

BIG AND LITTLE QUILCENE RIVERS COMPREHENSIVE FLOOD HAZARD MANAGEMENT PLAN

Prepared for
Jefferson County

June 2023



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Prepared by
Environmental Science Associates

Cover Photo: Outlets of Little Quilcene River
and Donovan Creek at tidal marsh on Quilcene
Bay October 2022. Photo by Environmental
Science Associates.

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ACRONYMS AND ABBREVIATIONS

2D	two-dimensional
BDA	beaver dam analog
BMPs	best management practices
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
CAO	Critical Areas Ordinance
CASP	Critical Areas Stewardship Plan
CDP	Census Designated Place
CFHMP	Comprehensive Flood Hazard Management Plan
cfs	cubic feet per second
CIO	Washington Office of the Chief Information Officer
CMZ	Channel Migration Zone
CPF	Coastal Protection Fund
CRS	Community Rating System
DOH	Department of Health
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FbD	Floodplains by Design
FCAAP	Flood Control Assistance Account Program
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FWHCA	Fish and Wildlife Habitat Conservation Area
gpm	gallons per minute
HCSEG	Hood Canal Salmon Enhancement Group
HMG	Hazard Mitigation Grant
JCC	Jefferson County Code
LLTK	Long Live the Kings
LWD	large woody debris
MP	milepost
NBI	National Bridge Inventory
NCRF	National Coastal Resilience Fund
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OGWS	Olympic Gravity Water System

OHWM	ordinary high-water mark
ONF	Olympic National Forest
PA	Public Assistance
PGG	Pacific Groundwater Group
PUD	Public Utility District
RCO	Washington Recreation and Conservation Office
RCW	Revised Code of Washington
RM	River Mile
RV	recreation vehicle
RVC	Rural Village Center
SASSI	Salmon and Steelhead Stock Inventory
SDP	Substantial Development Permit
SEPA	State Environmental Policy Act
SFHA	Special Flood Hazard Area
SLR	Sea Level Rise
SMP	Shoreline Master Program
SRFB	Salmon Recovery Funding Board
SRP	Salmon Recovery Portal
USACE	United States Army Corps of Engineers
USDOT	United States Department of Transportation
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation

CHAPTER 1

Plan Development

1.1 Purpose and Scope

This Comprehensive Flood Hazard Management Plan (CFHMP) was developed by Jefferson County and Environmental Science Associates. An Advisory Team and citizens of Jefferson County, Washington provided input to guide the development of the CFHMP. The purpose of this CFHMP is to evaluate flood risks along the lower reaches of the Big Quilcene and Little Quilcene Rivers and recommend actions that Jefferson County can implement to reduce these risks.

The development of this CFHMP was funded by a grant from the Washington State Department of Ecology (Ecology) through the Flood Control Assistance Account Program (FCAAP) authorized under Chapter 86.26 of the Revised Code of Washington (RCW) and Chapter 173-145 of the Washington Administrative Code (WAC).

1.2 Plan Development Process

This CFHMP incorporates the elements required by WAC 173-145-040, which were developed through the following steps:

- **Organizing an Advisory Team:** The Advisory Team is comprised of Jefferson County staff; consultants; Tribal representatives; staff of federal, state, and local agencies; members of the public; and other stakeholders.
- **Advisory Team and Public Meetings:** Meetings were held to define goals and objectives, collect input on flood hazards and risks, discuss flood hazard management and risk reduction alternatives, and identify community needs for the CFHMP to address.
- **Existing Conditions Assessment:** A study area for the lower Big and Little Quilcene Rivers was conducted. The project team evaluated existing conditions and detailed them in the CFHMP, providing information on natural resources, land use, infrastructure, planning and regulations, demographics, the river basins, future conditions, flood management activities, flood history, and vulnerabilities.
- **Determination of Need:** From the assessment of existing conditions in the Big and Little Quilcene River basins and engagement with stakeholders, needs for flood hazard management and risk reduction in the study area were determined.
- **Identify Alternatives:** The project team identified potential measures for flood risk reduction.
- **Evaluate Alternatives and Recommend Actions:** Flood risk reduction measures that were identified as potential alternatives were assessed in the context of evaluation criteria,

including consistency with CFHMP goals and objectives, complexity, costs, environmental benefits, funding sources, effectiveness, environmental impacts, and operation and maintenance requirements. Alternatives that sufficiently met evaluation criteria and were supported for implementation by Jefferson County staff and the Advisory Team were advanced as recommended actions.

- **Adoption and Implementation:** Following selection of priority actions and review of the CFHMP, a final CFHMP will be sent to Ecology for approval, and Jefferson County will adopt the CFHMP.

1.3 Advisory Team Meetings

The Advisory Team was organized to provide information and feedback on the development of the CFHMP, with representatives from government and non-governmental entities who could provide perspectives from a variety of resource management and emergency response interests and jurisdictions (see **Table 1**). Five Advisory Team meetings were held over the duration of the development of the CFHMP. Advisory Team meetings were used to refine goals and objectives for the CFHMP, identify flood hazards, assess flood hazard management alternatives, select evaluation criteria, and provide updates on the development of the CFHMP. Documentation of Advisory Team meetings is provided in **Appendix A**.

