Action

Fish

Although the proposed project activities are designed to improve aquatic habitat conditions for anadromous salmonids, post-project, construction activities could affect anadromous salmonids and other fish and aquatic organisms in the short-term, during construction.

The project is intended to provide substantial benefits for federally-protected anadromous fish, including UCR Chinook salmon and steelhead. The project would improve habitat conditions that support adult holding and successful spawning and egg incubation as well as juvenile rearing. Other native fish, both anadromous and resident fish, would also benefit from the increased habitat complexity created by the project.

The project would result in construction and post construction impacts. Fish and fish habitat would be affected by in-water construction activities that would include; installation of LWM structures, creation of off-channel habitat, heavy equipment crossing and operating within the active channel, installation of cofferdams, and the removal of riparian vegetation. Fish and fish habitat would be affected post-project by the habitat created, and the functions and processes that would develop post construction, which would be intended to provide increased habitat complexity and habitat forming processes over time.

To avoid and minimize potential adverse impacts, the proposed project would be implemented following the General Aquatic Conservation Measures required by the Programmatic HIP III BiOp (USFWS 2013), which at the time of design was intended to be the tool to comply with the ESA. Thus the avoidance and minimization measures outlined within the Programmatic BiOp were included as design features for the proposed project. However, the Programmatic BiOp would no longer be used to comply with the ESA Section 7 consultation requirements, and the project would be required to comply through an individual ESA Section 7 consultation. All of the required environmental design features and BMPs are listed in Chapter 2, Table 2-8 for each of the environmental elements for which they apply.

Construction Impacts

Construction impacts would result from in-water construction activities. The discussion below focuses on the impacts to fish and fish habitat that could result from such construction activities.

Sediment and Turbidity

In-water construction activities, such as driving heavy equipment across the wetted channel, coffer dam installation, off- and side-channel creation and enhancement, installation of LWM structures, levee removal, and gravel removal and replacement on adjacent gravel bar for new channel alignment, could result in an increase in sedimentation and turbidity. Sedimentation and erosion associated with construction of the project could potentially affect fish and fish habitat. Ground-disturbing construction activities could potentially degrade aquatic habitat through erosion and subsequent sediment transport and delivery to streams. Short-term pulses of suspended sediments (i.e., elevated turbidity) have been shown to cause Physiological effects (gill trauma in salmonids, changes to blood chemistry and impaired osmoregulatory capability (Bash et al. 2001). Suspended sediment may cause behavioral effects to fish including avoidance, changes in foraging ability, response to predation risk, and reduced territoriality (Meehan 1991). Deposition of excessive fine sediment on the stream substrate could eliminate habitat for aquatic insects; reduce density, biomass, number, and diversity of aquatic insects and vegetation; reduce the permeability of spawning gravel; and block the interchange of surface and subsurface waters. Increases in fine sediments in low-velocity stream reaches could also cover suitable spawning gravel. Other potential effects include channel braiding, increased width/depth ratios, increased incidence and severity of bank erosion, reduced pool volume and frequency, and increased subsurface flow. Such changes could result in a reduction in the quality and quantity of spawning and rearing habitat (Meehan 1991).

The project would incorporate BMPs to avoid or minimize sediment inputs to the river during construction, as well as minimize potential increases in turbidity associated with in-water activities. Spawning activity by Chinook salmon and steelhead has been documented within the project analysis area; however, the project would not introduce any new sources of fine sediments. Ground-disturbing activities would disturb floodplain soils, where much of the sediments are alluvial. Thus, the project would not be likely to introduce fine sediments at quantities that would be expected to affect spawning areas, further increase substrate embeddedness, or degrade existing channel conditions.

Turbidity would increase during construction from in-water construction activities outlined above (see Section 3.4 Water Resources), but would likely not increase to levels that could cause injury to, or affect the physiology of fish that may be present within the analysis area. Turbidity levels may temporarily affect the behavior of fish, causing such behavioral changes as avoidance of project activities, or turbidity levels may temporarily affect juvenile foraging success and response to potential predation.

Adhering to the approved in-water work window would ensure that in-water activities occur when the life history stages of federally-protected fish species that are best able to avoid increased turbidity are present and impacts to incubating eggs or alevins (newly hatched fish)

are minimized to the greatest extent practicable. In-water work windows are intended to be protective of all fish life, not just federally-protected fish.

Riparian Vegetation Removal

Riparian vegetation directly influences the quality of salmonid habitat, affecting cover, food, instream habitat complexity, streambank stability, and temperature regulation. LWM recruited from streamside trees provides instream cover and habitat complexity, an essential component of fish habitat. Riparian vegetation also provides shade and an insulating canopy that moderates water temperatures in both summer and winter. Riparian vegetation provides a filter that reduces the transport of fine sediment to the stream, and the roots provide streambank stability and cover for rearing fish (Meehan 1991).

Riparian vegetation influences the food chain of a stream, providing organic detritus and terrestrial insects. Riparian vegetation also controls aquatic productivity dependent on solar radiation (Meehan 1991). Because of the numerous ways riparian vegetation influences the stream ecosystem, the effects of altering riparian vegetation are highly variable, ranging from potential increased sedimentation and stream temperatures to decreased food production and habitat complexity depending on various factors ranging from the size of the stream to the condition and integrity of the riparian corridor.

The project would permanently remove approximately 5 acres of riparian grasses, trees or shrubs where LWM structures would be placed and side channel habitat would be enhanced and created. The project would also temporarily disturb approximately 23 acres of grass and shrubs to accommodate access roads and staging areas. To the extent practicable, every effort would be made to preserve riparian vegetation. The project would restore and enhance habitat to improve conditions for salmonids, which would also include restoration of riparian habitat. Temporarily disturbed areas would be replanted with native vegetation appropriate for site conditions within the riparian corridor and monitored to ensure compliance with survival metrics that would be required as part of the terms and conditions of permits to be issued for the project.

Underwater Noise

A total of 672 pilings would be driven with a vibratory pile driver for the construction of the primary LWM and secondary LWM structures. Injury threshold values typically result from impact pile driving, as opposed to vibratory pile driving because sound- or pressure-related injuries, such as barotraumas, are thought to result from the rapid rise times and fluxes in over- versus under-pressure during a pile strike, which does not occur during vibratory pile driving. Impacts on fishes or other aquatic organisms have not been observed with vibratory hammers. This may be due to the slower rise time of the sound pressure levees and the fact that the energy produced is spread out over the time it takes to drive the pile. As such,

vibratory driving of piles is generally considered less harmful to aquatic organisms and is the preferred method, as opposed to impact pile driving (WSDOT 2017).

Fish Removal and Exclusion

Fish exclusion and removal efforts would be required to construct many of the primary LWM structures and avoid and minimize impacts to fish, fish habitat and water quality. The approved in-water work window for Chelan County is July 15 through July 31. No work would be allowed from August 1 through mid-September. In water work would be allowed to proceed in isolation of flowing waters from around mid-September through October 31. Specific dates to be defined by WDFW, NOAA Fisheries, and USFWS. The flow in the Entiat River is anticipated to be low during the in-water work windows (July 15 through August 31 and mid-September through October 31), depending upon snow pack and precipitation the year of construction.

Fish exclusion and removal would require the use of a beach seine. The beach seine would be deployed from shore and would move waterward from shore to exclude fish from the in-water work area. Juvenile salmonids that may occur in the vicinity will likely be located in the water column, above the substrate, and would move away from the beach seine as it is deployed.

Beach seining can affect fish in several ways, causing stress, scale loss, physical damage, suffocation, or desiccation. These stresses are more likely when fish are captured as a result of beach seining. For this project, the beach seine would not be used to capture fish but to exclude fish from the in-water work area. Thus, these types of impacts are not anticipated.

No electrofishing or fish salvage is proposed or anticipated based on the methods for fish exclusion and removal and the volitional movement of fish from the in-water work area being isolated. Additionally, beach seining efforts are expected to be effective at excluding fish from the in-water work due to the low water levels, lack of complex substrate and channel structure and uniform profile of the channel bottom in much of the project area.

Once the in-water work area has been isolated with the beach seine, a cofferdam would be installed to isolate the work area from flowing water, but would be open at the downstream end and would not completely isolate the work area from the river. The beach seine would be used as a block net at the downstream end of the cofferdam. Another beach seine would be used to sweep the isolated work area to ensure no fish are located in the isolated in-water work area. Biologists would snorkel the isolated in-water work area to confirm no fish are present. Once the absence of fish from the in-water work area is confirmed, a silt curtain would be installed at the downstream end of the cofferdam to contain turbid waters within the isolated work area.

Post-Construction Impacts

The post construction impacts are intended to be beneficial for fish by improving habitat conditions. The project would reconnect floodplain habitat; create and enhance side-channel habitat; increase habitat complexity, and; enhance habitat forming processes such as lateral channel migration, channel scour and formation and maintenance of pool/riffle habitats. Specifically, the project would result in the following benefits to fish and fish habitat:

Installation of 86 LWM structures and placement of 37 individual logs within side channel areas to enhance cover. LWM structures would create pools in which adult salmonids could hold and create tailouts at the downstream end of pools that would contribute to suitable spawning habitat in terms of water depth, velocity and substrate sizes. The pools and cover created by the LWM structures would also provide suitable rearing habitat for juvenile salmonids, provide food resources such as aquatic insects for juvenile salmonids and other fish species. Most of the LWM structures would be wetted and provide cover for juvenile salmonids during a range of flow conditions, while some LWM structures would be dry during summer low flow conditions.

Channel modifications would increase habitat complexity for juvenile and adult salmonids and other native fish species by providing deep-water habitat, which provides rearing and holding areas for fish within the main-stem river, creating and increasing accessing to off-channel habitat, encouraging some lateral channel migration as well as protecting some streambanks from erosion with placement of LWM structures, and reconnecting floodplain habitat. Channel modifications include the installation of several instream structures intended to benefit juvenile and adult salmonids and increase productivity. Refer to Sections 2.2.2 for specific information related to instream structures.

The creation of pools would be maintained by the hydraulic conditions created by the LWM structures. The LWM structures have been designed concentrate the current and subsequent scour to avoid bank erosion in certain instances as well as direct flow away from sensitive structures such as Entiat River Road. The LWM structures are also intended to create channel scour, develop pool habitat and create tailouts with suitable substrate for spawning by Chinook salmon and steelhead, as well as rearing habitat for juvenile salmonids. The hydraulic conditions created by the LWM structures would maintain the pool formation and prevent sediment from settling out and filling in the pool.

Overall, the channel modifications that would occur as a result of the project would increase productivity within the Entiat River.

The project would result in a total of 5,240 linear feet of newly inundated side channels. This includes 4,634 linear feet of newly constructed side channels and an additional 606 linear feet of existing side channel that would be reconnected to flows from the Entiat River.

Side channel habitat would provide suitable rearing habitat for juvenile salmonids (Roni et al. 2014). Increased side-channel habitat would increase opportunities for juvenile salmonids to seek areas with reduced water velocities and reduce the potential that juveniles would be swept downstream to less suitable habitats or areas with increased predation pressure (i.e., the Columbia River), allowing juveniles to grow larger before outmigrating through downstream areas with increased predation risk. Larger juvenile salmonids have increased survival during their downstream migration. Increases in rearing habitat could contribute to greater duration for juvenile salmonid rearing and opportunity for greater growth prior to beginning downstream migration.

Removal of 1,000 linear feet of existing levee would further increase the extent of potential rearing habitat for juvenile salmonids. The exiting levee disconnects the Entiat River from its floodplain. Removal of the levee would reconnect floodplain habitat. Floodplain habitat can provide considerable benefits to juvenile salmonids (Roni et al. 2014), and other fish species.

The post construction condition is intended to provide beneficial effects by improved conditions for federally-protected anadromous fish, such as Chinook salmon and steelhead. The post construction condition would also provide benefits to other anadromous and resident fish that occur in the Entiat River, similar to the benefits outlined above.

Wildlife

Construction Impacts

There would be a low likelihood that the proposed project would impact ESA-listed Canada lynx, grizzly bear, gray wolf, or wolverine. These species are not expected to be in the project area based on the lack of potentially suitable habitat and current level of human activity. If they were traveling through the analysis area to areas of suitable habitat, they would likely avoid the area during construction when increased human activity would occur.

Impacts to terrestrial habitat in general would be avoided and minimized during construction of the proposed project, thus limiting the potential impacts to protected and non-protected wildlife species and migratory and resident birds. There is the potential that construction noise and activity would disturb wildlife and result in avoidance of the analysis area; however, this disturbance would be short in duration (June through August of 2018 and 2019), occurring only in localized areas.

Construction activities would occur during times that migratory birds may be breeding (June through September). Construction noise has the potential to disturb breeding and nesting birds and could result in temporary or permanent impacts to migratory birds. Noise impacts to nesting migratory birds could occur from helicopter activity, transporting logs from the staging area to each LWM structure on the southern bank of the Entiat River. Helicopter operation would be required for up to 2 to 3 days during each of the two construction seasons to complete the wood

placement. Helicopter operations can generate substantial noise levels (>100 dB) that could lead to nest abandonment for birds nesting in close proximity (i.e., within 0.5-miles) of the wood storage areas and the locations of the primary, secondary and individual log placement locations and points between. Conversely, it is also possible that given the short duration of construction activity, birds would remain on their nests. Additionally, as mentioned previous under the Affected Environment section, it is expected that wildlife species that occur within the subbasin are acclimated to elevated noise levels that currently occur from the use of heavy equipment (i.e., trucks, helicopters) and hand-equipment (i.e., chain saws) related to existing land use, as well as military jets that use the Entiat subbasin as a flight corridor during training exercises. The noise levels generated by these existing and use activities and military exercises would be similar to those that would be generated by the proposed project.

Construction would result in removal of vegetation that could be used by nesting migratory and resident song birds, which would reduce the extent of suitable habitat for these birds during and after construction. Trees would be replaced, post construction, which would reduce this impact over time. See below, for further discussion.

Construction would occur in close proximity to the Entiat River and in areas that lack mature vegetation suitable for the nesting of northern spotted owls. Wood obtained for the project would be commercially procured prior to construction and would adhere to regulatory and permitting requirements related to their procurement. Thus procurement of wood for the proposed project would have no effect on northern spotted owls or their habitat.

Construction of the project would require the use of helicopters to deliver wood, boulders, and machinery. Helicopters would be used because of the large amount of wood that would need to be moved in a short period of time. Helicopters would also minimize the disturbance of riparian vegetation and crossings of the river by heavy equipment during construction. Because of the in-water work window required by NOAA Fisheries and WDFW, the project would be implemented between July 15 and July 31, which overlaps with the critical nesting period for the northern spotted owl. In addition, helicopters would begin flying in the Entiat Valley as early as July 1. The presence of spotted owl nests in the analysis area has not been documented (WDFW 2017); however, relative habitat suitability of the area that would be influenced by helicopter noise is <0.26 (Halupka 2017), reducing the likelihood of nesting owls and subsequent impacts to owls. If nesting owls were present, they could potentially be impacted during the period when helicopters are operating.

While no golden or bald eagle nest sites are documented in the analysis area, one golden eagle nest site is documented approximately 1,100 feet beyond the analysis area (WDFW 2017), or 2,100 feet from the nearest LWM structure. The golden eagle nesting season occurs from January through August, although regional variations occur and this timeline is used as a general guideline (Pagel et al. 2010). For purposes of this analysis, it is assumed that the regional timing for the golden eagle nesting season within the analysis areas is the

same as the bald eagle nesting season in Washington. The bald eagle nesting season in Washington generally begins in January and extends into July. Fledging of young eaglets begins in June and extends into August (USFWS 2007). Construction would begin in July, with helicopter flights occurring in early-July and lasting approximately 2 to 3 days each year of construction, to transport the logs for the LWM structures. Nesting, egg incubation/hatching and rearing of young should be completed by early-July. Fledglings would likely be starting to fly and be mobile in early-July. Helicopter operations may cause disturbance to adult juvenile golden eagles, but would not result in nest abandonment or loss of eggs, as the eggs would be hatched and eaglets would be fledging.

Post Construction Impacts

Post-project, improvements intended to contribute toward natural functions within the Entiat River through the placement of LWM structures, creation and enhancement of side-channel habitat, reconnecting floodplain habitat, and the enhancement to the riparian corridor would result primarily in benefits to fish species but would also result in beneficial effects to wildlife. Since the Proposed Action would restore natural functions to the Entiat River, such as increased side-channel and floodplain connection, and improve riparian habitat conditions, wildlife species that rely on aquatic features such as side channels and functioning floodplain habitat as well as functioning riparian habitat would also benefit. Wetland enhancement and creation would also benefit amphibians, aquatic reptiles and birds that rely on wetlands all, or part of their life history.

Replanting of native trees in the disturbed areas post construction, would avoid and minimize long-term impacts of the project on wildlife/riparian habitat conditions. The project would result in an increase in vegetation in, and enhancement of the riparian areas along the Entiat River, which would provide improved habitat conditions for migratory and resident birds post-project, as vegetation becomes established.