TABLE 1
ADVISORY TEAM MEMBERS FOR THE BIG AND LITTLE QUILCENE RIVERS CFHMP

Name	Affiliation
Susan Beall	U.S. Forest Service
Lisa Belleveau	Skokomish Tribe
Brent Butler	Jefferson County Department of Community Development
Benjamin Cross	U.S. Fish and Wildlife Service
Donna Frostholm	Jefferson County Department of Community Development
Glenn Gately	Jefferson County Conservation District
Matt Gerlach	Washington State Department of Ecology
Gus Johnson	Hood Canal Salmon Enhancement Group
Randy Johnson	Jamestown S'Klallam Tribe
Tami Pokorny	Jefferson County Public Health
Marla Powers	Port Gamble S'Klallam Tribe
Robin Shoal	U.S. Forest Service
Nam Siu	Washington Department of Fish and Wildlife
Don Svetich	Quilcene Fire Rescue

1.4 Public Involvement

Public involvement, especially engagement with underrepresented communities, is an important component of the development of the CFHMP. Outreach using a variety of local and regional media was utilized to raise awareness of the plan development process and encourage attendance

at public meetings. Virtual public meetings were held in November 2022 and April 2023. The November public meeting provided an opportunity for attendees to learn about the process of developing the CFHMP, share their experiences with flood hazards, and discuss flood hazard management alternatives. The project team presented information about the purpose and scope of the project, summarized findings from the existing conditions assessment, discussed possible flood hazard management and risk reduction alternatives, facilitated discussions with attendees, and answered any questions. The April public meeting included a presentation of the contents of the draft CFHMP, including proposed actions, and an opportunity for members of the public to ask questions and share comments. Members of the public also attended Advisory Team meetings and were able to provide feedback during those opportunities as well. Documentation of public involvement is provided in **Appendix B**. Factsheets for use in future public involvement are provided in **Appendix C**.

1.5 Goals and Objectives for Flood Hazard Management

Most years, the Quilcene community and surrounding areas experience flood risks, which threaten vulnerable properties, utilities and infrastructure, and public health and safety, and disrupt public services. Historical development and modifications within the floodplain have had negative environmental impacts, but floodplain regulations in Jefferson County have been designed to reduce flood hazards to human life and property and mitigate impacts of development on the ecological functions of floodplains and critical areas.

Current best practices in flood hazard management emphasize the recognition of flooding as a natural process, utilization of non-structural flood hazard management strategies, and reduction of future risks and need for recovery. The goals and objectives of this CFHMP incorporate these principles by prioritizing sustainable and cost-effective flood hazard management strategies that minimize environmental impacts and future risks. The overarching intent of the following goals and objectives is to inform the development of a CFHMP that provides resources to guide future planning to protect life and property from flooding, in addition to supporting future efforts to fund and implement the actions detailed in this plan.

Based on the Department of Ecology’s CFHMP 2021 guidebook, *Comprehensive Planning for Flood Hazard Management*, and input from the project team, Advisory Team, and the public, the following goals and objectives were identified for this CFHMP:

Goals

1. Implement projects that reduce the future risk of flood damages and hazards.
2. Reduce public expenditures to repair damaged areas.
3. Minimize, to the extent possible, the environmental impacts of flood hazard management.
4. Focus on non-structural alternatives and ecological restoration to address flood safety.

Objectives

1. Protect public health and safety.
2. Identify and prioritize projects that increase resilience to increasing flood risks due to climate change.
3. Identify and prioritize projects that promote equity and environmental justice in the floodplain.
4. Incorporate thoughtful consideration of Treaty rights and other Tribal rights into floodplain management actions.
5. Evaluate the risks to existing development in flood hazard areas and identify actions to reduce risks to life and property.
6. Regulate floodplain development to reduce building in the floodplain.
7. Minimize the need for emergency rescue and relief efforts associated with flooding, which are generally undertaken at the expense of the general public.
8. Minimize the expenditure of public money on costly flood control projects.
9. Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone, streets and bridges located in areas of flood hazard.
10. Minimize prolonged business interruptions.
11. Acquire vulnerable properties, with a special emphasis on those that have been repeatedly damaged by floods, when acquisition opportunities arise.
12. Maintain, repair, or retrofit existing flood damage reduction facilities in a manner that addresses public safety, is cost-effective, and makes the facilities less susceptible to future damage.
13. Remove or retrofit existing river facilities or modify maintenance practices to protect, restore, or enhance riparian habitat and to support the recovery of state or federal species listed as threatened and endangered, while not increasing flood hazards.
14. Incorporate wetland and shoreline restoration, when possible, to support habitat, ecological functions, and water quality, while not increasing flood hazards.
15. Sponsor and support public outreach and education activities to improve awareness of flood hazards, especially in underserved communities, and recommend actions that property owners can take to reduce risks to themselves and others.
16. Identify appropriate funding sources for implementing the recommended flood hazard management activities, and pursue opportunities to use these funds in a timely and efficient manner.
17. Increase coordination across Jefferson County departments, U.S. government agencies, and Tribes to address flood hazard management at a watershed scale.

CHAPTER 2

Existing Conditions

2.1 Watershed Description

The Big and Little Quilcene Rivers are both located in the Quilcene-Snow Water Resource Inventory Area (WRIA) 17 in Jefferson County, Washington. These rivers flow generally east out of the Olympic Mountains into Quilcene Bay and Hood Canal. The Olympic National Forest (ONF), where the Big and Little Quilcene Rivers originate, is under federal jurisdiction, and Jefferson County does not have primary regulatory authority within the forest (see **Figure 1**). The portions of the watershed in the ONF are generally steep and heavily forested, with little human development or infrastructure. Snowmelt from their high-elevation headwaters, above 7,000 feet in the Buckhorn Wilderness, deliver cool, high flows during spring runoff and support base flows in the summer. The mouths of both rivers are associated with large tidal, estuarine areas that provide important habitat to a variety of species. However, the estuary is mostly unnatural due to sediment accumulations linked to historical diking and other changes upriver, including land development and logging.

Prior to European settlement in the mid to late 1800s, when homesteads, dikes, railroads, and the logging industry were first established, Native American Tribes inhabited the area for millennia. European settlement led to development that has degraded the ecological functions of large parts of the lower watershed. Channel modifications and development in wetlands significantly reduced habitat and the capacity for floodplain areas to store water, in addition to having widespread impacts on surface hydrology, land cover, and sediment transport.

The diverse fish populations in the Big and Little Quilcene Rivers have helped to sustain Tribal populations within the Pacific Northwest for thousands of years. Fishing is also a key part of the Tribes' connection to the land and cultural heritage. In the 1855 Point No Point Treaty, northern and eastern Olympic Peninsula Tribes, including the Jamestown S'Klallam, Port Gamble S'Klallam, and Skokomish Tribes, ceded their historical lands to the United States government, while retaining rights to fishing, hunting, and extraction of other natural resources on these lands. The rights associated with this Treaty encompass the watersheds of the Big and Little Quilcene Rivers, as well as spanning Hood Canal, Admiralty Inlet, the San Juan Islands, and Strait of Juan de Fuca.

Water Resource Inventory Area (WRIA) 17 is located in northwest Washington on the northeastern portion of the Olympic Peninsula, spanning eastern Jefferson County and eastern Clallam County. It includes the Big and Little Quilcene Rivers and Snow and Salmon Creeks, to the north, as well as various smaller tributaries on the Quimper, Bolton, and Toandos peninsulas and in the Chimacum Valley area. Much of the western portion of the WRIA lies inside the Olympic National Forest. The WRIA extends northeast up to Port Townsend (see **Figure 2**).