Overall, wildlife habitat would be created or enhanced post construction through the construction and enhancement of side-channels, creation and rehabilitation of wetlands, and rehabilitation of riparian vegetation. In addition, restoration actions would be protected in perpetuity where it occurs on lands owned by the Chelan-Douglas Land Trust, as one of their missions is to protect natural areas to promote clean air and water and provide abundant wildlife opportunities.

3.5.3 Environmental Consequences – No Action

Under the No Action alternative, there would not be disturbance to fish and wildlife or their habitats from construction activities. In addition, the post construction habitat improvements outlined above under post construction impacts for both fish and wildlife would not be realized, and habitat conditions for juvenile salmonids and other fish species, as outlined in

Section 3.5.1, would be maintained, however the RPA Habitat Actions would not be implemented, specifically RPA Action 35: Tributary Habitat Implementation 2010-2018—Achieving Habitat Quality and Survival Improvement Targets. This RPA is intended to offset the continued operations of the FCRPS.

3.6 Visual Resources

Visual resources include the Entiat River valley within the project area that is visible to human inhabitants and users

3.6.1 Affected Environment

The landscape of the Entiat Valley is typical of the Northeast Cascade Mountains. The parallel ridges extend east-west and have approximately uniform crest elevations. The ridge tops have jagged rocky peaks of exposed rock that can be seen from the valley below. The geologic uplift that created the Cascades resulted in steep topography resulting in the Entiat and its tributaries becoming more erosive and resulting in narrow incised canyons. In addition, alpine glaciation significantly affected the upper half of the Entiat subbasin. During the last ice age a nearly 25-mile long glacier extended from its source at the top of the Entiat watershed to just below Potato Creek, where the debris accumulated at the front of the glacier as it moved, stopped. This feature, called a terminal moraine, indicates the furthest downstream influence of the glacier on the valley. Above the terminal moraine the Entiat Valley has a characteristic U-shaped appearance. As the glacier cut away the valleys of smaller tributaries it created what are called “hanging valleys” while broadening out the valley floor (the bottom of the “U”) creating a moderately broad floodplain.

The project area begins at the boundary with the Wenatchee-Okanogan National Forest. The majority of privately owned land is located within 1 mile of the mainstem Entiat River in a band that extends 26 miles upriver to the USFS Boundary above the project area.

Views within the project area are generally restricted by vegetation growing along the river. The clearest views of the project area are in areas closest to the Entiat River Road. Potential viewers of the project area would be either recreational users (boaters) or people travelling along Entiat River Road to access the OWNF lands. Residences on the northeast bank of the river in Project Area F also have views of the river. Recreational users are assumed to have high visual sensitivity to the aesthetic or visual environment because, for many types of recreation, the visual quality of the outdoor setting is an important component of the experience. Views from the portion of Entiat River Road that passes through the project area are limited to moving views because there are few places to safely pull-over. Motorists are

considered to have moderate to low sensitivity to the aesthetic or visual environment because they are focused on the road and have short viewing durations of an area as they pass by.

Approximately four residences located on the northeast bank of the Entiat River in Project Area F have views of the project area. Residents are considered to have high viewing sensitivity because of their familiarity with the landscape and long viewing duration. This is especially true for residents who have chosen to live in scenic areas such as the Entiat Valley.

Chelan County does not have regulations or ordinances related to or concerned with the visual or aesthetic quality of the project area.

3.6.2 Environmental Consequences – Proposed Action

Construction Impacts

The majority of construction activities would be visible from July through October in 2019 and 2020. During this time, construction vehicles, construction materials, and disturbed areas would be visible. Since construction would last for up to 6 months in both 2019 and 2020 and BMPs listed in Chapter 2 would minimize effects, the visual change to the landscape would be temporary.

Post Construction Impacts

Once construction is completed, elements of the proposed project would result in changes to the visual landscape. Many of the LWM structures would be visible from several locations along the Entiat River Road, the public access areas at Stormy Preserve, and the residences in Project Area F. LWM structures not visible from these locations would be visible to recreational boaters floating on the river and passing through the Project Areas. Over time, as new vegetation establishes and matures, the wood on the LWM structures bleach, and other wood debris collects on the structures, the changes would likely resemble natural features that commonly occur along large rivers and appear visually consistent with the surrounding landscape. Figure 3-1 shows a simulation of the construction of a Primary LWM structure in project area E. Photo 1 shows existing conditions. Photos 2-4 show the expected progression of the structure through construction to completion.

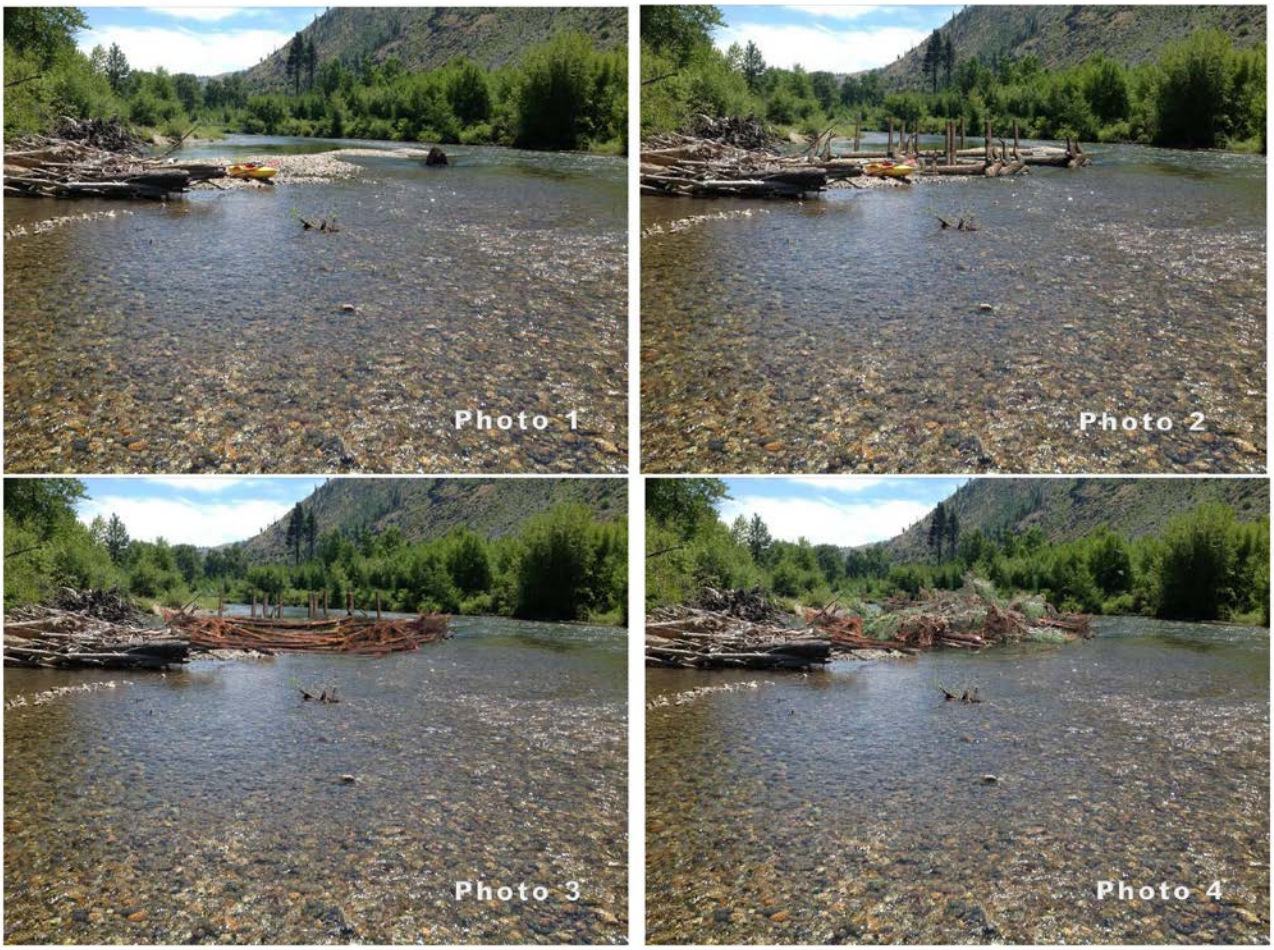

Figure 3-1. Photo simulations of primary LWM structure in Project Area E.

3.6.3 Environmental Consequences – No Action

Under the No Action alternative, no habitat improvement actions would occur along the Entiat River. The views, both from land and water, would still change overtime as the river bank erodes, cut banks shift, and as the river channel redeposits materials but would not be as pronounced due to lack of natural wood recruitment.

3.7 Cultural Resources

Cultural resources refers to the broad range of resources that represent or convey a place's heritage or the region's past. Cultural resources were analyzed in the locations of all proposed Project activities, including potential ground disturbance from temporary activities such as access sites and staging areas.

3.7.1 Affected Environment

Cultural resources are resources associated with human occupation or activity related to history, architecture, archaeology, engineering, and culture. Historic properties, as defined by 36 CFR 800, the implementing regulations of the National Historic Preservation Act (NHPA) (54 U.S.C. § 300101 et seq.), are a subset of cultural resources that are eligible for inclusion in the National Register of Historic Places (referred to as the NRHP). Historic properties may be districts, sites, buildings, structures, artifacts, ruins, objects, works of art, or natural features important in human history. These properties may be eligible for inclusion to the NRHP at the national, state, or local level. The properties may also be of traditional religious and cultural importance to an Indian tribe. To determine how the project would affect cultural resources, BPA contracted with Cultural Resource Consultants, Inc. (CRC) to conduct a cultural resource survey and prepare a cultural resources assessment that included conducting background research, a pedestrian survey of all areas where ground-disturbing activities would take place, and subsurface testing in areas with a high probability for encountering cultural resources (Berger and Hartmann 2015). An additional 1-acre parcel was identified after the completion of fieldwork that was not surveyed. Reclamation staff have completed cultural resource survey with the same field methods employed by CRC. Archaeological survey did not identify any new historic properties.

Archaeological Overview

Comprehensive overviews of more than 10,000 years of human occupation of Plateau and Cascade environments have summarized numerous archaeological, ethnographic, and historic investigations conducted over the past few decades (Ames et al. 1998; Mierendorf 1986 cited in Berger and Hartmann 2015). The general pattern of precontact adaptation and land use through time in the project area appears to demonstrate a change from a dispersed hunting and foraging strategy to a seasonal and semi-sedentary, riverine-oriented subsistence (Hollenbeck and Carter 1986:75-79 cited in Berger and Hartmann 2015).

Archaeological investigations were first conducted at the mouth of the Entiat River along the Rocky Reach of the Columbia River during the 1950s (Gunkel 1961). Gunkel's (1961) research distinguished many similarities between the Rocky Reach and the southern Plateau relative to projectile point types and tool-stone raw materials (Berger and Hartmann 2015). Schalk and Mierendorf (1983) conducted investigations throughout the Rocky Reach area of the Columbia River during the 1980s and suggested that precontact subsistence patterns were reflective of the unique regional environment, meaning that there appeared to be a subsistence pattern that incorporated significant resource exploitation of upland forested biomes rather than the predicted Plateau riverine regime (Berger and Hartmann 2015). Mierendorf (1986, cited in Berger and Hartmann 2015) developed a model of precontact land use in the North Cascades based upon production zones that can be applied to the project area: Zone 1 (river channels, lakes, and their shorelines), Zone 2 (floodplains), and Zone 3

(river terraces and valley margins). Subsistence activities in Zone 1 would have consisted of building and maintaining fish traps and other structures from rock and wood to procure fish, Zone 2 areas consist of larger villages and short-term habitations, and Zone 3 would include a variety of artifacts associated with residential, ceremonial, subsistence, manufacture, and travel (Mierendorf 1986:90-92 cited in Berger and Hartmann 2015).

Cultural resources previously identified in the vicinity of the study area consist of a single cryptocrystalline silicate flake; the remains of the Tyee Creek Logging Camp that was occupied in 1912; the Stormy Creek Pumice Pit, which was a 1940s pumice mining operation; an historic refuse scatter; the Mad River Trail #1409, which is an historic fire and grazing administration trail; and an earthen catchment ditch.

Although no previously recorded archaeological sites are located in the study area based on existing data from the Entiat Valley area, types of precontact and historic archaeological sites that could be present in the project area include cairns, lithic materials, fire-modified rock or other processing features, homesteads, logging, ranching, farming, or mining operations (Berger and Hartmann 2015).

Ethnographic Overview

The project area is within the traditional territory of the Entiat Tribe who were known for making their settlements close to watercourses and a reliance on fish and roots as food sources (Miller 1998). There were four known Entiat villages. The closest was a large permanent village located approximately 16 river miles downstream (12 miles southeast) from the project area at the mouth of the where the Entiat River meets the Columbia River. The Entiat Tribe fished for salmon primarily between the mouth of the river and approximately three miles upstream from the project (Hollenbeck and Carter 1986:141; cited in Berger and Hartmann 2015). Although the proposed Project is not located on federal land, Section 106 consultation was completed. No Traditional Cultural Properties (TCP) were identified in the study area during the archaeological investigation (Berger and Hartmann 2015).

The area was ceded in the Yakama Treaty of June 9, 1855, which formed the confederated tribes and bands of the Yakama signed by Governor Isaac Stevens of Washington Territory and Indian chiefs from different bands consisting of the Yakama, Palouse, Pisquouse, Wenatshapam, Klikatat, Klinquit, Kow-was-say-ee, Li-ay-was, Skin-pah, Wish-ham, Shyiks, Ochechotes, Kah milt-pah, and Se-ap-cat. From the original 10.8 million acres of Yakama lands, the treaty set aside 1.3 million acres for the Yakama Reservation. The remaining land, including the project area was ceded land (YN 2017).

The establishment of tribal treaties facilitated European American entry into the area. The project area was originally within the Moses-Columbia Reservation, established through

President Hayes's Executive Order on April 19, 1879. It reached from the Spokane River to the Columbia River to Lake Chelan and north to the Canadian border. The Moses-Columbia Reservation was expanded in 1880 to include the Entiat and other lands. Although Congress ratified the agreement, the reservation was short-lived. When gold and silver was discovered within the reservation's borders, miners and settlers hoping for land claims placed pressure on the government, nearly coercing Congress to eliminate the reservation. Chief Moses compromised and agreed to relocate to the Colville Reservation if his people were allowed to occupy parcels of land up to one square mile within the reservation. Presidential Executive Order of 1886 determined allotment boundaries, which were known as Moses allotments totaling to over 25,000 acres. However, many of these allotments were never granted to Native Americans who moved to the Colville Reservation. Irrigation right-of-way, mining claims, road development, and dams were constructed and settlers filed many homestead claims taking many of these allotments in the study area between 1898 and 1911 (Ruby and Brown 1995; Berger and Hartmann 2015). Allotments continued to be made on the former reservation until after 1934. The project site is located entirely on private land. The land is not owned by a recognized Indian tribe and does not occur on an individual tribal allotment.

Historic Overview

The first white settlers arrived in the Entiat Valley in May 1887 (Sage 1997). Settlement of the river valley upstream from Ardenvoir was sparse, but the population in the valley was large enough to support a school at McKenzie Canyon (Sage 1997), approximately one mile southeast of the project. Charles A. Harris & Son built Entiat's first lumber mill 1892 and a second mill was built at the mouth of the river in 1894 along the north bank of the Entiat River which helped establish the town of Entiat, Washington. Late nineteenth century economic pursuits in the area mainly consisted of logging, milling, and farming. Entiat's first lumber mill was constructed by Charles A. Harris & Son in 1892 and by 1894, a second lumber mill was constructed along the bank of the Entiat River (Holstine 1994; Berger and Hartmann 2015). The town grew and prospered around the second lumber mill and was reported to have a settler population of 80 individuals by 1894. Harris & Son continued to build lumber mills along the Entiat drainage as timber harvesting at the edge of the forest traveled up the valley (Holstine 1994; Berger and Hartmann 2015).

In the early twentieth century, irrigation schemes were developed and orchards and grain crops gained importance in the Entiat Valley (Luttrell 1994). Orchards were planted as far upriver as RM 14 or 15 but no farther due to the climate (Sage 1997). Between 1910 and 1921, the Entiat watershed was administered by the Chelan National Forest. By 1912, there was a ranger station near the mouth of Brennegan Creek a few miles upstream from the project (USFS 1912). At this time, the Entiat River Road was on the east side of the river and there was a trail on the north side of Potato Creek and another from the mouth of Tyee Creek up to Tyee Mountain (USFS 1912).

In 1933, the Civilian Conservation Corps (CCC) established Camp Entiat about 3 miles upstream from the project area. The camp served as a base for the construction of the Entiat Valley Road, which became the main transportation route from the Wenatchee National Forest downstream to Entiat. In conjunction with Chelan County, the CCC completed the project in 1936, but went on to construct additional roads, campgrounds, and other buildings in the Forest during the 1940s (Berger and Hartmann 2015).