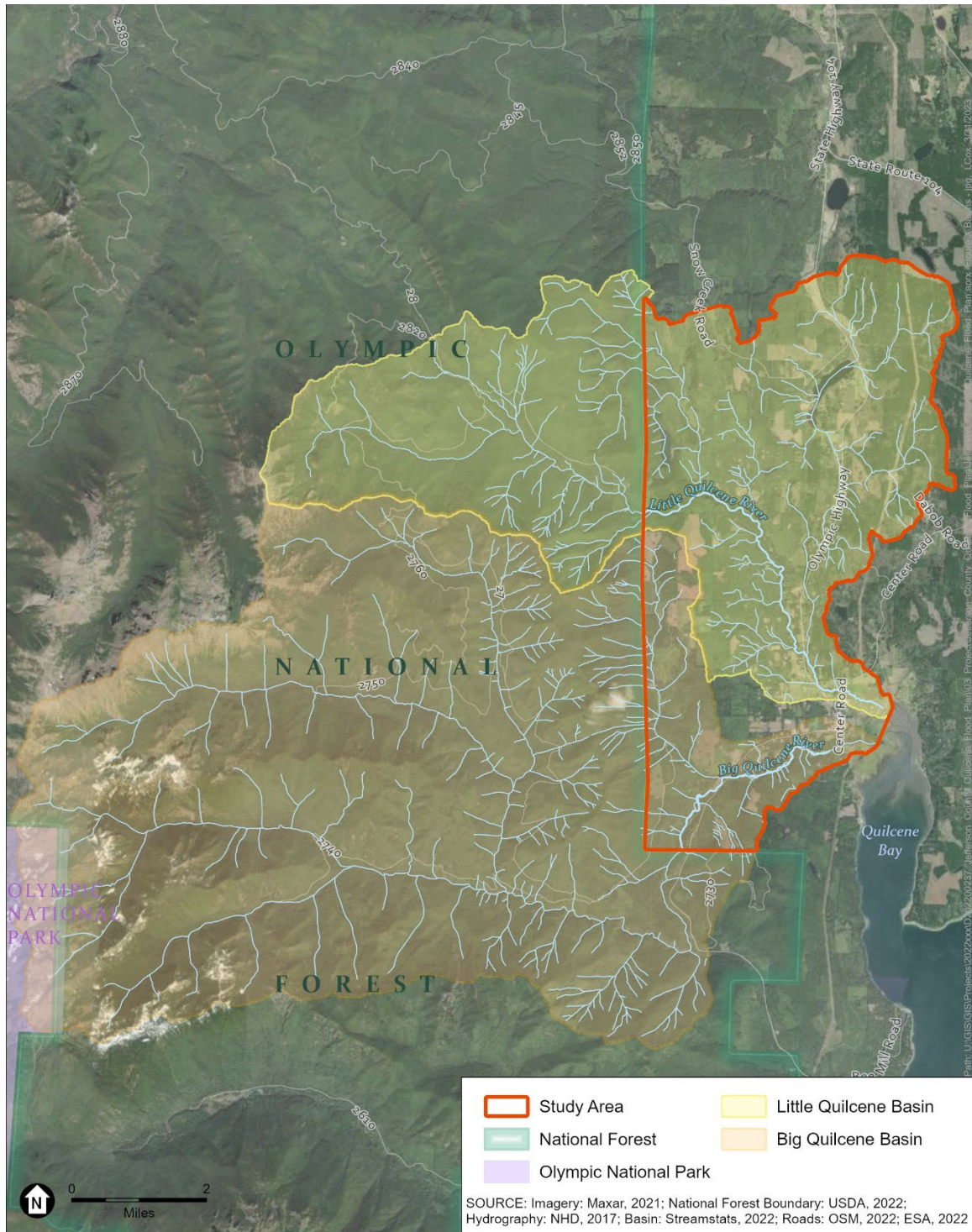


Figure 1. Big and Little Quilcene River Basins

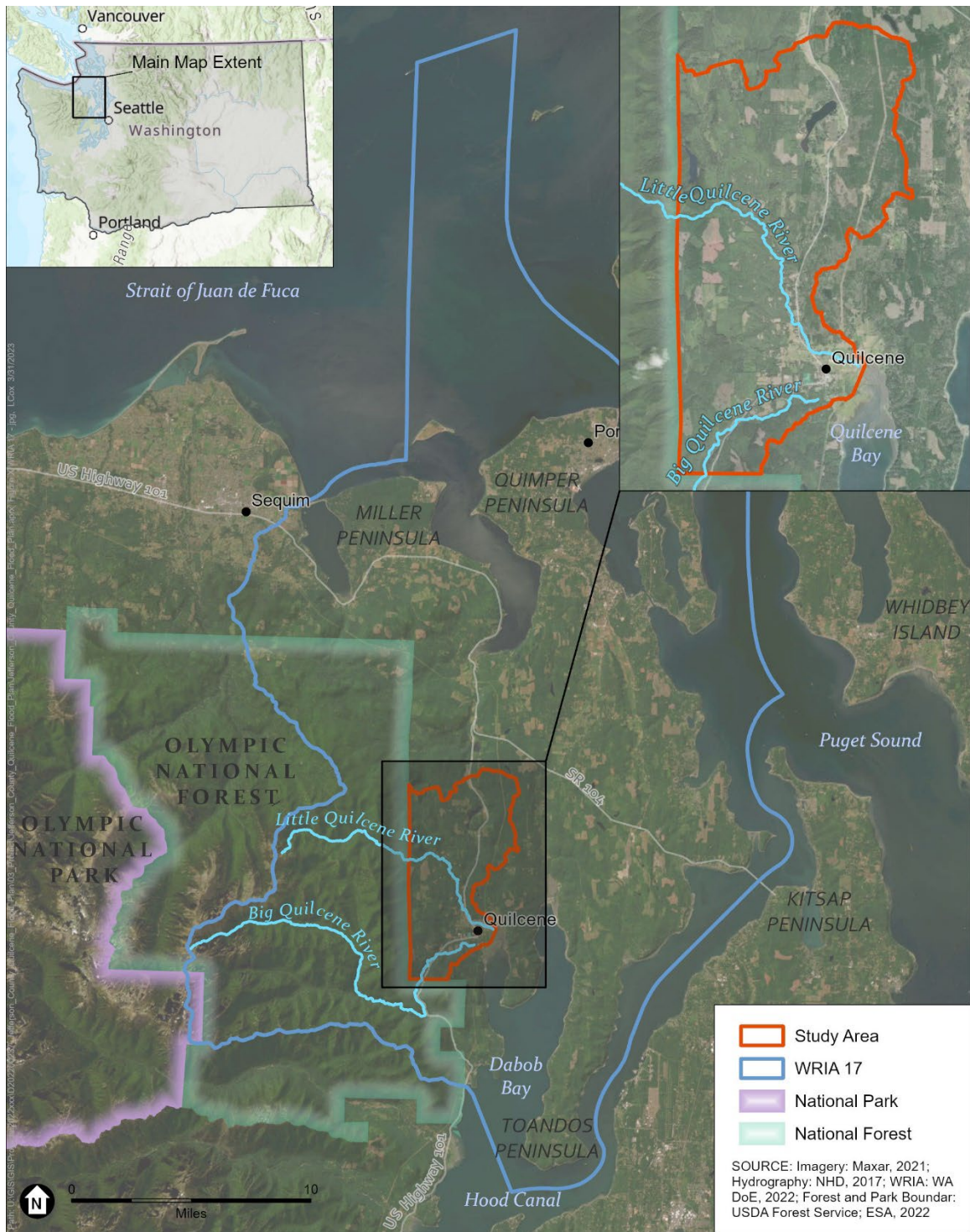


Figure 2. WRIA 17 and the CFHMP Study Area

Because of their location in the rain shadow of the Olympic Mountains, the lower portions of the watershed (near sea level) rarely see any significant accumulation of snow. Mean annual precipitation in the basins varies from over 80 inches in the upper reaches of the watershed to 51 inches in the town of Quilcene, near the rivers' mouths. Approximately 70% of the annual precipitation falls during the wet season, starting in November and ending in May.

CFHMP Study Area

The study area for the CFHMP encompasses the watersheds of both the Big and Little Quilcene Rivers, excluding areas within the Olympic National Forest, as shown in Figure 2. The study area focuses on the lower 2.4 miles of the Little Quilcene River and the lower 4.3 miles of the Big Quilcene River, downstream of the ONF. The ONF is excluded from the study area because Jefferson County, as the entity that developed and will implement this CFHMP, lacks jurisdiction on federal lands. While the study area is limited to the area within Jefferson County's jurisdiction, the CFHMP also considers impacts from and potential actions in the ONF. Additionally, the project team engaged stakeholders from the U.S. Forest Service with interests in the ONF throughout the development of the CFHMP. Consideration of the ONF in this CFHMP is crucial to guiding a watershed-scale approach flood hazard management, which enables coordination across jurisdictions to address the hydrologic relationship between upstream conditions and downstream conditions.

Little Quilcene River

The Little Quilcene River is 12.2 miles long with a watershed encompassing 36.3 square miles. Elevations within the basin range from sea level to 6,260 feet above sea level. Approximately 68% of the basin has canopy cover. The basin includes more than 120 miles of tributaries; major tributaries to the Little Quilcene River include Leland Creek, Ripley Creek, Howe Creek, and Deadfall Creek. The Little Quilcene River empties into Quilcene Bay at the far northern end of the bay, where it has a prograding river delta, approximately 0.5-mile north of the mouth of the Big Quilcene River. The lower portion of the Little Quilcene River is tidally influenced up to approximately River Mile (RM) 0.8 (Wild Fish Conservancy 2008). The estuary supports an extensive tidal marsh complex that can present challenges to migrating salmon.

Above RM 6.6, the river flows through the Olympic National Forest. This area is dominated by coniferous forest that has been logged in the past, but otherwise has little to no other human development and contains 16 square miles (or 44%) of the Little Quilcene River watershed. Below RM 6.6, the Little Quilcene River flows through privately owned commercial forest, including some areas of clearcuts harvested as recently as 2021. Around RM 2.4, the land surrounding the river transitions from forest to primary residential developments with scattered agricultural uses. The river passes through the northern end of the town of Quilcene, and is spanned by a Highway 101 bridge at RM 1.9 and the Center Road bridge at RM 0.9.

The mapped Little Quilcene River 1% annual chance floodplain covers approximately 130 acres of property, entirely within the study area (see **Figure 3**). The floodplain portions of the study area are largely residential, with some agricultural and forestry land. The floodplain is narrow in most places, but expands to include structures at isolated locations, as well as widening near its outlet on Quilcene Bay.