During the 1940s and 1950s, especially in the West and Pacific Northwest, hydroelectric power development was taking place within major river systems. Hydroelectric power plants and dams quickly became an efficient and inexpensive way to provide electrical energy and by the 1940s, hydropower supplied roughly 75 percent of the Pacific Northwest's electricity (Reclamation 2017). Construction of The Rocky Reach Dam began in 1956 on the Columbia River, approximately seven miles upstream from Wenatchee, and was an important hydropower project that brought over 2,000 jobs to the area by the late 1950s. Cofferdams, a spillway, and a powerhouse was built and additional generators added to increase the power plant's generating capability by 60 percent between the late 1960s and early 1970s. Updates to the dam and power plant since the 1970s include newer fish friendly turbines and a juvenile fish bypass system added in the 1990s and early 2000s (Chelan County PUD 2017).

3.7.2 Environmental Consequences – Proposed Action

Construction Impacts

The cultural resources study concluded no pre-contact archaeological sites or isolates were identified as a result of the investigations (Berger and Hartmann 2015). No TCPs were identified in the project area based on the results of the investigations and tribal consultation, therefore, there are no anticipated project-related impacts on TCPs. Washington State Department of Archaeology and Historic Preservation (WDAHP) concurred with the determination of No Historic Properties Affected (WDAHP 2015). CCT issued no objections to the Project through consultation (CCT 2015). Therefore, BPA determined no additional cultural resource survey work was necessary. A single acre was later identified as not having been included for cultural survey. Reclamation staff completed survey of that parcel with the same field methods employed by CRC and found no new historic properties. Reclamation plans to adopt BPA's Section 106 process and findings.

In the event of a post-review discovery or inadvertent discovery during construction, Reclamation would implement an Inadvertent Discovery Plan that would be prepared before construction occurs, which would halt all ground-disturbing activity in the vicinity of the find and immediately notify Reclamation cultural resource staff. Reclamation would develop a similar plan regarding the procedures that would be followed in the event that human remains are inadvertently discovered. Ground-disturbing activities at the location of the discovery would be stopped until the legally required notification and evaluation processes had been

completed, depending on the nature of the discovery. The project proponent would be responsible for contacting Reclamation, who would then contact other appropriate agencies and Tribes. Construction at the site would not resume until a determination is made on any appropriate mitigation or protection of the resource. The Post-Review Discovery Plan would outline procedures that comply with Federal regulations specified at 36 CFR 800.13, as well as Washington State law Revised Code of Washington (RCW) 27.53. Because the project would take place on private or state lands, the Inadvertent Discovery Plan would focus on Washington State law, especially RCW 27.44: Indian Graves and Records, as opposed to the federal Native American Graves Protection and Repatriation Act.

One of the positive impacts of the proposed Project is that more fish would become available for tribal members exercising their treaty and traditional rights to fish. The greater availability of fish at locations along the Entiat River would serve to enhance tribal traditional cultural practices and could result in an overall positive benefit to cultural.

Post Construction Impacts

No post construction impacts would occur on cultural resources. Natural river processes would continue to occur and if no further project activity occurs, no post construction impacts are expected. If during post construction a decision is made by Reclamation or local sponsors to reshape or re-build a LWM structure or side channel, Reclamation would reinitiate the Section 106 compliance process by consulting with the Washington SHPO, the YN, and the CCT.

3.7.3 Environmental Consequences – No Action

Under the No Action alternative, because no habitat improvement actions would be implemented, there would be no potential for effects on cultural resources.

3.8 Sacred Sites

3.8.1 Affected Environment

Executive Order 13007, Indian Sacred Sites, provides further responsibilities for federal land management agencies to accommodate access to, and ceremonial use of, Indian sacred sites located on federal land by Indian religious practitioners and to avoid adversely affecting the physical integrity of such sacred sites. It also requires agencies to develop procedures for reasonable notification of proposed actions or land management policies that may restrict access to or ceremonial use of, or adversely affect, sacred sites on federal lands. Sacred sites are defined in the executive order as “any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an

appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site." The project area resides entirely on private land.

3.8.2 Environmental Consequences – Proposed Action

None of the tribes contacted as a part of this Project have specifically identified specific, discrete, or narrowly delineated sacred sites within the project area. Further, the Project would occur on private land. Therefore, there would be no impact of the Proposed Action on sacred sites.

3.8.3 Environmental Consequences – No Action

There have been no identified specific, discrete, or narrowly delineated sacred sites within the privately-owned project area. Therefore, there would be no impact of the No Action alternative on sacred sites.

3.9 Indian Trust Assets

3.9.1 Affected Environment

Indian trust assets (ITAs) are legal interests in property held in trust by the United States for federally-recognized Indian Tribes or individual Indians. ITAs may include land, minerals, federally reserved hunting and fishing rights, federally reserved water rights, and instream flows associated with trust land. The Yakama Treaty of 1855 states that "the exclusive right of taking fish in all the streams, where running through or bordering said reservation, is further secured to said confederated tribes and bands of Indians, as also the right of taking fish at all usual and accustomed places" (Yakama Treaty of 1855, Article 3).

As stated in the Presidential Memorandum dated April 29, 1994, *Government-to-Government Relations with Native American Tribal Governments*, Reclamation is responsible for the assessment of project effects on Tribal trust resources and federally recognized Tribal governments. Reclamation is tasked to actively engage and consult federally-recognized Tribal governments on a government-to-government basis when its actions affect ITAs.

The DOI Manual Part 512.2 delegates the responsibility for ensuring protection of ITAs to the heads of bureaus and offices (DOI 1995). The Department is required to "protect and preserve ITAs from loss, damage, unlawful alienation, waste, and depletion" (DOI 2000).

Reclamation is responsible for determining if a proposed project has a potential to affect ITAs.

Federally-recognized Indian Tribes with trust land are beneficiaries of the Indian trust relationship with the U.S. acts as trustee. No one can sell, lease, or otherwise encumber ITAs without approval of the U.S. Government. While the majority of ITAs are located on-reservation, ITAs can also occur outside reservation boundaries. No ITAs have been identified in the project area. The project occurs on private land not owned by a recognized Indian tribe or on an individual allotment.

3.9.2 Environmental Consequences – Proposed Action

Construction Impacts

Any Project related activities which might affect ITAs requires Reclamation to consult with the tribes, the Bureau of Indian Affairs, and other appropriate agencies to identify potentially affected ITAs, determine potential impacts to these assets, and provide recommendations for appropriate protection. No ITAs have been identified in the project area; therefore, there would be no loss, damage, unlawful alienation, waste, or depletion of these sites, and no change in the ability to exercise existing treaty rights due to the proposed project.

Post Construction Impacts

No post construction impacts would occur on ITAs. The Project, which is located entirely on private land and does not include ITAs, would not affect current access to the river or ability to fish in the river by tribes that consider the river a traditional or treaty fishing area.

3.9.3 Environmental Consequences – No Action

Under the No Action alternative, no habitat improvement actions would be implemented, and there would be no potential for effects on ITAs.

3.10 Land Use and Recreation

Land use includes current human uses, ownership, and local land use regulations within the project area. Recreation includes the recreational resources within the project area associated with floodplain and river-related activities.

3.10.1 Affected Environment

Land Use

Land ownership in the project area includes state and private interests. The State of Washington owns the land occupied by the Entiat River (not on federal land) below the river's the OHWM and the WDNR manages this land. The remainder of the project area is on private land with more than 85 percent of the land owned by the CDLT; this land was purchased over time and managed as conservation land. In addition, the shoulder of Entiat Valley Road would be used for equipment access and staging. The roadway is owned and maintained by Chelan County.

Several houses are located along the Entiat River within the project area. The residences are typically occupied year-round and include landscaped yards and several have horse pastures. Several of the homes are located adjacent to project activities in Area F.

The Chelan County Comprehensive Plan was adopted February 1, 2000 and was last amended by Resolution 2016-09, effective February 16, 2015. According to the County Comprehensive Plan:

> *"The Entiat basin is primarily natural habitat area with rural residential primarily along the Entiat River. Development is limited by single public access up the valley. The City of Entiat and associated urban growth area are located at the base of the Entiat River along the Columbia. "*

The specific areas where the habitat improvement actions would be constructed is governed by the Chelan County Shoreline Master Plan. The Shoreline Master Plan establishes policies that govern development along waterbodies in the County. While the Shoreline Master Plan does not include policies regarding habitat improvement action, it does include a section on shoreline works and structures.

Recreation

The Entiat River has three distinct sections, each offering different recreational opportunities. The upper section (RM 21.1 to RM57) (valley segment [VS] 3), which flows primarily through USFS land, has a steeper gradient, with large rapids. The upper section has several public access points that are used by kayakers and boaters. The Middle Entiat section (VS2; RM 16.1 to RM 21.1), where the Proposed Action would occur, is a lower gradient stream that flows through primarily private land and has few public access points. The Lower Entiat River (VS1, RM 0 to RM 16.1) has a steeper gradient, has few large rapids, flows through primarily private land, and has few public access points.

Based on these recreational characteristics of the three stream sections, the majority of the recreational use for the Entiat River occurs in the upper portion of the river where public land allows for easy access for kayaking, fishing, and camping. The lower river also has recreational users but the lack of public land for access often requires boaters to float the entire 14.5 miles from the Mad River, near Ardenvoir, Washington, to the mouth where it meets the Columbia River. The middle portion of the river is primarily used by local residents.

Within the project area there are currently 13 natural large wood structures that pose potential risks to recreational users (Cascadia Conservation District 2014). The large wood structures were classified on a rating scale from A to F to rate the difficulty of boater navigation around the structure. The Type A rating assumes that no active navigating action would be required by a boater to navigate the wood, and a Type F, or most difficult rating, would require a boater to leave the river and portage around the structure. Types A and B were not surveyed as they typically do not present hazards to recreational users. Ten of the large wood structures were classified as Type C, which are easily avoided through routine navigation by boaters. Three large wood hazards were identified as Type D, which require river users to actively avoid them. The LWM structures E and F are not present in the project area.

Type D is rated higher than Type C due to a few factors making the structure more hazardous; factors include the orientation of the wood to the channel, location to bend and line of sight from upriver (Cascadia Conservation District 2014). Overall, the study concluded that there is a lack of challenging or technical areas in this stretch of river, save for the need to navigate around some areas of large wood. Table 3-9 summarizes the LWM structure and number by project area.

Table 3-9. Number of LWM structures in each project area.

Project Area	LWM Type C	LWM Type D	LWM Type E	LWM Type F	Total
B	0	1	0	0	1
C	2	1	0	0	3
E	2	1	0	0	3
F	6	0	0	0	6
Total	10	3	0	0	13

In 2014, the CCD conducted a recreational use report for the Middle Entiat River (Cascadia Conservation District 2014). Development of the recreational use report was done in accordance with Reclamation's Risk Based Design guidelines (Reclamation 2014). The recreational use report used interviews, observations, and an online questionnaire targeting local users to determine the level of use and the types of users found on the project area. Recreational uses of the project area include kayaking, canoeing, swimming, floating

(tubing), and fishing. There is currently no commercial rafting or recreational boating outfitters that utilize the project area. The project area has a relatively low-gradient, slow moving water, and no whitewater rapids. Most recreational boaters in the Entiat basin utilize areas above the project area in areas on USFS property and below the project area between Ardenvoir (RM 14.5) and the Columbia River (RM 0). Recreational use on the Middle Entiat was found to occur mostly in the summer and fall, with limited use as early as late spring. River flows during the period ranges from 200 to 500 cfs. Respondents to the recreational survey showed the frequency of use in the project reach of the Middle Entiat is low compared to the more popular reaches of the river and much lower that the more popular rivers in the Upper Columbia such as the Wenatchee and Methow Rivers. The average age of boaters in the project area is between 40 and 60 years of age and the majority claimed to be at a Class III or higher skill level in relation to the American Whitewater Association rating system for river difficulty. This system rates a stretch of river with Class I being the easiest and Class VI being the most difficult to navigate. Class III indicates an intermediate boater. One respondent reported that children have accompanied them on multiple occasions, but under direct supervision. Several local residents reported that usage in the reach is primarily local residents and families with extensive knowledge of obscure or private ingress and egress points (Cascadia Conservation District 2014).

In the summer of 2015, Reclamation was contacted by several local residents that float the river and expressed concerns for boater safety as a result of the Proposed Action. Reclamation conducted a field tour with local recreationalists on October 23, 2015. Input from the local users of the river was used to adjust structure locations where Reclamation and local users agreed that an undesired risk was going to be created.

3.10.2 Environmental Consequences – Proposed Action

Land Use

Construction Impacts

No construction impacts related to land use are associated with the proposed project. Potential noise impacts to adjacent residents are discussed in Section 3.11.2.

Post Construction Impacts

The proposed project would be consistent with the Chelan County Comprehensive Plan and the zones in which it would be located. The project is located within zones that are part of the Rural District designation. This designation allows a number of uses that would be compatible with rural character, including tourism and recreation uses. The Rural District designation also encourages creating open space and protecting environmental features while enhancing recreational opportunities, and the project is consistent with this goal.

Recreation

Construction Impacts

Construction of the LWM structures would require operation of tracked equipment within the river channel, isolation by cofferdams of construction areas, and helicopter flights over the river channel to deliver materials. These activities would require closure of the river channel through the project areas during construction to ensure public safety. The closure would be temporary and occur only during the in-water work period as defined in Chapter 2, Section 2.2.3 which occurs during the typical summer low-flow recreational season.

Post Construction Impacts

The implementation of the proposed project, specifically the placement of LWM structures, would alter the river in ways that could affect the way recreational boaters experience the river but is unlikely to result in conditions that would prevent boats from navigating the river or be considered unsafe. While the placement of some structures would result in boaters needing to alter the path they travel along the river, boaters would experience these changes as they would any other changes that occur as a result of natural occurrences of wood and rock.

Risk to the public was a primary design criterion for all of the structures that would be built. Designs for the proposed project were developed following Reclamation's Large Woody Material - Risk Based Design Guidelines (Reclamation 2014). The Risk Based Design Guidelines were used to assess and evaluate watershed-level, reach-level, and site-level characteristics as part of the design approach. In addition, by following the guidelines, the design team was able to document the decision-making process and follow a consistent evaluation methodology for identifying the potential risks from each LWM structures.

Per the Risk Guidelines, the 10 steps of the risk-based design approach are as follows:

1. Pre-project planning and site visit
2. Watershed and reach level risk assessment
3. Project concept development
4. Site level risk assessment
5. Risk level determination
6. Define minimal design criteria including design team members
7. Risk-based design
8. Design team review

9. Design completion
10. Documentation

Step 1 was completed in May 2014 with a review of the project area and field reconnaissance. Following the field visit, an assessment of the risk posed by proposed LWM structures at the conceptual design level was conducted at the watershed- and reach-level and site level (Steps 2 and 4). The information gathered during the risk assessment was used to develop a risk-matrix for each of the proposed LWM structures. Together, information at the watershed- and reach-level (Step 2) and the site-level (Step 4) were used to determine the level of risk (Step 5) of low or high for public safety and for property damage. This risk level determination defined the minimal design criteria and design team members that should be used for ensuring stability and safety for each of the proposed LWM structures (Step 6). The risk-based design process was then conducted based on the established design criteria (Step 7). During Step 7, the project designs went through four iterations. With each of the four iterations, the project design was assessed and evaluated to determine the potential risks to people and property, after which the design was refined and modified. The proposed project reflects the fourth iteration of this process.

The design team conducted a field survey of the 30 percent LWM structures on July 30, 2015 and conducted a field tour with local recreationalists on October 23, 2015. These field efforts informed the recreational safety review of the proposed LWM structures and was used to adjust structure locations where the team or local users agreed that an undesired risk was going to be created.

By following the Risk Based Design Guidelines and evaluating how each structure would potentially interact with recreational users, and requesting input from users of the river, five planned LWM structures were eliminated from the project design and eight LWM structures were modified, either by changing the type or the location of the structure, to reduce conflicts with recreational boaters.

Conflicts with recreational boaters have been further reduced through the location of the structures. Many of the structures that would be installed have been designed to interact with the river at higher flows (>500cfs). This is because high flows provide the energy necessary to achieve the desired hydrological response. Also, at higher flows many of the structures are intended to provide low-velocity refuge for juvenile fish, giving them safe places to hide during high flows. Recreational use through the project area is most common in the summer and fall, with limited use as early as late spring, when the mean discharge ranges from 200 – 500 cfs (USGS 2017) when the river is calmer/safer and warmer. At low flows, many structures would likely be in shallow water or not in the water at all. This would reduce the risk for recreational users by removing the structure from the water and through reduced depths and velocities adjacent to the structure.

The implementation of the proposed project would result in changes to the river that would affect how recreational boaters see and interact with the Entiat River. The proposed project would also require boaters to adjust their path to avoid LWM structures that would be placed throughout the project area. However, because the affected section of river does not receive high recreational use like the Wenatchee or the Methow rivers, the number of users affected would be low. In addition, users typically boat the river during low water levels when depths and velocities result in conditions that allow boaters to avoid LWM structures.

3.10.3 Environmental Consequences – No Action

Under the No Action alternative, Reclamation would not fund the project and no construction or post construction effects would occur and land use and recreation would remain unchanged.

3.11 Noise, Air Quality, and Public Health and Safety

This section discusses noise, air quality, and public health and safety for the proposed project areas. The analysis area for this section includes the Entiat River valley along the four project areas where project construction activity occurs.

3.11.1 Affected Environment

Noise

Noise is defined as unwanted sound. Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. Noise can be measured in several different ways depending on the source of the noise, the receiver, and the reason for the noise measurement.

Audible noise is measured in decibels on the A-weighted scale. The A-weighted sound pressure level on a decibel (dBA) scale describes sound that corresponds to human perception. Table 3-10 shows the relative A-weighted sound pressure levels of common sounds measured in the environment and in industry for various sound levels.

Table 3-10. Common activities and associated noise levels.

Noise Source at a Given Distance	Sound Level (dBA)a
Civil defense siren (100 feet)	130
Jet takeoff (200 feet)	120
Vibratory Pile driver (50 feet)	100
Ambulance siren (100 feet)	90
Freight cars (50 feet)	84
Pneumatic drill (50 feet)	80
Freeway (100 feet)	70
Vacuum cleaner (10 feet)	60
Department store; light traffic (100 feet)	50
Large transformer (200 feet)	40
Note: an A-Weighted Sound Level in Decibels (dBA) (Beranek 1988).	

Decibels on the A-weighted scale cannot be directly added arithmetically; that is, 50 dBA + 50 dBA does not equal 100 dBA. When two sources of equal level are added together the result will always be 3 dB greater; that is 50 dBA + 50 dBA = 53 dBA and 70 dBA + 70 dBA = 73 dBA. If the difference between the two sources is 10 dBA, the level (when rounded to the nearest whole decibel [dB]) will not increase; that is 40 dBA + 50 dBA = 50 dBA and 60 dBA + 70 dBA = 70 dBA.

The action area for noise consists of any area within the vicinity of the project that could be affected by noise from construction equipment used on the ground and would include homes nearby the four project areas. In addition, the action area for noise would include the Entiat River valley for 2 to 3 days each construction season when helicopters would be used to deliver logs.

Sensitive noise receptors consist of homes located along the Entiat River Road near the Project areas. Given the noise levels associated with the type of construction equipment that would be used for the Project, homes within 2,000 feet of the construction areas in this rural setting where ambient noise can generally be low. A total of 41 homes are located within 2,000 feet of the construction areas at the four project sites. At Area B there are four homes located approximately 2,000 feet from the Entiat River where the levee removal and LWM structure construction would occur; at Area C there are ten homes approximately 2,000 feet from where LWM structures would be constructed; at area E there are eleven homes approximately 2,000 feet from construction activity with the closest home approximately 800 feet from where project activity would occur; and in area F there are sixteen additional homes within 2,000 feet (not already considered in area F) with several homes within 200 feet from where project activity would occur at area Additional sensitive noise receptors in the action area could consist of recreational users on or along the shoreline of the Entiat River.

Existing noise sources consist of traffic along the Entiat River Road. Background noise levels in rural areas such as those in the action area are roughly 45 dBA during the day and 35 dBA at night (EPA 1974). To provide a reference of noise generated by common activities, Table 3-10 shows a range of noise levels from 40 to 130 dBA.

No federal regulations apply to noise generated by the project. Washington has not established statewide limits on noise levels from construction equipment. However, Chelan County has a noise control ordinance that limits noise emissions on motorboats and vehicles. Any vehicle operating for the purpose of on-site construction of structures between the hours of 7:00 a.m. and 10:00 p.m. are exempt from the county ordinance.

The ability to perceive a new noise source intruding into background conditions depends on the nature of the intruding sound, and the background sound. For situations where the nature of the new sound is similar to the background sound (e.g., new traffic noise added to background traffic noise), a noise of 3 dBA is just noticeable, a change of 5 dBA is clearly noticeable, and a change of 10 dBA is perceived as doubling (or halving, if the sound is reduced) the sound level. For situations where the nature of the new intruding sound is different from background sound (e.g., construction noise in an otherwise quiet setting), the new sound (including sporadic "clanks" from construction equipment) can be easily perceived, even if it only raises the overall noise level by less than 1 dBA.

Air Quality

The WDOE administers an air quality regulation and permitting program for commercial and industrial sources of air contaminants. There are no registered sources within the project area, although there are a few regulated sources within the City of Entiat. Although WDOE monitors airsheds across the state, no monitoring data exist for the Entiat airshed. The nearest monitoring site is in the Wenatchee area, where the WDOE has been collecting information since 1998. The project area is classified by the Washington State Department of Ecology as being in attainment of the National Ambient Air Quality Standards. WDOE has no immediate plans to expand their air monitoring to include the Entiat airshed.

Public Health and Safety

The affected environment for public health and dafety includes the areas where construction, log storage, and equipment staging activities would occur, 18 miles along the Entiat Valley Road from the junction with US 97, and the Entiat River and its floodplain for each of the project areas.

Areas where construction, log storage, and equipment staging activities would occur are located on private land. The majority of the private land within the project areas is owned and managed by Chelan Douglas Land Trust. Entiat Valley Road is a county road and is the primary transportation corridor up and down the valley. Entiat Valley Road is used by local

residents and visitors. It also provides access to USFS property upstream of the project area. The Entiat River and its adjacent floodplain are utilized and enjoyed by local residents and recreationalists who float and swim in and along the river.

Currently, the Project area supports mosquito breeding. Mosquito populations associated with annual flooding typically increase with the spring freshets (i.e., sudden rise in the level of a stream caused by heavy rains or the rapid melting of snow and ice) and can produce millions of mosquitos per acre. At this time there are no measures being taken to control mosquitos along the Entiat River.

3.11.2 Environmental Consequences – Proposed Action

Noise

Construction Impacts

One of the more recent and complete compilations of construction equipment noise is the Roadway Construction Noise Model (RCNM) (FHA 2006). Noise levels from the RCNM User's Guide are shown in Table 3-11 for the equipment anticipated to be used during the project. All listed noise levels are maximum A-weighted sound pressure levels at a reference distance of 50 feet.

Table 3-11. Construction equipment noise levels (FHA 2016).

Construction Equipment	Noise Level (dBA)a
Backhoe	80
Compressor (air)	80
Dozer	85
Dump truck	84
Excavator	85
Generator	82
Grader	85
Vibratory pile driver	101
Loader	80
Pickup truck	55
Tractor	84
Notes: a Specified A-weighted sound pressure level (*Lmax*) at 50 feet.	

The intensity of sound attenuates, or diminishes, by about 6 dBA as distance doubles (FHA 2006). Review of the table of construction equipment noise levels indicates that, with the

exception of pile driving, the loudest equipment generally emits noise in the range of 80 to 90 dBA at 50 feet. The types and numbers of construction equipment near any specific receptor location would vary over time. Individual equipment operating in the construction zone could be discernible above ambient noise up to 2,000 feet away from the construction zone. Individuals at homes near the project construction zones would likely hear noises associated while construction equipment is in use if no other noise associated with individual use at the homes would override the construction noise. Length of time the equipment would run during the day would vary, depending on how the construction contractor utilizes equipment to construct the project. However, work hours would be defined to limit the construction generally from no earlier than 7 a.m. through late afternoon (as defined by the construction contractor but within the Chelan County noise ordinance requirements).

A vibratory pile-driver (see Figure 2-14) is a large device that is attached to the arm of an excavator. The excavator lifts the pile into place and applies downward pressure on the pile while the vibratory driver shakes the pile, driving it into the ground. The noise from the vibratory pile-driver comes from the vibratory mechanism and engine noise from the excavator. These levels can vary depending on the type and condition of the material. Noise levels at 50 feet from the vibratory pile-driver can range from 80 to 110 dBA.

A helicopter would also be used to deliver logs to site locations. Logs would first be placed at several staging area locations, sorted and bundled with the specific logs needed for each LWM structure. Helicopters would then be used to deliver those bundles to the location of each LWM structure location. Some LWM structures would be constructed by the helicopter lifting and placing the logs and boulder and chain ballast direct to their location in the river. Noise associated with helicopter use would be temporary and intermittent with the anticipated total time for helicopter use at two to three days during each construction year. A loaded cargo helicopter flying 250 feet away produces noise that is roughly 95 dBA, which is the same amount of noise produced by a diesel locomotive 100 feet away (Helicopter Association International 1993). During the 2 to 3 days each construction season the helicopters are used, homes within approximately 1 mile of the helicopters would be exposed to temporary noise levels above 65 dBA. Noise from helicopters would not be a new source of noise in the area as helicopters are used for timber harvest and to suppress wildfires that occur in the Entiat and surrounding watersheds. Other aircraft have also been observed by design team members to fly in or across the valley including jets from military bases located in Washington that have flown over the river at low elevations.

Assuming maximum construction-generated noise level of 110 dBA at 50 feet, and an average exterior or interior structural attenuation of 15 dBA, inhabitants of residences within approximately 2,000 feet of the construction areas and material yards could experience increases in ambient noise levels of greater than 10 dBA. There are approximately 41 residences within 2,000 feet of the proposed construction areas. Construction activities

would not occur during the more noise-sensitive periods of the day (i.e., evening and nighttime hours), to avoid sleep disruption to occupants of these residential dwellings.

For all other general construction activities, noise generated during construction would likely be only slightly louder than existing background levels. Overall, noise levels associated with construction equipment would range from 55 dBA to 110 dBA and would be short in duration during the construction period.

Air Quality

Construction Impacts

Air pollutant emissions would be generated during the construction of the Proposed Action. Pollutants, when emitted in substantial amounts, can be hazardous to public health, especially for people with respiratory ailments. Emissions can also reduce visibility on roads, highways, and in scenic areas, to the detriment of public safety or enjoyment. In addition, vehicle emissions and combustion of fossil fuels during project operations, as well as during construction, could emit greenhouse gases. Emissions would be temporary in nature and controlled through BMPs as described below.

The pollutants that could increase because of project construction are carbon monoxide, ozone, and particulate matter (dust). Dust could be created during construction by vehicles travelling on unpaved surfaces and from ground-disturbing activities. Sixteen houses are within 1,000 feet of construction and staging areas and could experience an increase in dust and particulate matter during construction depending on wind patterns and amount of construction in a given day. However, dust effects would be temporary, occur only during construction (June – August of 2018 and 2019), and would occur in localized areas.

Particulate matter, such as dust, would impact air quality during the ground-disturbing activities and travel along unpaved access roads. BMPs such as use of water trucks to reduce dust, would be applied, to maintain air quality standards (Table 2-6). (See Figures 2-2 through 2-4, Section 2.2.1, for locations of access roads and staging areas where dust sources could occur.) Project emissions would be temporary and localized in nature, and with the use of BMPs would reduce and minimize release of particulate matter in the air.

Greenhouse gas emissions were estimated based on the approximate number of vehicles to be used during project construction, and the approximate distance those vehicles would travel during the construction period. For the proposed project, workers would have an estimated 14 to 20 vehicle round trips per day over the 2-year construction period (based on 60 to 90 days at the site during two 2-month construction periods [2019 and 2020]). While all emissions of greenhouse gases contribute to global greenhouse gas concentrations and potentially to climate change, the total CO_2 emissions from the proposed project would be low compared to emissions from other regional, national and worldwide contributors. The

emissions from the Project would also be much lower than the EPA's mandatory reporting threshold for annual CO_2 emissions, which is 25,000 metric tons of CO_2 equivalents (74 FR 56260). For example, it would take approximately 5,200 individual passenger cars driven for one year (approximately 62,000,000 miles) to generate 25,000 metric tons of CO_2 equivalents – based on EPA's on line greenhouse gas equivalencies calculator.[1] Vehicle traffic miles from the Project would much less than 1 percent of the total associated with the example mileage from individual passenger cars. When the project is complete, all construction related emissions of greenhouse gases and other air pollutants are expected to cease.

The EPA requires mandatory reporting for greenhouse gas emissions in excess of 25,000 metric tons of CO_2 and considers emissions below this threshold to be low impact (74 FR 56260). Because of the short duration of the project construction, low number of vehicles and equipment, and estimate of emissions well below the reporting threshold, the impact from greenhouse gas emissions would be below the threshold.

Public Health and Safety

Construction Impacts

Construction activity at the construction, log storage, and equipment staging areas would pose a potential risk of injury to workers using heavy equipment while working in and near the water and during access road construction and earthwork. As part of the Project, Reclamation would require the construction contractor to submit a work safety plan to reduce and minimize risk to workers and public. The work plan would state that anyone entering the work site would be required to wear personal protective equipment to reduce and minimize exposure to hazards that cause serious workplace injuries and illnesses. This safety plan would include other safety features as well as features necessary to provide a safe work environment in and around water. As described in Chapter 2, river crossings include wet crossing where equipment would cross the river. Work around water would occur during low flow periods to further reduce and minimize water related safety hazards.

Construction trucks and vehicles entering or leaving the project site from Entiat Valley Road could increase safety hazards for vehicles and travelers using the road. Safety hazards related to construction traffic on Entiat Valley Road would be greatest during the weekends when highway use is greater. The level of daily vehicle trips would be approximately 85 to 175 trips during construction and would be within the design capacity of the roadway.

Potential public safety risks would also be associated with logs from LWM structures installed as part of the Proposed Action. There is a risk that logs could potentially come loose and cause damage to people and property. To reduce and minimize this risk, designs

[1] https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

for the proposed project were developed following Reclamation's Risk Based Design Guidelines to ensure stability of each structure (Reclamation 2014). As the designs for each project area were developed, a two-dimensional hydraulic model, developed by Reclamation's Technical Service Center in Denver, Colorado, was used to evaluate the effects of the structure and also the stability of each structure. Although the minimum stability design flow criteria in the Risk-Based Design Criteria is the 25-year flow, the designs were evaluated using the 100-year design flow to meet recent legislation in Washington exempting landowners from liability for the LWM structures on their property if the structures are designed for the 100-year event (RCW 77.85.050).

The design life of the proposed LWM structures would be 25 years. The design life is based on the materials used, delivery methods, construction methods, climate conditions, and hydrologic conditions (Reclamation 2014). While wood elements naturally decay at variable rates dependent upon their species, size, and their environment there is little research on the absolute decay rates of different types of wood (Abbe, Brooks, and Montgomery 2003). Wood used for the proposed project would be primarily Douglas fir which has been shown to decay by approximately 20 percent over a period of approximately 30 to 50 years in a forest environment (Harmon et al. 1986).

The modeling of the proposed project showed that all of the proposed structures would meet the risk-based design criteria for stability (Reclamation 2016b). To meet risk-based design criteria requirements, additional mechanical anchoring would be used but no cable would be used in any of the LWM structures. Anchoring the LWM structure along with other design features following the risk-based design process would reduce and minimize the potential risk to public safety.

The proposed project's potential public health and safety effects from the creation of wetlands and ponded water can provide breeding habitat for mosquitoes, which are considered both a nuisance and a public health threat since they can serve as vectors for diseases such as West Nile virus Washington State is not considered as a risk area for the Zika virus as there are no known occurrences in Washington State. Within the United States only small portions of southern Texas and Florida have reported cases of Zika spread by local mosquitoes (CDC 2017).

Mosquitos that spread West Nile virus become infected when they feed on infected birds. Infected mosquitoes can then spread the virus to humans and other animals. West Nile was first detected in North America in 1999 and has since spread across the continental United States and Canada. Anyone living in an area where West Nile virus is present in mosquitoes can get infected and outbreaks have been occurring every summer since 1999. The risk of infection is highest for people who work outside or participate in outdoor activities because of greater exposure to mosquitoes. West Nile virus has been reported in Washington State although the Centers for Disease Control and Prevention (CDC) indicates most people who

are infected would not get sick as the CDC reports an incidence rate of 0.01 to 0.24 per 100,000 population for those with a neuroinvasive disease from West Nile virus (e.g., meningitis, encephalitis, or acute flaccid paralysis (CDC 2017). The Washington Department of Health also indicates that most people who are infected with West Nile virus would not get sick. About 1 in 150 people infected, would have more severe symptoms. Severe symptoms may include headache, high fever, neck stiffness, stupor, disorientation, tremors, convulsions, muscle weakness, paralysis, and coma (Washington DOH 2017).

Increased inundation of the Entiat River floodplain would likely increase the specific habitats supporting mosquito populations. The additional wetland and floodplain habitat that would be flooded has been designed to facilitate flow through and off floodplain areas that would prevent the stagnation of waters supporting nuisance mosquito populations. While there would be an increase in the floodplain areas inundated during seasonal floods, these areas are not expected to result in a problematic mosquito population beyond that which is experience under existing conditions, so the risk to public health and safety is not greater than under current floodplain conditions.