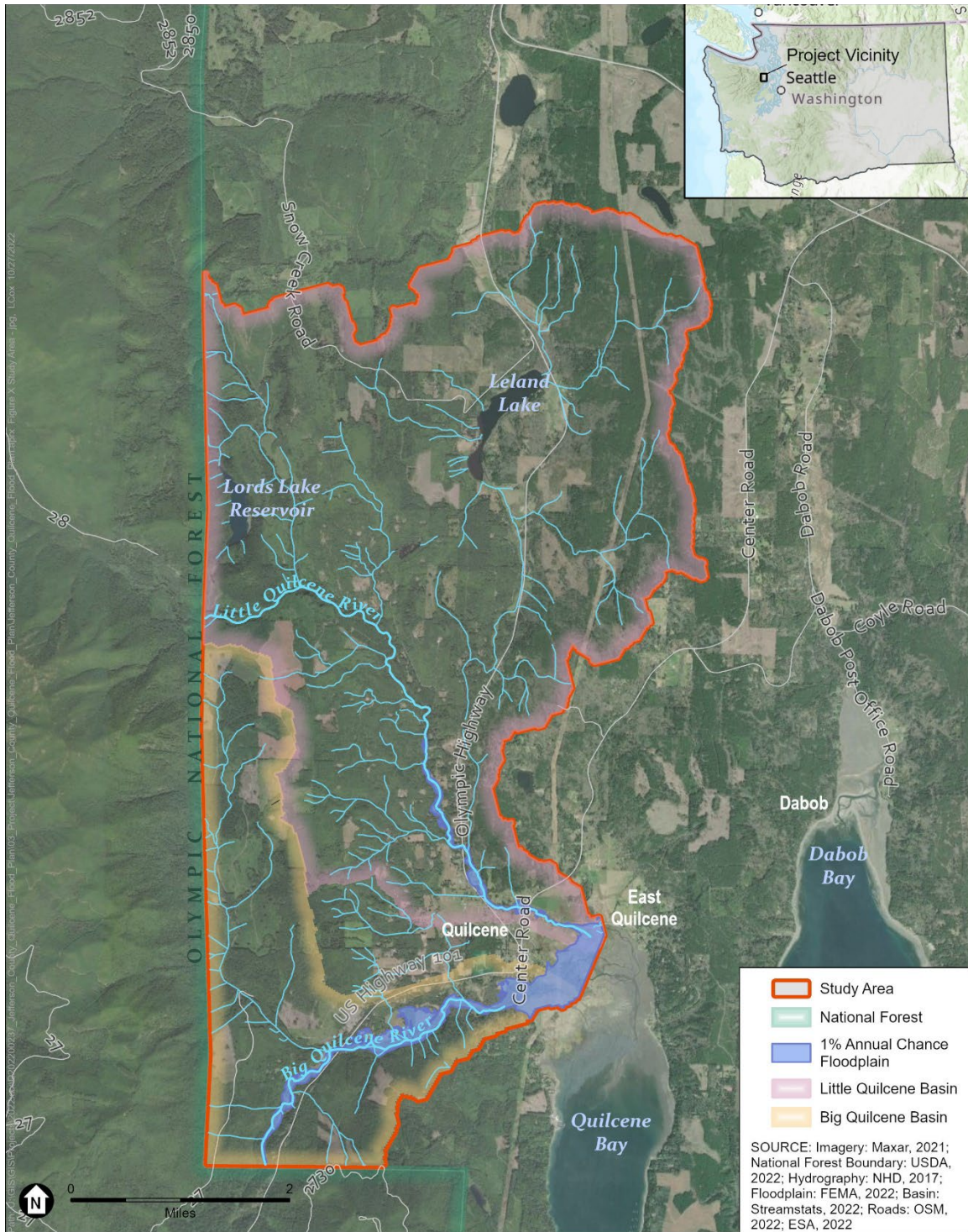


Figure 3. CFHMP Study Area and 1% Annual Chance Floodplain

Leland Lake and Leland Creek

Leland Lake, located within the Little Quilcene River basin, is at an elevation of 191 feet above sea level and covers approximately 107.8 acres. The lake shoreline has been altered by residential development. The lake is shallow with large wetland complexes to the north and south (WDFW 2023a). Numerous home sites, recently logged areas, small farms, a music festival venue, campground, and boat docks populate its shoreline and the adjacent landscape, and Leland Valley Road runs along the eastern lake margin. Leland Creek, which is a tributary to the Little Quilcene River, flows into Leland Lake at the northwestern end and out at the southern end.

Big Quilcene River

The Big Quilcene River is 19 miles long with a watershed encompassing 68.4 square miles. Elevations within the basin range from sea level to 7,000 feet above sea level. The basin has a canopy cover of approximately 75% and more than 270 miles of tributaries. Major tributaries to the Big Quilcene River include Penny Creek, Elbo Creek, Mile and a Half Creek, Threemile Creek, Tunnel Creek, and Townsend Creek. Like the Little Quilcene River, the Big Quilcene River empties into Quilcene Bay in the northern portion of Quilcene Bay. The lower 1.1 miles of the river are tidally influenced, and the estuary includes a tidal marsh complex and a prograding river delta.

Above RM 4.3, the Big Quilcene River flows through the Olympic National Forest, encompassing 61 square miles (or 89%) of its basin. This forested area is remote and rugged, with gravel access roads and hiking trails. Aerial photographs indicate this area was logged in the past. Below RM 4.3, the Big Quilcene River flows northeast, parallel to Highway 101, as it runs through privately held commercial forest. The Hiddendale Drive community is a residential development located along the river and immediately north of the federal land boundary at the southern edge of the study area. Residential development density increases as the river flows downgradient, where it discharges south of the town of Quilcene. The river is spanned by a bridge on Linger Longer Road at RM 0.5 and by a Highway 101 bridge southeast of the town at RM 2.4.

The mapped Big Quilcene River 1% annual chance floodplain covers approximately 241 acres of property, entirely within the study area (see Figure 3). The floodplain portions of the study area are largely residential, with some agricultural and forestry land. The floodplain is expansive in much of the lower sections of the Big Quilcene River, impacting numerous structures, especially relatively dense residential areas.

Flooding in the Lower Big Quilcene River watershed was studied for a previous CFHMP: the 1998 Lower Big Quilcene River Comprehensive Flood Hazard Management Plan. The 1998 CFHMP has influenced the current conditions of the study area, recommending levee repair, property acquisitions, sediment removal, and fish habitat restoration. While this plan had advanced some environmentally beneficial actions that generally align with current floodplain management best practices, other recommended actions reflect historical approaches to floodplain management that involved environmentally impactful instream work. This Big and Little Quilcene Rivers CFHMP will identify ways to address impacts of past human activity on the

watershed and floodplains, as well as identify effective means to continuing past floodplain management activities that have worked with natural processes.

2.2 Natural Features

The Big and Little Quilcene Rivers are both steep rivers in the upper reaches of the watershed that flow downgradient to the low-lying areas near Quilcene Bay. The rivers and estuarine areas provide important habitat for multiple anadromous and resident salmonids as well as other wildlife. However, the lower portions of the rivers and the estuary are generally deficient of large woody debris (LWD) and habitat complexity. This CFHMP is intended to be consistent with the Jefferson County Comprehensive Plan, Shoreline Master Program, flood damage prevention regulations, critical areas regulations, and with existing and planned restoration efforts in these two river watersheds.