Post Construction Impacts

Impacts on noise and air would not occur apply the project construction is completed. Post construction impacts from the Project on public health and safety would be associated with public use of the river. The Project was designed using Reclamation Risk Based Design Guidelines to reduce and minimize impacts on property or the public using the river. Additionally, the Proposed Action (See Chapter 2) includes a post construction inspection process to survey and inspect status of LWM structures. Any LWM structures or side channels that have changed from their constructed condition would be subject to repair if they are not meeting the project's purpose or cause an increased risk to public safety or homes. As previously mentioned in the Construction Impacts for Public Safety, although the minimum stability design flow criteria in the Risk-Based Design Criteria is the 25-year flow, the LWM structures designs for the Project were evaluated using the 100-year design flow. This was done to meet recent legislation in Washington exempting landowners from liability for the LWM structures on their property if the structures are designed for the 100-year event. In the event a LWM structure should need repair or revision, CCNRD would be responsible for all adaptive management of structures on/adjacent to Chelan Douglas Land Trust property (Project Areas B, C, and F), per *Adaptive Management Program Agreement between CDLT and Chelan County Natural Resource Department for Entiat Restoration Projects* (Chelan County PUD 2017), and CCD would be responsible for the same in Area E unless agreements are made with CCNRD to assume responsibility.

3.11.3 Environmental Consequences – No Action

Under the No Action alternative, there would be no change from current levels of noise, which would continue to be low to negligible.

Under the No Action alternative, there would be no construction-related emissions, and air quality in the region would remain similar to current conditions.

Under the No Action alternative, the potential risks to public health and safety associated with the project would not occur.

3.12 Climate Change

3.12.1 Affected Environment

This section discusses climate change and how climate experts predict changes to rivers and streams in the Columbia Basin. Greenhouse gas emissions associated with project construction are discussed in Section 3.11.2.

Climate change could alter precipitation patterns and river hydrology. This could result in potential increases in the magnitude and duration of flow events, alteration of the timing of snowmelt, increased flow regimes, and changing lake levels. Increases in velocities and erosive forces along streambanks and shorelines and effects on water temperatures also could likely occur. (See Section 3.4 for additional information on climate change and water resources in the project area.) All of these factors could influence physical sites and biological communities - affecting species assemblages, timing, and use of the river, and could also lead to changes in noxious and invasive weed cover.

The FCRPS BiOp (NOAA Fisheries 2014) climate experts predict the following physical changes to rivers and streams in the Columbia basin:

- Warmer temperatures will result in more precipitation falling as rain rather than snow.
- Snowpack will diminish, and streamflow volume and timing will be altered.
- More winter flooding is expected in transient and rainfall-dominated basins.
- Historically transient watersheds will experience lower late summer flows.
- A trend towards loss of snowmelt-dominant and transitional basins is predicted.
- Summer and fall water temperatures will continue to rise.

These changes in air temperatures, river temperatures, and river flows are expected to cause changes in salmon and steelhead distribution, behavior, growth, and survival. Although the magnitude and timing of these changes currently are poorly understood and specific effects are likely to vary among populations, the following effects on listed salmon and steelhead in freshwater are likely:

- Winter flooding in transient and rainfall-dominated watersheds may scour redds, reducing egg survival.
- Warmer water temperatures during incubation may result in earlier fry emergence, which could be either beneficial or detrimental depending on location, and prey availability.
- Reduced summer and fall flows may reduce the quality and quantity of juvenile rearing habitat, strand fish, or make fish more susceptible to predation and disease.
- Reduced flows and higher temperatures in late summer and fall may decrease parr-to-smolt survival.
- Warmer temperatures will increase metabolism, which may either increase or decrease juvenile growth rates and survival, depending on availability of food.
- Overwintering survival may be reduced if increased flooding reduces suitable habitat.

The FCRPS BiOp (NOAA Fisheries 2014) recognizes there have been advances in projecting tributary temperature and hydrologic changes. The BiOp identifies different studies projecting decreased summer streamflow in Pacific Northwest streams and increases in mean summer stream temperatures from 1.77°F (0.92°C) to 3.78°F (2.0°C). The simulations indicate that projected climate change would have greater impacts on snow dominant streams, like the Entiat River, with lower summer stream flows and warmer summer stream temperature changes relative to transient and rain dominant regimes. Lower summer flows combined with warmer stream temperatures suggest a future with widespread increased summertime thermal stress for cold-water fish in the Pacific Northwest region.

3.12.2 Environmental Consequences – Proposed Action

Construction Impacts

Due to the short construction duration, low number of vehicles and equipment, and estimate of emissions well below the EPA reporting threshold, the impact from greenhouse gas emissions would be low and therefore, there is little potential for the project to accelerate climate change.

Post Construction Impacts

After the Project is completed and construction equipment is no longer in use, there would be no further impacts on climate change. However, after the Project is constructed one can also consider potential interaction of the Project's features and river conditions in a future climate change scenario.

As stated in the affected environment, climate change is predicted to result in some changes to the physical conditions of rivers in the Columbia Basin. The exact effect of climate change on this 4-mile reach of the Project on the Entiat River are unknown. However, the potential increase in temperature that could result in more winter rain (or more rain on snow events) could still result in sufficient winter streamflows where LWM structures direct flow to side channels, and the side channels and LWM structures continue to provide cover, resting, and foraging habitat for any salmonids present in the system. Additionally, the creation of LWM structures within the main channel would help to retain peak flows and decrease their downstream effects, flood a greater portion of the existing floodplain to recharge groundwater, and help to augment summer low flows with cooler groundwater discharge. The project would increase site resiliency to shifting site conditions that might arise through climate change or other external ecological or hydrological factors, resulting in beneficial effects to native plant and animal species. For more discussion on climate change related to hydrology, see Sections 3.4.

3.12.3 Environmental Consequences – No Action

Under the No Action alternative, no habitat improvement actions would be implemented and there be no effect on climate change. Climate change as affected by ongoing activities unrelated to the Project that occur in the local, regional, and nationwide perspective would continue to occur.

3.13 Transportation

The analysis area for transportation resources includes the existing roads and temporary construction access within the project area, as well as roads used by construction equipment within the Entiat River valley.

3.13.1 Affected Environment

The only public road found within the project area is Entiat River Road which starts at the junction with US 97, where the Entiat River joins the Columbia River and continues 37 miles upriver. The lower 19 miles is owned and maintained by Chelan County. Once Entiat River

Road enters USFS property, it becomes National Forest Road-51. Entiat River Road provides access to residences and businesses in the Entiat Valley and for recreational and commercial activities on USFS land.

3.13.2 Environmental Consequences – Proposed Action

Construction Impacts

The construction of the proposed project would result in increased truck and equipment traffic on Entiat River Road during the years 2019 and 2020. Actual timing of increased traffic would depend on the contractor's schedule. Construction activity at each of the project areas would also result in traffic delays when machinery and construction equipment enters the roadway. Also, for Project Areas B and F, haul trucks would be moving excavated material off-site and down the Entiat Valley Road. Each of the construction contractors would develop a traffic management plan to ensure public safety for trucks entering and leaving the Entiat River Road to and from the project area sites.

At Project Area B, the removal of the levee would require 9,500 cubic yard of material to be excavated, loaded into dump trucks, and hauled away. Dump trucks used to haul the material would transport 18 - 20 cubic yards of material at a time. Hauling 9,500 cubic yards of material would require 600 round trips down the valley. Once the material was dumped, those trucks would make a return trip for another load. Because neither the method for removing and loading the material nor the location to which it would be hauled is known, the number of trucks traveling Entiat Valley Road per day is not known. The range of potential truck trips per day would be between 7 to 10 round trips per day, each year of construction, depending on the number of days for construction, which could be 60 to 90 days. Each truck arriving to and leaving from the project area would require a flagger to halt traffic in both directions resulting in some travel delays. Transportation effects from the removal of the levee at Project Area B would occur during the summer of 2019 and would be from the increased truck traffic necessary to haul materials and allow off site and traffic delays as trucks enter and exit the site.

In 2020, construction of the ford at Project Area E would require the removal and offhaul of 96 cubic yards of material. This would generate approximately 6 round trip truck trips down the Entiat River Road.

In 2020, material excavated for the side channel enhancements in Project Area F would require 10,801 cubic yards of material to be hauled offsite. This would generate approximately 675 truck round trips down the Entiat River Road. Transportation effects from the removal of the soils at Project Area F would occur during the summer months and would be from the increased truck traffic necessary to haul materials and allow off site and traffic delays as trucks enter and exit the site.

Post Construction Impacts

The project would not require upgrades to expand the capacity of Entiat Valley Road and travel delays and traffic volumes would be temporary, occurring only during construction. Therefore, the project would have no effects after construction.

3.13.3 Environmental Consequences – No Action

Under the No Action alternative, Reclamation would not fund any habitat improvement actions and no transportation effects from construction activities would occur.

3.14 Socioeconomics

The analysis area for socioeconomics is the Entiat River Valley, which is where most of the direct effects during construction and operation would occur. The larger geographic area of Chelan County was also identified as the economic study area because it is at the county level where most of the economic benefits may manifest, including spending on goods and services from the workers and the materials and equipment to construct the project.

3.14.1 Affected Environment

The project is located in unincorporated Chelan County, Washington. Entiat, Washington is the closest community and is approximately 16 miles southeast of the project at the mouth of the river. Wenatchee, the largest city in Chelan County, is located about 20 miles south of Entiat, Washington. The Entiat River valley is within U.S. Census Tract 9601. U.S. Census Bureau data for this census tract 9601, Chelan County, and the City of Wenatchee were used for this analysis.

Population

The total population for Census Tract 9601 in 2014 was 1,225 people. The largest city in Chelan County is Wenatchee, Washington, with a 2014 population of 32,627. The population of Chelan county in 2014 was 73,664 (see Table 3-12) (U.S. Census Bureau 2016).

Table 3-12. Total population of Chelan County in 2014 (U.S. Census Bureau 2016).

	Census Tract 9601	Wenatchee, WA	Chelan County
Total Population	1,225	32,627	73,664
Minority population	146 (5.7 percent)	574 (5.2 percent)	171,095 (10.9 percent)
Low-income population	23.9 (+/- 7.9)	16.1 (+/- 3.8)	15.0 percent (+/- 0.3)

Employment and Income

About 1,016 people age 16 and over had jobs in some capacity in Census Tract 9601 in 2014 (U.S. Census Bureau 2016). The unemployment rate in Census Tract 9601 on 2014 was 6.6 percent. In Wenatchee the unemployment rate was 4.8 percent, and in Chelan County the unemployment rate was 5.7 percent. In 2014, per-capita personal income in the Census Tract 9601 was $23,532, for Wenatchee per capita income was $23,922, and Chelan County per capita income was $25,619. In Census Tract 9601 15.5 percent of the population had an income below the poverty level, and in Wenatchee there were 13.7 percent, and in Chelan County 14.8 percent.

Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations was signed by President Clinton on February 11, 1994. This Executive Order directs federal agencies to take the appropriate and necessary steps to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on the health or environment of minority populations and low-income populations (collectively, the environmental justice populations) to the greatest extent practicable and permitted by law.

Guidelines provided by the CEQ (1997) and EPA (1998) indicate that a minority community may be defined where either 1) the minority population comprises more than 50 percent of the total population, or 2) the minority population of the affected area is meaningfully greater than the minority population in the general population of an appropriate benchmark region used for comparison. Based on the Census Tract 9601 data, Environmental Justice is not considered an associated socioeconomic condition for the Project.

3.14.2 Environmental Consequences – Proposed Action

Construction Impacts

Population and Housing

Because staging and construction for the Proposed Action would occur in 2019 and 2020, the duration of the work would likely not be long enough to induce any permanent changes to population in Entiat Valley. Construction would require approximately 20 to 50 workers, with the workforce coming from both inside and outside Chelan County. Workers from outside Chelan County would likely reside temporarily within the county and have an indiscernible effect on the overall population of the study area. Any workers from out of the area would require temporary lodging in the local area and would likely occupy recreational vehicle parks and hotels or motels within a 35-mile driving distance from Project Area F (most downstream site). There is expected to be sufficient temporary lodging to accommodate this small increase in demand over the construction period.

Employment and Income

The temporary increase in jobs during construction would represent a very small proportion of the current workforce in the project area. For those people who get construction jobs, especially if they are currently unemployed, the individual effect would be beneficial and positive.

Construction of the Proposed Action is expected to cost approximately $5.2 million as estimated in the Project's Basis of Design Report (Reclamation 2016b). This cost would include expenditures on materials and equipment, and expenditures on Reclamation – some of which would be spent locally in the project area. These local expenditures would have ripple effects on the economy, as workers and businesses that receive that money would spend some locally, and so on. These temporary direct and indirect expenditures would represent a small proportion of the total annual income in the study area.

Environmental Justice

During construction, properties adjacent to the project areas would experience short-term disturbances, including noise and dust from construction equipment and activities, and traffic delays from construction traffic. These effects would be greatest for the residences within Project Areas E and F. Projects are being constructed primarily on land owned by CDLT and would avoid directly affecting private land owners, with exceptions at Project Area E and F. A private landowner at Area E (with no residence at Project Area E) and three landowners at Area F have been notified of the project and the need to construct temporary access roads on their property. To minimize disturbance on their properties, input from landowners on Areas

E and F has been incorporated into the location of access roads across their properties, and LWM structure design on the river adjacent to their properties. To further minimize and reduce potential impacts of work at all project areas, the proposed work would be scheduled during daylight hours and would be limited to the appropriate allowed in water work window of approximately 60 to 90 days (other than some staging in upland areas could occur beyond the work window).

Because of the low population densities in Entiat Valley, census tracks are large, and do not provide sufficient detail on the race or income level area within each of the Project Area B, C, E, or F. As described above, construction of the Proposed Action would have a small but beneficial impact on the economy and temporary impacts on noise and air quality in the affected area. Individual landowners at Project Area E and F have been notified of the project. Minority and low income populations make up less than 6 percent and 25 percent, respectively, of the population in the census tract as shown in Table 3-11. Additionally, all persons, regardless of race or income, would experience the same effects associated with construction. Thus, construction of the Proposed Action would likely have no adverse or disproportionate effects on minority or low-income populations in the project area or in Chelan County.

Post Construction Impacts

No known post construction impacts on socioeconomic conditions would occur. The project would be completed and no activities would occur that affect population, employment, or environmental justice.

3.14.3 Environmental Consequences – No Action

Under the No Action alternative, the Proposed Action would not occur; therefore, the effects related to construction would not happen, and there would be no effect on socioeconomics or environmental justice populations.

3.15 Cumulative Effects Analysis

Cumulative effects are the effects on the environment that result from the incremental effect of a proposed project when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). For the cumulative effects analysis for this project, past and current actions are considered in the affected environment and environmental consequences sections for the different human and natural resources previously discussed in Chapter 3.

3.15.1 Past Actions

The nature and extent of resource management efforts that have resulted from past actions in the vicinity of the project area are included in this chapter as part of the "Affected Environment" sections for each resource. Past actions with effects to the Entiat subbasin started in the early 1900s and include commercial timber harvest, road building, mining, sheep grazing, hayfields, commercial and residential development, stocking of non-native fish species, and other management actions with the potential to effect aquatic habitat. Wildfire suppression occurs as a land management activity and to protect property, structures, and human lives.

Natural processes such as wildfires occur in the Entiat Watershed and are expected to continue to occur on a semi-regular basis. Wildfires are part of the natural ecosystem process, but their intensity and extent may be affected by past actions such as timber harvest (that may affect stand density and forest age) and road building (that may serve as fire breaks). As part of the Basis of Design report (Reclamation 2016b), a fire history memorandum was prepared acknowledging the fires that have occurred in the Entiat Watershed (Wolverine fire of 2015, Duncan fire in 2014, Tyee fire in 1994, and Entiat and Gold Ridge fires in 1970). The most recent fires occurring in the last 10 years (Wolverine and Duncan fires) were located approximately 12 miles upstream of the Project location) and burned approximately 38,000 acres of the 270,000 acre Entiat Watershed.

Past actions also include habitat improvement projects that have been implemented in the Entiat Watershed in the past 5 to 10 years. Habitat improvement projects have been constructed both upstream of the project area and downstream. Reclamation has implemented projects along the Tyee and Preston reaches upstream of the Project that total approximately 2 miles of restoration actions along the Entiat River. These two projects included 2,000 linear feet of side channel development, installation of forty LWM structures and numerous single logs, and riparian plantings and enhancement. Approximately 12 miles downstream of the Project, Reclamation developed the 1,500-foot-long Harrison side channel enhancement and habitat complexity project that included five LWM structures. Other habitat projects have been constructed along the Entiat River by other project sponsors such as the YN. The YN has treated approximately one mile of in stream river habitat that includes 7 LWM structures, 0.75 mile of created side channel, and 9 acres of improved riparian habitat. These habitat improvement efforts have focused on improving the quantity and quality of habitats available to ESA-listed fish species.

3.15.2 Present and Reasonably Foreseeable Future Actions

Present actions are those projects, developments, and other actions that are currently underway, because they are either under construction or occurring on an ongoing basis.

Reasonably foreseeable future actions generally include those actions formally proposed or planned, or highly likely to occur based on available information. Various sources, including local, state, and federal agency websites and city and county staff, were consulted to obtain information about any current and potential future development in the project vicinity. For this analysis, a reasonably foreseeable time period of the next 10 years is considered when other projects may occur. This is based on several factors such as:

- Anticipated continuance of state and federal funding opportunities for salmon recovery habitat projects,
- USACE's Nationwide Permit No. 27 (Aquatic Habitat Restoration Activities) that can be issued for restoration projects is valid through 2022,
- Monitoring programs commonly associated with state and federal permits for aquatic habitat projects are typically 5-10 years for projects where scrub shrub and forested wetlands are restored (Section 401 water quality certification and Section 404 wetland fill permit of the Clean Water Act) (WDOE, USACE, and EPA 2006; USACE 2008), and
- Anticipated continued listing of UCR spring Chinook salmon and UCR steelhead under the Endangered Species Act and Reclamation's ongoing commitment to meet the FCRPS BiOp habitat complexity goals as noted in Chapter 1.

Although Reclamation does not currently have other projects planned in the foreseeable future on the Entiat River, there are two known projects planned by other project proponents.

In 2018, the Upper Stillwater Restoration Project is planned for construction by the YN on USFS property approximately 5. 5 miles upstream of the project area. The purpose of the Stillwater project is to improve aquatic habitat within the Entiat River at key locations along the Entiat River Road, re-establish river processes along the margins of the Entiat River via placement of approximately 75 LWM structures, and re-connect a 2,000-foot long side channel to promote continued improvement in aquatic and riparian conditions.

Another proposed project would be located immediately upstream of Project Area B. The Yakama Nation is proposing a restoration project that would likely include placement of LWM structures in the river and a side channel reconnection. The timing of the project construction is unknown at this time, but anticipated within the next several years.

Other restoration projects may be proposed by local sponsors as part of ongoing state and federal funding associated with salmon recovery; but none are currently known.

The cumulative effects analysis assumes that many of the same construction techniques, equipment, and types of river crossings would likely apply to these future projects as described for the Project in Chapters 2 and 3. Construction periods would be similar (i.e., 60 to 90 days per construction season) to meet the restricted periods when work can occur in

aquatic resources. Because of the similar nature of the restoration features in these potential future projects to the proposed Project (i.e., LWM structures, side channel enhancement, and access roads required to construct the project), it is assumed the types of impacts on human and natural resources would be similar. The cumulative effects of these projects is discussed in the following sections.

3.15.3 Soils and Geology

The proposed project and other foreseeable projects would contribute to the cumulative effects on soils and geology when added to the past, present and reasonable foreseeable future actions. The cumulative effect as realized in the post construction condition would result in more channel migration, sediment transport, and during higher river flows, increased sediment movement onto floodplains through the reconnection of river flows to side channels and floodplain (as compared to naturally low summer flows). These are natural river processes, which is one of the goals of river restoration projects. As stated in Section 3.4, any potential for an increased response to runoff, erosion, flash floods, debris flows and sediment deposition from post fire is generally limited to within 3 years after a fire, once watershed vegetation and soils recover (Reclamation 2016b). This analysis considers the soils and geology within the Project area and upstream to the other two reasonably foreseeable projects.

3.15.4 Vegetation and Wetlands

Vegetation and wetlands are considered for the proposed Project and area where the foreseeable projects would occur. The proposed Project would contribute to the cumulative effects on vegetation and wetlands. There would be a very small permanent loss of vegetation from the construction of LWM structures and side channels (compared to all the naturally vegetated areas in the floodplain at the project sites and in the watershed); and a temporary loss of vegetation to develop construction access roads and staging areas. However, during the foreseeable future, revegetation with native plants of construction disturbance areas, upper banks of side channels, and other floodplain areas would result in the establishment of native riparian floodplain vegetation. Wetlands would benefit from the project and reasonably foreseeable projects through the creation of new wetlands and rehabilitation of existing wetlands.

3.15.5 Water Resources

The Project and other foreseeable projects would contribute to cumulatively impact water resources through sediment discharges and vegetation removal from construction actions within the subbasin where the Project and foreseeable projects would occur. Cumulative impacts on water resources would occur during project construction as localized turbidity and

sediment discharge. BMPs and design features would minimize and reduce these impacts (see Table 2-6) during the post construction period. For the reasonable foreseeable future, Project effects would cumulatively benefit water resources by restoring connections to adjacent floodplains and historical side channels that would increase flood storage capacity, reducing flood risk to downstream properties and infrastructure. The placement of LWM structures would improve floodplain sediment storage as part of the re-establishment of natural river processes. By capturing sediment on the floodplains and behind LWM structures, the project would help to decrease potential effects from natural sediment run off. While some sediment would likely be released during construction, once implementation of the project was complete the project would, in combination with past, present, and future habitat improvement actions, contribute to improving flood storage, sediment storage, and overall water quality in the Entiat River subbasin. As discussed in Section 3.4, any water resource issues related to post-fire conditions are not expected to occur.

3.15.6 Fish and Wildlife Habitat

Within the context of the foreseeable future for fish habitat, the cumulative effects of the Project and past/present/foreseeable actions would result in beneficial conditions for fish. Projects are designed to provide increased cover, forage, rearing, and resting habitat for UCR spring Chinook salmon and UCR steelhead. Creation and reconnection of side channels would provide juvenile rearing habitat and the construction of LWM structures would result in the development of increased pool holding habitat and cover. These restoration projects are specifically targeted to cumulatively address the need for improvements in habitat quality in the Entiat River as identified in the FCRPS BiOp (NOAA Fisheries 2008, 2014; USFWS 2013).

Wildlife habitat would also be created or enhanced following construction of the Project and the other foreseeable projects through the creation of side channels, creation and rehabilitation of wetlands, and riparian revegetation. In addition, restoration actions would be protected where it occurs on CDLT owned lands, as one of their missions is to protect natural areas to promote clean air and water and provide abundant wildlife opportunities. Aquatic permits issued by regulatory agencies for project construction also typically require 5 to 10-year monitoring to ensure riparian and wetland habitats persist, with these restoration sites protected in perpetuity.

3.15.7 Visual Resources

There are no major construction projects or other development planned in the immediate vicinity of the project area that would be visible to the same sensitive viewer groups (see Section 3. 6, Visual Resources). Residents along the Entiat River Road would see more truck use on the road and would be able to see some construction equipment in places where the road is adjacent to the river. The impact would be during the construction seasons for the

individual projects. During the post construction period, more LWM structures would be visible to recreationists using the river. However, LWM structures would be designed to replicate the look of natural structures and over time as wood bleaches and other wood debris collects on the structures, they would resemble natural features.

3.15.8 Cultural Resources, Sacred Sites, and Indian Trust Assets

Within the context of this Project there would be no direct or indirect impacts to historic properties, cultural resources, Indian Trust Assets, or Sacred Sites, and therefore no contribution to cumulative impacts (See Sections 3.7, 3.8, and 3.9). In the event of a post-review discovery during construction, Reclamation would implement an Inadvertent Discovery Plan that would be prepared before construction occurs, which would halt all ground-disturbing activity in the vicinity of the find and immediately notify Reclamation cultural resource staff. In the context of a post construction time frame, the Project could provide more fish that would become available for tribal members exercising their treaty and traditional rights to fish. The greater availability of fish at locations along the Entiat River would serve to enhance tribal traditional cultural practices and could result in overall positive benefit to cultural resources.

3.15.9 Land Use and Recreation

The geographical area considered for cumulative effects on land use and recreational resources is the Project area along with the area associated with the two foreseeable future projects. Land use and recreation in the Entiat River subbasin have incrementally changed because of past and present development, and this trend is expected to continue. However, there would be no cumulative effects from the project to land use because land use is not expected to change in the action area. While recreational users of the river would encounter additional LWM structures in the river, the Project's structures have been designed using Reclamation's Risk Based Design Guidelines and adjusting the design and location of LWM structures based on input received during a field meeting with recreational river users.

3.15.10 Noise, Air Quality, and Public Health and Safety

The Proposed Action would cause a temporary increase in noise levels for nearby residents, and recreationalists during construction. Noise levels and sources of noise from the other foreseeable future projects would be similar to the incremental impact of the Proposed Action's noise when added to existing noise sources (cars on Entiat River Road) described in Section 3.11. The cumulative effect of the Project and other foreseeable projects would be temporary and limited to the 60 to 90 day construction periods during each year of the

construction period associated with the projects. No noise impacts post construction would occur.

Ongoing vehicular use, wildfires (and the management and suppression of fires), timber harvest, and residential sources in the Entiat River subbasin all contribute to ambient air pollutant emissions. These sources of pollutants would continue to occur. When the Proposed Action's construction impacts are combined with present and reasonably foreseeable future actions in the affected area, there would be a small amount of pollutant levels during the each year of the construction period. No air quality impacts would occur post construction. All levels of GHG emissions play a role in contributing cumulatively to global GHG concentrations and climate change. The estimated low emissions caused by the construction of the Proposed Action (two, 60 to 90 day construction periods), are well below EPA's reporting threshold (see Section 3.11). The cumulative effect of the Project when combined with the reasonable foreseeable projects would be below the threshold as well.

3.15.11 Transportation

The Proposed Action would cause noticeable increases in traffic during construction with associated truck traffic. Construction of the Upper Stillwater Restoration project and the project upstream of Area B would also contribute to construction traffic along Entiat River Road from the Upper Stillwater project to its intersection with US 97 as described in Section 3.13. The primary sources of traffic along Entiat River Road are residential, recreational, and agricultural and these sources are expected to continue. Traffic increases would be limited to the time the different projects are scheduled for construction and would not result in extended periods of increased traffic during the post construction time frame.

3.15.12 Socioeconomics

Construction of the Project, the Upper Stillwater project, and the project upstream of Area B in the Entiat River subbasin may contribute to the local economy, as well as temporarily affect population and housing, employment, and income. The effects of the Proposed Action and other foreseeable projects would primarily be limited during the construction period when construction workers could spend money associated with lodging and supplies needed during the construction periods; no post construction impacts are anticipated. There is no anticipated effect on environmental justice populations from the Project or other restoration projects.

Chapter 4 ENVIRONMENTAL CONSULTATION, REVIEW, AND PERMIT REQUIREMENTS

This chapter briefly describes the overall environmental consultation and coordination with responsible agencies associated with the local, state, and federal laws, regulation, executive orders, and policies that are pertinent to the Project.

4.1. National Environmental Policy Act

Reclamation prepared this Draft EA pursuant to regulations implementing NEPA (42 U.S.C. 4321 et seq.), which requires federal agencies to assess the effects that their actions may have on the environment. NEPA requires preparation of an EIS for major federal actions significantly affecting the quality of the human environment. Reclamation prepared this Draft EA to determine if the Proposed Action would create significant environmental effects that would warrant preparing an EIS, or if a FONSI is justified.

4.2. Wetlands, Floodplains, and Water Resources

Executive Order 11988, dated May 24, 1977, instructs federal agencies to determine prior to taking an action whether the Proposed Action would occur in a floodplain. If the action does occur in a floodplain, the agency must consider alternatives to avoid adverse effects to the greatest extent practicable. If the only feasible alternatives are located within a floodplain, the agency shall take action to design or modify its action to minimize potential harm to or within the floodplain consistent with regulations accompanying Executive Order 11988. Section 3.4 Water Resources addresses floodplains.

Executive Order 11990, dated May 24, 1977, directs federal agencies to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial value of wetlands in carrying out programs affecting land use. Wetlands provide great natural productivity, hydrological utility, environmental diversity, natural flood control, improved water quality, recharge of aquifers, flow stabilization of

streams and rivers, and habitat for fish and wildlife resources. Section 3.3 Vegetation and Wetlands addresses wetlands and Section 3.5 addresses fish and wildlife resources.

Several sections of the Clean Water Act (33 U.S.C 1251 et seq.) and Washington State's Shoreline Management Act (90.58 RCW) address wetland and waterway management, regulation, and protection. The project Sponsors would submit a Joint Aquatic Resources Permit Application (JARPA) to the USACE, WDOE, and WDFW before construction. The applicable regulations to the project are discussed below.

4.2.1 Clean Water Act Section 401

A federal permit to conduct an activity that causes discharges into navigable waters is issued only after the State of Washington certifies that existing water quality standards would not be violated if the permit were issued. The DOE would review the project's Section 401 and Section 404 permit applications for compliance with Washington water quality standards and grant certification if the permits comply with these standards. In the state of Washington, the JARPA process is used for project applicants to apply for Section 401 project review and certification. For the Project, the local sponsor associated with each project area (i.e., CCNRD for Project Area B, CCFEG for Project Area C, CCD for Project Areas E and F) would be responsible for completing the JARPA and submitting application materials to the DOE for the 401 water quality certification.

4.2.2 Clean Water Act Section 402

This section authorizes National Pollutant Discharge Elimination System permits for the discharge of pollutants, such as stormwater. The EPA, Region 10, has a general permit for discharges from construction activities. The Sponsors would issue a Notice of Intent to get coverage under this general permit, and would prepare a stormwater pollution prevention plan to address stabilization practices, structural practices, stormwater management, and other controls.

4.2.3 Clean Water Act Section 404

When dredged or fill material discharges into waters of the United States, including wetlands, it requires authorization from the USACE in accordance with the provisions of Section 404 of the Clean Water Act. The Sponsors would work with the USACE to get a Section 404 permit for fill placed in wetlands or other waters, and work with DOE to get Section 401 water quality certification (see Section 4.2.1). Sections 3.3 (Vegetation and Wetlands) and 3.4 (Water Resources) of this EA describe potential effects on wetlands and other waters. In the State of Washington, the JARPA process is used for project applicants to apply for Section 404 project review and approval. For the Project, the local sponsor associated with each

project area (i.e., CCNRD for Project Area B, CCFEG for Project Area C, CCD for Project Areas E and F) would be responsible for completing the JARPA and submitting to USACE for the 404 wetland fill permit.

Wetland permits issued by the USACE may be an individual permit, or a permit authorized under the nationwide permit (NWP) process per 33 CFR Chapter II, FR V82 No.4. Currently there are 54 NWP's with one of the NWP's designated for aquatic habitat restoration, establishment, and enhancement activities (NWP 27). The USACE determines if the proposed project meets the general, national, and regional conditions associated with the NWP process. If not, the project is reviewed under the individual permit process.

4.3. Fish and Wildlife

4.3.1 Endangered Species Act

The ESA and its amendments (16 U.S.C. 1531 et seq.) require federal agencies to ensure that the actions they authorize, fund, and carry out do not jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. The effects on species listed under the ESA are discussed in Chapter 3.5 of the EA. As a federal agency, Reclamation would meet its ESA Section 7 responsibilities using various mechanisms. For spotted owls, Reclamation would use the technical memorandum approach as directed by the USFWS. Reclamation would address the remaining listed species under the USFWS purview using the Restoration Programmatic for the State of Washington issued to the USACE. This process requires Reclamation to complete a Specific Project Information Form. Relative to ESA-listed anadromous salmonids, Reclamation would either prepare a project-specific biological assessment for review and approval by NOAA Fisheries, or use the current USACE programmatic consultation process with NOAA Fisheries (NOAA Fisheries 2017).

4.3.2 Fish and Wildlife Conservation Act and Fish and Wildlife Coordination Act

The Fish and Wildlife Conservation Act of 1980 (16 U.S.C 2901 et seq.) encourages federal agencies to conserve and promote conservation of non-game fish and wildlife and their habitats. The Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) requires federal agencies with projects affecting water resources to consult with USFWS and the state agency responsible for fish and wildlife resources. Section 3.5, Fish and Wildlife of this EA provides an analysis of the Project's benefits and impacts relative to fish and wildlife species and habitat. Impacts that may occur during construction may be reduced and minimized by BMPs

and the Project's design features as described in Chapter 2. Beneficial impacts would be realized during the post-construction time frame as the project increases off channel habitat for juvenile fish, improves in stream habitat complexity for various fish life stages, and increases wildlife habitat through creation and rehabilitation of wetlands. Reclamation is addressing the potential effects of the project on ESA-listed fish and wildlife species through Section 7 ESA consultation with both USFWS and NOAA Fisheries. The USFWS, NOAA Fisheries, and WDFW have been notified of the project and will be sent copies of the Draft and Final EA.

4.3.3 Migratory Bird Treaty Act and Federal Memorandum of Understanding

The Migratory Bird Treaty Act of 1918, as amended, implements various treaties and conventions between the United States and other countries, including Canada, Japan, Mexico, and Russia, for the protection of migratory birds (16 U.S.C 703–712). Under the act, taking, killing, or possessing migratory birds, or their eggs or nests, is unlawful. The act classifies most species of birds as migratory, except for upland and nonnative birds such as pheasant, chukar, gray partridge, house sparrow, European starling, and rock dove.

Reclamation (through the DOI) and USFWS have a memorandum of understanding to address migratory bird conservation in accordance with Executive Order 13186 (Responsibilities to Federal Agencies to Protect Migratory Birds). This order directs each federal agency taking actions that could negatively affect migratory birds to work with the USFWS to develop an agreement to conserve those birds (DOE and USFWS 2013). The memorandum of understanding addresses how both agencies can work cooperatively to address migratory bird conservation, and includes specific measures to consider implementing during project planning and implementation.

The analysis in Section 3.5.2 of this EA describes the Project's effect on migratory birds and how the Project requires revegetation of areas that would restore habitat temporarily disturbed during construction. Project construction would be conducted between July and October, which is outside the nesting period for many migratory birds.