Salmonid species with a documented presence in the Big and Little Quilcene Rivers include Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), summer and fall chum salmon (*O. keta*), pink salmon (*O. gorbuscha*), winter steelhead (*O. mykiss*), and sea-run cutthroat trout (*O. clarkii clarkii*). Rainbow trout (*O. mykiss*) are also presumed present within the Big Quilcene River (SWIFD 2023). The Hood Canal summer-run chum and Puget Sound Chinook salmon and steelhead are listed as federally threatened species under the Endangered Species Act (ESA). Further information on fish in the river basins is detailed below.

Both rivers, their tributaries, and their riparian areas offer valuable habitat resources for a variety of species including bald eagles, turkey vultures, great blue heron, waterfowl, and common nesting birds. The rivers also provide habitat for many mammalian species including deer, beaver, raccoon, coyote, bear, and mountain lion. The vegetation and canopy cover of riparian areas around the Big and Little Quilcene Rivers varies, with some areas dominated by conifers with scattered deciduous vegetation throughout and some areas dominated by deciduous vegetation with conifers dispersed throughout. The quality of riparian habitat along the Big and Little Quilcene Rivers also varies, as some areas have been altered through past development and logging. Some areas, including those around Leland Lake and Leland Creek, have historically had high levels of invasive plant species, especially reed canarygrass (*Phalaris arundinacea*) (Correa 2002).

Little Quilcene River

There are no artificial fish passage barriers in the lower reaches of the Little Quilcene River. Accessible fish habitat stretches from the mouth of the river to just above Penny Creek Road at RM 7. Upstream of this, the river narrows and steepens as it enters the foothills of the Olympic Mountains. Most coho salmon return to the river between mid-August and mid-November and spawn mid-November through January. In the 1992 Salmon and Steelhead Stock Inventory (SASSI), the Washington Department of Fish and Wildlife (WDFW) reported the coho stocks in Quilcene/Dabob Bays as depressed (WDFW 1993). As of 2011, coho stocks continue to be listed as depressed in the Quilcene and Dabob Bay sub-basins. A depressed status is defined as “a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely” (WDFW 1993).

Hood Canal summer chum salmon spawn shortly after entering freshwater, typically in the lowest 1 to 2 miles of a river. Hood Canal and Strait of Juan de Fuca summer chum salmon are currently ESA-listed threatened species, but hatchery rearing programs and habitat restoration efforts undertaken by the Hood Canal Coordinating Council and co-managers along with other partners, beginning in the late 1990s, have contributed to an increase in population levels (Downen et al. 2018). Extensive recovery planning efforts are underway with dozens of federal, state, Tribal, and local partners (NMFS 2022). According to WDFW’s online SalmonScape tool, summer chum spawn in the lower reaches of the Little Quilcene River, below the Highway 101 bridge in September through mid-October (WDFW 2022). The stock was almost extinct in the early 1990s, with the 1992 SASSI reporting the stock status as critical due to low escapement numbers. The latest National Marine Fisheries Service (NMFS) viability assessment summarizes that while there have been gains since the 2015 status review, the overall population is not meeting viability criteria, so it remains at “moderate” risk of extinction (Ford 2022). Despite not meeting viability criteria, the populations that return to the Big and Little Quilcene Rivers to spawn show much higher rates of survival and productivity than other ecological diversity groups in the Hood Canal and Strait of Juan de Fuca, which is important for the overall population viability for the region.

Unlike summer chum, fall chum utilize higher fall and winter flows to travel farther upstream to spawn. Hood Canal fall chum spawn in November through early January and have been documented spawning as far upstream as the Howe Creek confluence with the Little Quilcene River (WDFW 2022). Fall chum are not an ESA-listed species and their stock was listed as healthy in the 1992 SASSI report. There is little information on the number of summer or fall chum in the Little Quilcene River.

Winter steelhead spawn between mid-February and May, as far upstream as the Howe Creek confluence on the Little Quilcene River. Currently, Puget Sound steelhead are listed as threatened under the ESA. In 2019, an ESA recovery plan for the Puget Sound steelhead was finalized, emphasizing strategies related to floodplain connectivity, maintaining instream flows, and climate change mitigation, among other strategies (NMFS 2019). Long Live the Kings (LLTK) estimated that fewer than 1,500 steelhead return to the Hood Canal annually, despite adequate habitat on undammed rivers like the Little Quilcene River (LLTK 2017). Juvenile Hood Canal steelhead face high mortality rates at the Hood Canal Bridge, which creates a passage barrier in the top 15 feet of surface water where they primarily migrate (Moore and Berejikian 2022). This barrier makes them easy targets for predators, especially seals and sea lions. As of 2022, WDFW has issued a statewide ban on coastal steelhead fishing due to indications of lower-than-expected returns. The Hood Canal Salmon Enhancement Group (HCSEG) and LLTK’s Hood Canal Steelhead Project have performed intensive monitoring efforts of winter steelhead in the Little Quilcene River and other watersheds on Hood Canal. This work has involved annual monitoring of juvenile steelhead outmigrants to compare against other rivers in Hood Canal that are supplemented with adults and smolts using native stocks. HCSEG installed a fish trap on the Little Quilcene River; smolts were then collected to estimate the total freshwater production (HCSEG 2011).