4.3.4 Bald Eagle and Golden Eagle Protection Act

The Bald Eagle and Golden Eagle Protection Act (16 USC. 668–668d) addresses taking or possessing of and commerce in bald and golden eagles, with limited exceptions. The Act only covers intentional acts or acts in "wanton disregard" of the safety of bald or golden eagles.

Bald and golden eagles may occur in the project site (Section 3.5). However, PHS data do not indicate the presence of any bald eagle nest sites or winter roost sites, or the presence of

golden eagle breeding activity in the project area. Because the project would not involve knowing take or other acts in wanton disregard of bald or golden eagles, its implementation would not violate the provisions of the Bald Eagle and Golden Eagle Protection Act.

4.4. Land Use Plan Consistency

The Chelan County Comprehensive Plan (Chelan County 2016) establishes policies to guide development of the county. Zoning and other development regulations must be consistent with the comprehensive plan. The Comprehensive Plan identifies policies for Natural Resources and Environment and Title 11 and 13 of the associated County's Code provide regulations for environment and critical areas. As indicated in Section 3.10 construction activities would occur in the main channel of the Entiat River and result in no changes to land use. Also, there would be no change in land use from temporary access road construction and staging of materials. The Project is designed for consistency with planning policies, the County Code, and Chelan County's Shoreline Master Plan's Conservancy shoreline designation (Chelan County 1980).

4.5. Cultural and Historic Resources

Laws and regulations govern the management of cultural resources. A cultural resource is an object, structure, building, site, or district that provides irreplaceable evidence of natural or human history of national, state, or local significance, such as National Landmarks, archaeological sites, and properties listed (or eligible for listing) in the NRHP. Cultural resource-related laws and regulations include the following:

- Antiquities Act of 1906, (54 U.S.C. Subtitle III, National Preservation Programs, Division C-American Antiquities § 320101-320303); 18 U.S.C. § 1866(b),
- Historic Sites Act of 1935, (54 U.S.C. § 320101- 320106; 54 U.S.C. § 102303, 102304; 54 U.S.C. § 309101),
- Section 106 of the NHPA (54 U.S.C. § 300101 et seq.), as amended,
- Archaeological Data Preservation Act of 1974, (54 U.S.C. § 312501-312508),
- Archaeological Resources Protection Act of 1979 (16 U.S.C. 470aa-mm), as amended,
- Native American Graves Protection and Repatriation Act (25 U.S.C. 3001 et seq.),
- Executive Order 13007 Indian Sacred Sites, and
- American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996, 1996a).

Section 106 of the NHPA requires federal agencies to consider the effects of their actions on historic properties. The regulations that implement Section 106 define "historic property" as follows:

> *Historic property* means any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria [36 CFR 800.16(l)(1)].

After historic properties have been identified, federal agencies then assess effects to historic properties along with interested and affected parties such as tribes and state historic preservation offices, and then work to resolve those adverse effects.

To this end, BPA has provided information about the Proposed Action to, and requested information from various agencies and tribes, on the level and type of proposed identification and evaluation efforts of the prehistoric resources. Agencies consulted include the WDAHP (i.e., the Washington SHPO), CCT, and YN. Public notification was also made regarding the project. Both the Washington SHPO and the CCT concurred with BPA's Finding of No Historic Properties Affected, and because Reclamation has not changed the project design from when BPA consulted with these parties on the project, Reclamation is planning to adopt the documentation and findings prepared by BPA. A Finding of No Historic Properties Affected means that Reclamation would have no further obligations under the Section 106 process for this project other than making sure that any post-review or inadvertent discoveries are properly addressed. However, a change in project design as a part of adaptive management would likely require reinitiation of the Section 106 consultation process for the proposed work.

4.6. Sacred Sites

Executive Order 13007, dated May 24, 1996, instructs Federal agencies to promote accommodation of access to, and protect the physical integrity of, American Indian sacred sites. A sacred site is a specific, discrete, and narrowly delineated location on Federal land. An Indian tribe or an Indian individual determined to be an appropriately authoritative representative of an Indian religion must identify a site as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion, provided that the tribe or individual is an appropriate authoritative representative of an Indian religion. No Sacred Sites were identified during consultation with tribes. See Chapter 3.8 for a discussion of Sacred Sites.

4.7. Indian Trust Assets

ITAs are addressed in Chapter 3.9. ITAs are legal interests in property held in trust by the United States (with the Secretary of the Interior acting as trustee) for Indian tribes or Indian individuals. Examples of ITAs are lands, minerals, hunting and fishing rights, and water rights. In many cases, ITAs are on-reservation; however, they may also be found off-reservation.

The United States has an Indian trust responsibility to protect and maintain rights reserved by or granted to Indian tribes or Indian individuals by treaties, statutes, and Executive Orders (Secretarial Order 3175: Department Responsibilities for Indian Trust Assets). These rights are sometimes further interpreted through court decisions and regulations. This trust responsibility requires that officials from Federal agencies, including Reclamation, take all actions reasonably necessary to protect ITAs when administering programs under their control. As stated in Chapter 3.9, there would be no change in the ability to exercise existing treaty rights from this project. No ITAs have been identified in the affected area and there would be no loss, damage, unlawful alienation, waste, and depletion of ITAs.

4.8. Air Quality

The Clean Air Act, as amended (42 U.S.C. 7401 et seq.), requires the EPA and states to carry out a wide range of regulatory programs intended to comply with the National Ambient Air Quality Standards. In Washington, both the EPA and Department of Ecology are responsible for air quality. The Project area is classified by the Washington State Department of Ecology as being in attainment of the National Ambient Air Quality Standards. Air quality standards would be maintained as Project emissions would be temporary and localized in nature, and the use of BMPs would reduce and minimize release of particulate matter in the air.

4.9. Climate Change

Gases that absorb infrared radiation and prevent heat loss to space are called greenhouse gases (GHGs). Models predict that atmospheric concentrations of all GHGs would increase over the next century, but the extent and rate of change is difficult to predict, especially on a global scale. As a response to concerns over the predicted increase of global GHG levels, various federal and state mandates address the need to reduce GHG emissions, including the following.

- The Clean Air Act is a federal law with regulations to control emissions from large generation sources such as power plants; limited regulation of GHG emissions occurs through the New Source Review permitting program.

- The EPA's Final Mandatory Reporting of Greenhouse Gases Rule (40 CFR 98) requires reporting of GHG emissions from large sources. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHGs must submit annual reports to the EPA (EPA 2009).
- Executive Orders 13423 (Strengthening Federal Environmental, Energy, and Transportation Management) and 13514 (Federal Leadership in Environmental, Energy and Economic Performance) directs federal agencies to measure, manage, and reduce GHG emissions by agency-defined target amounts and dates.

GHG emissions would be below EPA's mandatory reporting threshold of 25,000 metric tons or more per year for the proposed Project. There would be no impact on climate change based on this threshold as discussed in Section 3.11, Noise, Air Quality, and Public Health and Safety.

4.10. Noise

The Noise Control Act of 1972 (42 U.S.C. 4901 et seq.) sets forth a broad goal of protecting all people from noise that jeopardizes their health or welfare. The Act further authorizes federal agencies to carry out the programs within their control to further this policy. The noise effects from the Project would be temporary during the construction period for people within 2,000 feet of construction. Section 3.11 describes the noise effects associated with the Project.

4.11. Spill Prevention and Control

Several federal laws related to petroleum products and toxic substances potentially apply to the project, depending upon the quantities and types of materials being used.

4.11.1 The Spill Prevention, Control, and Countermeasures Rule

The Spill Prevention Control and Countermeasures Rule (40 CFR Part 112) includes requirements to prevent discharges of oil and oil-related materials from reaching navigable waters and adjoining shorelines. It applies to facilities with total aboveground oil storage capacity (not actual gallons onsite) of greater than 1,320 gallons, and facilities with belowground storage capacity of 42,000 gallons. This project does not propose onsite below ground storage of oil or oil-related materials. Chapter 2 recognizes it is the responsibility of the construction contractor to adhere to all spill prevention, containment/ and counter

measures described in the construction plans and specifications that would be prepared for the Project.

4.12. Environmental Justice

In February 1994, the President released Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations. This order directs federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The proposed project would not cause disproportionately high and adverse effects on minority and low-income populations. (See Section 3.14, Socioeconomics).

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Chapter 5 CONSULTATION AND COORDINATION

5.1 Introduction

Those consulted include local, state, and federal agencies and tribes in the project vicinity. Specific individuals were consulted to gather information and data about the project area and applicable requirements, as part of consultation, or for permit applications. This chapter closes with a list of preparers of this EA.

5.2 Federal Agencies

- NOAA Fisheries Service
- BPA
- USACE
- USFWS

5.3 State Agencies

- WDFW
- WDAHP
- WDOE

5.4 Tribes

- CCT
- YN

5.5 Local Governments

- Chelan County – Chelan County Natural Resource Department
- Entiat, Washington

5.6 Others

- Chelan Douglas Land Trust
- Cascadia Conservation District
- Cascade Columbia Fisheries Enhancement Group

5.7 Preparers

The following contributors to the EA are part of Reclamation's Pacific Northwest Region Office and their contractors and subcontractors.

- Reclamation
  - Ecosystems Analysis
  - Columbia Snake River Office
  - Columbia-Cascades Area Office
  - Land Resources
  - Project Management and Coordination
- Contractors
  - ICF
  - Natural Systems Design

Chapter 6 REFERENCES

Parenthetical Reference	Bibliographic Citation
74 FR 56260	Federal Register. 2009. Environmental Protection Agency, 40 CFR Parts 86, 87, 89, et al. *Mandatory Reporting of Greenhouse Gases; Final Rule*. Vol. 74, No. 209, pp. 56260-56519.
77 FR 71875	Federal Register. 2012. *Endangered and Threatened Wildlife and Plants: Designation of Revised Critical Habitat for the Northern Spotted Owl; Final Rule*. No. 233 December 4, 2012. Part II Department of the Interior Fish and Wildlife Service. 50 CFR Part 17. Vol. 77, No. 233, pp. 71876-72068.
79 FR 19594	Federal Register. 2008. Department of the Army, Corps of Engineers. 33CFR Parts 325 and 332 Environmental Protection Agency. 40 CFR Part 230 Compensatory Mitigation for Losses of Aquatic Resources: Final Rule. Vol. 79, No. 70, pp. 19594-19705
Abbe and Montgomery 2003	Abbe, T.B., and D.R. Montgomery. 2003. "Patterns and processes of wood debris accumulation in the Queets river basin, Washington." Geomorphology 51 (1-3): 81–107 DOI: 10.1016/S0169-555X(02)00326-4
Abbe et al. 2003	Abbe, T.A., A.P. Brooks, and D.R. Montgomery. 2003. "Wood in river rehabilitation and management." Pages 367-389 in S. V. Gregory, K. 1. Boyer, and A. M. Gurnell, editors. The ecology and management of wood in world rivers. American Fisheries Society, Symposium 37, Bethesda, Maryland.
Adam et al. 2009	Adam, J.C., A.F. Hamlet, and D.P. Lettenmaier. 2009. "Implications of global climate change for snowmelt hydrology in the twenty-first century." Hydrological processes, 23(7), 962-972.
Aho and Beieler 2007	Aho, T. L., & Beieler, V. 2007. *Soil Survey of Cashmere Mountain Area, Washington, Parts of Chelan and Okanogan Counties*. Natural Resources Conservation Service.
Ames et al. 1998	Ames, K. M., D. E. Dumond, J. R. Galm, and R. Minor 1998. "Prehistory of the Southern Plateau." In Handbook of North American Indians, Volume 12: Plateau, edited by D. E. Walker, pp. 103-119. Smithsonian Institution Press, Washington, D.C.

Parenthetical Reference	Bibliographic Citation
Andonaegui 1999	Andonaegui, C. 1999. *Salmon and steelhead habitat limiting factors report for the Entiat Watershed Water Resource Inventory Area (WRIA) 46, Version 3*. Olympia, Washington: Washington State Conservation Commission.
Bash et al. 2001	Bash, J., C. Berman, and S. Bolton. 2001. *Effects of Turbidity and Suspended Solids on Salmonids. Center for Streamside Studies, College of Forest Resources.* University of Washington. In press for Washington State Department of Transportation. Seattle, WA.
Bellmore et al. 2012	Bellmore, J. R., C. V. Baxter, K. Martens, and P. J. Connolly. 2012. "The floodplain food web mosaic: a study of its importance to salmon and steelhead with implications for their recovery." Ecological Applications 23(1):189-207.
Beranek 1988	Beranek, Leo, L. 1988. *Noise and Vibration Control.* McGraw-Hill, Inc. Published by Institute of Noise Control Engineering. Washington, D.C.
Berger and Hartmann 2015	Berger and Hartmann. 2015. *Cultural Resources Assessment of the Middle Entiat Restoration Project, Chelan County, Washington*. Prepared for Bonneville Power Administration. August 28, 2015, Revised September 9, 2015. CRC Project #1504J
BPA 2016	Bonneville Power Administration. 2016. HIP III Handbook, Version 3.0. Downloaded: July 5, 2016. https://www.bpa.gov/efw/Analysis/NEPADocuments/esa/2016HIPIIIHandbookVer3.0.pdf
Cascadia Conservation District 2014	Cascadia Conservation District. 2014. *Middle Entiat Recreational Use Repor*t. Wenatchee, Washington.
CCCD 2004	Chelan County Conservation District. 2004. *Entiat Water Resource Inventory Area (WRIA) 46 Management Plan*. Chelan County Conservation District.
CCT 2015	Confederated Tribes of Colville Reservation. 2015. Email from Eric Oosahwee-Voss, Senior Archaeologist to Bonneville Power Administration. November 2, 2015.
CDC 2017	Center for Disease Control and Prevention. 2017. World Map of Areas with Risk of Zika. Online at: https://wwwnc.cdc.gov/travel/page/world-map-areas-with-zika, Accessed June 8, 2017.

Parenthetical Reference	Bibliographic Citation
CEQ 1997	Council on Environmental Quality Executive Office of the President; Old Executive Office Building, Room 360 Washington, D.C. 20502. December 10, 1997 http://www.whitehouse.gov/CEQ/ December 10,
Chapman 1995	Chapman, D. 1995. *Status of sockeye salmon in the mid-Columbia Region*. Boise, Idaho: Don Chapman Consultants, Inc.
Chelan County 1980	Chelan County. 1980. Shoreline Master Program for Chelan County.
Chelan County 2016	Chelan County. 2016. *Chelan County Comprehensive Plan*. Approved February 1, 2000 and last amended by Resolution 2016-109, effective December 20, 2016.
Chelan County PUD 2017	Chelan County Public Utility District 2017. Rocky Reach Dam. Chelan County P.U.D. Electronic document. Accessed 14 June 2017. https://www.chelanpud.org/hydropower/rocky-reach-dam
Clemens et al. 2013	Clemens, B. J., S. van de Wetering, S. A. Sower, and C. B. Schreck. 2013. "Maturation Characteristics and Life-History Strategies of the Pacific Lamprey, Entosphenus tridentatus ." Canadian Journal of Zoology 91:775–788.
Craig and Suomela 1941	Craig, J., and Suomela, A. J. 1941. *Time of appearance of the runs of salmon and steelhead trout native to the Wenatchee, Entiat, Methow, and Okanogan rivers. Unpub. MS*. U.S. Fish and Wildlife Service.
DOE and USFWS 2013	Department of Energy and U.S. Fish and Wildlife Service. 2013. Memorandum of Understanding, Responsibilities of Federal Agencies to Protect Migratory Birds. Office of Enterprise Assessment. http://energy.gov/hss/downloads/memorandum-understanding-responsibiitiesfederal-agencies-protect-migratory-birds
DOI 1995	Department of the Interior. 1995. U.S. Department of the Interior Departmental Manual Part 512.2. Departmental Responsibilities for Indian Trust Resources. Available at: https://www.usbr.gov/native/policy/DM_FInal_12-1-95_512%20DM%202.pdf.

Parenthetical Reference	Bibliographic Citation
DOI 2000	Department of the Interior. 2000. Secretarial Order 3215. Trust Principles. Office of the Special Trustee for American Indians (OST). April 2000. Online at: https://www.doi.gov/ost/about_us/Trust
English et al. 2001	English, K.K., C. Sliwiaski, B.L. Nass, and J.R. Stevenson. 2001. *Assessment of adult steelhead migration through the Mid-Columbia River using radio-telemetry techniques, 1999-2000*. Report prepared by LGL Limited for Public Utility District No. 1 of Douglas County.
EPA 1974	Environmental Protection Agency. 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. EPA 550/9 74-004. March.
EPA 1998	Environmental Protection Agency. 1998. Final Guidance For Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses. April 1998. https://www.epa.gov/sites/production/files/2014-08/documents/ej_guidance_nepa_epa0498.pdf
FEMA 1982	Federal Emergency Management Agency. 1982. *Flood Insurance Rate MapChelan County, Washington , Panel 375 of 1075*, Community-Panel 530015 0375 A.
FHA 2006	Federal Highway Administration. 2006. *Roadway Construction Noise Model (RCNM) User's Guide. Final Report*. FHWA-HEP-05-054, DOT-VNTSC-FHWA-05-01.
Fox and Bolton 2007	Fox, M. and S. Bolton. 2007. "A regional and geomorphic reference for quantities and volumes of instream wood in unmanaged forested basins of Washington state." North American Journal of Fisheries Management, 27, 342-359
Franklin and Dyrness 1988	Franklin, J., and Dyrness, C. 1988. *Natural Vegetation of Oregon and Washington*. Corvallis, Oregon: Oregon State University Press.
Gunkel 1961	Gunkel, Alexander 1961. A Comparative Cultural Analysis of Four Archaeological Sites in the Rocky Reach Reservoir Region, Washington. Theses in Anthropology No. 1. Department of Sociology and Anthropology, Washington State University, Pullman.
Halupka 2017	Halupka, Karl. 2017. Year. U.S. Fish and Wildlife Service. Fish and Wildlife Biologist. Central Washington Office. Wenatchee, Washington. Personal communication March 10.

Parenthetical Reference	Bibliographic Citation
Hamlet et al. 2010	Hamlet, A.F., P. Carrasco, J. Deems, M.M. Elsner, T. Kamstra, C. Lee, S-Y Lee, G. Mauger, E. P. Salathe, I. Tohver, and L. Whitely Binder. 2010. Final Project Report for the Columbia Basin Climate Change Scenarios Project. Online at: http://warm.atmos.washington.edu/2860/report/
Hamstreet 2012	Hamstreet, C.O. 2012. *Spring and summer Chinook salmon spawning ground surveys on the Entiat River, 2011*. U.S. Fish and Wildlife Service, Leavenworth, Washington.
Hamstreet and Carie 2002	Hamstreet, C., and D. Carie. 2002. *Spring and Summer Chinook Salmon Spawning Ground Surveys on the Entiat River, 2001*. Leavenworth, Washington: U.S. Fish and Wildlife Service Mid-Columbia R. Fishery Resource Office.
Harmon et al. 1986	Harmon, M.E., J.F. Franklin, F.J. Swanson, P. Sollins, S.V. Gregory, J.D. Lattin, N.H. Anderson, S.P. Cline, N.G. Aumen, J.R. Sedell, G.W. Lienkaemper, K. Cromack, Jr., and K.W. Cummins. 1986. "The ecology of coarse woody debris in temperate ecosystems." Pages 133-302 in A. MacFadyen and E. D. Ford, editors. Advances in ecological research. Volume 15. Academic Press, New York.
Helicopter Association International 1993	Helicopter Association International. 1993. *Fly NeighReclamationly Guide*. Alexandria, Virginia: HAI Fly NeighReclamationly Committee.
Holstine 1994	Holstine, Craig. 1994. "Timber Industry. In An Historical Overview of the Wenatchee National Forest." Prepared for Wenatchee National Forest, Wenatchee, edited by Craig Holstine, pp. 8.1- 8.26. Archaeological and Historical Services Report No. 100-80, Eastern Washington University, Cheney.
Hruby 2014	Hruby, T. 2014. "Washington State Wetland Rating System for Eastern Washington: 2014 Update." Published by Department of Ecology. Publication Number 14-06-018
ICF International 2015	ICF International. 2015. *Wetland Delineation Report: Gray Reach and Stormy Reach Restoration Projects*. Seattle, Washington.
Luttrell 1994	Luttrell, Charles. 1994. Settlement In An Historical Overview of the Wenatchee National Forest Washington, edited by Craig Holstine, pp. 3.1-3.34. Eastern Washington University Reports in Archaeology and History 100-80. Archaeological and Historical Services, Cheney, Washington.

Parenthetical Reference	Bibliographic Citation
Mantua and Raymond 2014	Mantua, N.J. and C.L. Raymond. 2014. Climate Change, Fish, and Fish Habitat in the North Cascade Range. Chapter 7 in Climate Change Vulnerability and Adaptation in the North Cascades Region, Washington. C.L Raymond, D.L. Peterson, R.M. Rochefort, Eds. General Technical Report, PNW-GTR-892. U.S. Department of Agriculture. Pacific Northwest Research Station. Portland, Oregon.
Mantua et al. 2009	Mantua, N.J., I. Tohver, and A.F. Hamlet. 2009. *Impacts of climate change on key aspects of freshwater salmon habitat in Washington State*. Chapter 6 in The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate. Climate Impacts Group. University of Washington, Seattle, Washington.
Martens and Connolly 2014	Martens, K.D., and P.J. Connolly. 2014. "Juvenile Anadromous Salmonid Production in Upper Columbia River Side Channels with Different Levels of Hydrological Connection." Transactions of the American Fisheries Society. 30 April, 2014.
Meehan 1991	Meehan, W. R. (ed.). 1991. "Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats." Special publication 19. American Fisheries Society. Bethesda, MD.
Melillo et al. 2014	Melillo, J.M., Richmond, T.C., Yohe, G.W. (Eds.). 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program.
Miller 1998	Miller, Jay. 1998. "Middle Columbia River Salishans. In Handbook of North American Indians, Volume 12." Plateau, edited by D. E. Walker, pp. 253-270. Smithsonian Institution, Washington D.C.
Mosey and Murphy 2000	Mosey, T. and Murphy, L. 2000. *Spring and Summer Chinook Spawning Ground Surveys on the Wenatchee River Basin, 2000*. Public Utility District No. 1 of Chelan County, Wenatchee, WA
Mote and Salathé 2010	Mote, P.W., and E.P. Salathé. 2010. Future climate in the Pacific Northwest. Climatic Change, 102(1-2), 29-50.
Moyle 2002	Moyle, P.B. 2002. Inland Fishes of California. Revised and Expanded. Berkeley, CA: University of 7 California Press.
Mullan 1986	Mullan, J. W. 1986. *Determinants of sockeye salmon abundance in the Columbia River, 1880s -1982: a review and synthesis*. Leavenworth, Washington: U.S. Fish and Wildlife Service.

Parenthetical Reference	Bibliographic Citation
Nelson 2014	Nelson, M.C. 2014. *Spawning migrations of adult fluvial bull trout in the Entiat River, WA 2007-2013*. U.S. Fish and Wildlife Service, Leavenworth WA. 55pp.
NOAA Fisheries 2008	National Oceanic and Atmospheric Administration's National Marine Fisheries Service. 2008. *Endangered Species Act Section 7(a)(2) Consultation Biological Opinion And Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation*. Northwest Region. May 5, 2008.
NOAA Fisheries 2010	National Oceanic and Atmospheric Administration's National Marine Fisheries Service. 2010. Endangered Species Act Section 7 (a)(2) Supplemental Biological Opinion. Supplemental Consultation on Remand for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(I)(A) Permit for Juvenile Fish Transportation Program.
NOAA Fisheries 2013	National Oceanic and Atmospheric Administration's National Marine Fisheries Service. 2013. *Endangered Species Act Section 7 Formal Programmatic Biological and Conference Opinion, Letter of Concurrence, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Bonneville Power Administration's Habitat Improvement Program III (HIP III) KEC-4*
NOAA Fisheries 2014	National Oceanic and Atmospheric Administration's National Marine Fisheries Service. 2014. *Endangered Species Act Section 7 (a)(2) Supplemental Biological Opinion*. Consultation on Remand for Operation of the Federal Columbia River Power System NOAA Fisheries Log Number NWR-2013-9562
NOAA Fisheries 2017	National Oceanic and Atmospheric Administration's National Marine Fisheries Service. 2017. *Endangered Species Act Section 7(a)(2) Programmatic Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Fish Passage and Restoration Actions in Washington State (FPRP III).* Action Agency: U.S. Department of the Army, Corps of Engineers. Issued June 21, 2017
NPCC 2004	Northwest Power and Conservation Council. 2004. *Entiat Subbasin Plan*.

Parenthetical Reference	Bibliographic Citation
Opperman et al. 2010	Opperman, J. J., R. Luster, B. A. McKenney, M. Roberts, and A. W. Meadows. 2010. "Ecologically Functional Floodplains: Connectivity, Flow Regime, and Scale." JAWRA Journal of the American Water Resources Association 46(2):211-226.
Pagel et al. 2010	Pagel, J.E., D.M. Whittington, and G.T. Allen. 2010. *Interim Golden Eagle inventory and monitoring protocols; and other recommendations*. Division of Migratory Bird Management, U.S. Fish and Wildlife Service.
Peven 1992	Peven, C.M. 1992. *Population status of selected stocks of salmonids from the mid-Columbia River basin*. Wenatchee, Washington: Chelan County Public Utility District.
Pollock et al. 2014	Pollock MM, Beechie TJ, Wheaton JM, Jordan CE, Bouwes N, Weber N, Volk C. 2014. "Using Beaver Dams to Restore Incised Stream Ecosystems." BioScience 64 (4): 279–290 DOI: 10.1093/biosci/biu036
Randall et al. 2007	Randall, D., Wood, R., Bony, S., Colman, R., Fichefet, T., Fyfe, J., Kattsov, V., Pitman, A., Shukla, J., Srinivasan, J., Stouffer, R., Sumi, A., Taylor, K. 2007. Climate models and their evaluation. In: S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. Averyt, M. Tignor, H. Miller (Eds.), Climate change 2007: the physical science basis. Contribution of working group I to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.
Reclamation 2009	Bureau of Reclamation. 2009. *Entiat Tributary Assessment, Chelan County, Washington*. Denver, Colorado: Technical Service Center.
Reclamation 2013a	Bureau of Reclamation. 2013. *Final Gray Reach Assessment Entiat River, Chelan County, Washington*. U.S. Bureau of Reclamation. Pacific Northwest Region. U.S. Department of the Interior. Boise, Idaho.
Reclamation 2013b	Bureau of Reclamation, 2013b. *Final Stormy Reach Assessment Entiat River, Chelan County, Washington*. U.S. Bureau of Reclamation. Pacific Northwest Region. U.S. Department of the Interior. Boise, Idaho.
Reclamation 2014	Bureau of Reclamation. 2014. *Large Woody Material – Risk Based Design Guidelines*. Boise, Idaho. U.S. Bureau of Reclamation. Pacific Northwest Region. U.S. Department of the Interior. Boise, Idaho.

Parenthetical Reference	Bibliographic Citation
Reclamation 2016a	Bureau of Reclamation. 2016a. *80% Preliminary Plans Not for Construction. Stormy Reach Project Area B; Project Area C; Gray Reach Project Area E; Project Area F*. Prepared by ICF, Natural Systems Design, Ch2M. Seattle, WA.
Reclamation 2016b	Bureau of Reclamation. 2016b. Post Construction Inspection Report (Draft), Entiat River, Gray & Stormy Reaches, Habitat Restoration Project. DRAFT. November 2016. (ICF 00070.16 and 00071.16) Seattle, WA. Prepared for the U.S. Bureau of Reclamation, Boise, ID.
Reclamation 2016c	Bureau of Reclamation. 2016c. *Basis of Design Report (80% Draft), Entiat River – Gray & Stormy, Habitat Restoration Projects*; Seattle, Washington: Prepared by ICF and Natural Systems Design.
Reclamation 2017	Bureau of Reclamation. 2017. The History of Hydropower Development in the United States. Bureau of Reclamation, Hydropower Program. Electronic document. Accessed 14 June 2017. https://www.usbr.gov/power/edu/history.html
Roni et al. 2014	R Roni, P., G.R. Pess, T.J. Beechie, and K.M. Hanson. 2014. Fish-habitat relationships and the effectiveness of habitat restoration. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-127.
Ruby and Brown 1995	Ruby, Robert H. and John A. Brown. 1995. Half-Sun on the Columbia: A Biography of Chief Moses. University of Oklahoma Press, Norman.
Sage 1997	Sage, Ginger. 1998. Entiat Remembers: An Anthology of Pioneer Strengths (1st ed). Ginger Sage Books, Entiat, Washington.
Schalk and Mierendorf 1983	Schalk, R.F., and R. Mierendorf (editors) 1983. Cultural Resources of the Rocky Reach of the Columbia River, Volumes I and II. Center for Northwest Anthropology, Washington State University, Pullman.
Stratten 2017	Stratten, Danny. 2017. ICF International. Restoration Designer/GIS Specialist. Bellingham, Washington. May 3, 2017 email.
U.S. Census Bureau 2016	U.S. Census Bureau. 2016. State and County QuickFacts. Available online at https://www.census.gov/quickfacts/table/PST045216/53007,00
USACE 2008	U.S. Army Corps of Engineers. 2008. Regulatory Guidance Letter No. 08-03. 10 October 2008. Washington, D.C.

Parenthetical Reference	Bibliographic Citation
USFS 1912	U.S. Forest Service. 1912. Chelan National Forest, Washington. U.S. Geological Survey, Washington, D.C. 2015 A Brief History of the Okanogan-Wenatchee National Forest. Electronic resource, http://www.fs.usda.gov/detail/okawen/about-forest/?cid=fsbdev3_053644#wen, accessed May 19, 2015.
USFS 1996	U.S. Forest Service. 1996. *Watershed Assessment Entiat Analysis Area, Version 2.0*. Wenatchee National Forest, Entiat Ranger District. Entiat, Washington.
USFWS 2004	U.S. Fish and Wildlife Service. 2004. Spring and summer Chinook salmon spawning ground surveys on the Entiat River, 2003. 18 pp
USFWS 2007	U.S. Fish and Wildlife Service. 2007. National Bald Eagle Management Guidelines. 23pp.
USFWS 2013	U.S. Fish and Wildlife Service. 2013. *Formal section 7 programmatic consultation on BPA's Columbia River Basin Habitat Improvement Program – Biological Opinion.* Oregon Fish and Wildlife Office, Portland, Oregon. TAILS no. 01EOFW00-2013-F-0199.
USFWS 2015	U.S. Fish and Wildlife Service. 2015. Recovery plan for the coterminous United States population of bull trout (*Salvelinus confluentus*). Portland, Oregon. Xii+179pp.
USFWS 2017a	U.S. Fish and Wildlife Service. 2017a. Accessed May 12, 2017 https://www.fws.gov/leavenworthfisheriescomplex/OurWork.cfm#ENFHWork
USFWS 2017b	U.S. Fish and Wildlife Service. 2017b. IPaC Resource List. Requested and received via USFWS IPaC web site on May 10, 2017: https://ecos.fws.gov/ipac/
USFWS and WNF 1996	U.S. Fish and Wildlife Service and Wenatchee National Forest. 1996. *Watershed assessment Entiat analysis area, v2.0. U.S. Forest Service Wenatchee National Forest, Entiat Ranger District, Entiat, WA*.
USGS 2017	U.S. Geological Survey. 2017. USGS 12452990 Entiat River Near Entiat, WA. https://waterdata.usgs.gov/nwis/uv?site_no=12452990

Parenthetical Reference	Bibliographic Citation
WDAHP 2015	Washington State Department of Archaeology and Historic Preservation. 2015. Letter from Robert G. Whitlam, PhD, State Archaeologist to Bonneville Power Administration, RE: RE: Middle Entiat Restoration Project / RM 16.2 to 20.7 Log No.: 022615-01-BPA. October 6, 2015.
Washington DOH 2017	Washington State Department of Health. 2017. *West Nile Virus*. Online at: http://www.doh.wa.gov/YouandYourFamily/IllnessandDisease/WestNileVirus Accessed June 8, 2017.
WDFW 2013a	Washington Department of Fish and Wildlife. 2013a. Threatened and Endangered Wildlife in Washington: 2012 Annual Report. Listing and Recovery Section, Wildlife Program, Washington Department of Fish and Wildlife, Olympia. 251pp
WDFW 2013b	Washington Department of Fish and Wildlife. 2013b. Wildlife Program Weekly Report; Week of February 11-17, 2013.
WDFW 2017	Washington Department of Fish and Wildlife. 2017. Priority Habitat and Species data for the Gray and Stormy Project. Olympia, Washington.
WDOE, USACE, and EPA 2006	Washington Department of Ecology, U.S. Army Corps of Engineers, and Environmental Protection Agency. Region 10. 2006. Wetland Mitigation in Washington State, Parts I and 2. Publication # 06-06-11a, 11b. Olympia, Washington
Whitehall 2015	Whitehall, R. 2015. Letter to Chris Clemons and Matt Wilderding of the Yakima Nation Fisheries, Yakama. Wenatchee, Washington: Okanogan – Wenatchee National Forest, U.S. Department of Agriculture Forest Service.
Wiles et al. 2011	Wiles, G. J., H. L. Allen, and G. E. Hayes. 2011. Wolf conservation and management plan for Washington. Washington Department of Fish and Wildlife, Olympia, Washington. 297 pp
WSDOT 2017	Washington Department of Transportation. 2017. Biological Assessment Preparation Advanced Training Manual Version 4-2017; 7.0 Construction Noise Impact Assessment. Olympia, Washington. 89pp.
Yanagimachi 2016	Yanagimachi, Lilith. 2016. Chelan County Community Development Department. Personnel communication. July 25, 2016.

Parenthetical Reference	Bibliographic Citation
YN 2017	Yakama Nation. 2017. *Yakama History: Confederated Tribes and Bands of the Yakama Nation*. Electronic document. Yakama Nation Museum and Cultural Center. Accessed 15 June 2017. http://yakamamuseum.com/home-history.php