Sea-run coastal cutthroat trout are a subspecies of cutthroat trout native to Washington. They typically spawn in the late winter, between December and May, in rivers like the Little Quilcene,

River before moving to saltwater, like Quilcene Bay, in the summer. Although they typically stay close to shore, during summer, they may move farther offshore to cooler waters. Because of great variation in spawning time and general life history, the status of the West Hood Canal stock, including trout in the Big and Little Quilcene Rivers, is unknown and there is little information on run sizes (WDFW 2000). WDFW has designated sea-run coastal cutthroat as a species of concern, but it is not ESA-listed.

Puget Sound Chinook salmon are federally listed as threatened under the ESA (NOAA 2023) and have been identified as Species of Greatest Conservation Need under the State Wildlife Action Plan (WDFW 2023b). The Puget Sound Chinook salmon is an Evolutionarily Significant Unit (ESU) of Chinook salmon native to Puget Sound. Fall run Chinook salmon have a documented presence within the Little Quilcene River (SWIFD 2023) but are not found in abundant numbers as spawners within WRIA 17 (Correa 2002). Summer and fall Chinook salmon are no longer raised by the Quilcene National Fish Hatchery and are present in sparse numbers (GeoEngineers 1998). Additionally, SWIFD does not map summer Chinook as occurring within the Little Quilcene River.

Big Quilcene River

The first artificial barrier to fish passage in the Big Quilcene River is the Quilcene National Fish Hatchery's concrete weir at RM 2.8, which adult fish can swim over at high flows or bypass via a fish ladder. Additionally, a natural waterfall at RM 7.6 completely blocks upstream fish passage. Like the Little Quilcene River, coho salmon return to the Big Quilcene River in mid-August through mid-November. During this time, adult coho are redirected to the Quilcene National Fish Hatchery by a second fish ladder downstream of the hatchery. Here, hatchery stock is separated from wild stock, and placed in holding ponds until they are ready to spawn. The hatchery releases 400,000 salmon smolts into the river every spring. A number of adult coho salmon are tagged and released to spawn upstream from November through mid-January. Coho are the only sport fishery in the Big Quilcene River that WDFW allows anglers to keep.

Summer chum spawn in the lower reaches of the Big Quilcene River, primary below the hatchery, from mid-September to mid-October. Summer chum are listed as threatened under the Endangered Species Act, with extensive recovery planning being undertaken with dozens of federal, state, Tribal, and local partners (NMFS 2022). Summer chum returns are greater in the Big Quilcene River than the smaller Little Quilcene River (WDFW 2010a, 2010b). WDFW stock estimates state that in 2010, the Little Quilcene River summer chum run size was 507, while the Big Quilcene River run size was 1,608 (WDFW 2010a, 2010b). The latest NFMS viability assessment summarizes that while there have been gains since the 2015 status review, the overall population of summer chum is not meeting viability criteria, so it remains at "moderate" risk of extinction (Ford 2022). Despite not meeting viability criteria, the populations that return to the Big and Little Quilcene Rivers to spawn show much higher rates of survival and productivity than other ecological diversity groups in the Hood Canal and Strait of Juan de Fuca, which is important for the overall population viability for the region.

Fall chum runs in Hood Canal are generally healthy, with spawning taking place November through early January. In the 1990s, the Quilcene National Fish Hatchery supported fall chum

runs before switching to raising primarily coho. (More information on the hatchery is presented in Section 2.4.)

Winter steelhead enter the river later than coho, and then spawn between mid-February and May. The status is unknown as there has historically been a small number of these fish in the river. Sea-run coastal cutthroat trout are also present in the river, but must be released if caught.

Coastal cutthroat have a documented presence within the Big Quilcene River (SWIFD 2023) and are designated by WDFW as a species of concern. As mentioned above, coastal cutthroat typically spawn in late winter in rivers before moving back to saltwater in the summer. The status of the West Hood Canal stock is unknown, and there is little information on run size due to the variation in spawning time and general life history (WDFW 2000).

As noted above, Puget Sound Chinook are federally listed as threatened under the ESA (NOAA 2023) and have been identified as Species of Greatest Conservation Need under the State Wildlife Action Plan (WDFW 2023b). Fall Chinook salmon have documented spawning and rearing presence within the Big Quilcene River (SWIFD 2023). However, within WRIA 17, Chinook salmon are not found in abundant numbers as spawners. The Quilcene National Fish Hatchery on the Big Quilcene River, operated by the U.S. Fish and Wildlife Service (USFWS), began a Chinook program in 1980 that continued until 1994 (Correa 2002). This run has not been able to sustain itself, and summer and fall run Chinook are only present in very sparse numbers (GeoEngineers 1998).

Quilcene Bay

Both the Little Quilcene and Big Quilcene Rivers flow into an estuary complex and Quilcene Bay. Several salmonid species rely on estuarine habitat during their life cycle for rearing and growing prior to migration and holding during their return migration to spawn. In addition to salmonids, Quilcene Bay offers habitat and vegetation for many other species, including shellfish and waterfowl.

However, the estuary is substantially larger than in the late 1800s due to geomorphic changes and sediment accumulation linked to past logging and land development practices. The bay and the surrounding waters, including Dabob Bay and Hood Canal, are highly productive shellfish growing areas. Just south of the mouth of the Big Quilcene River, along Linger Longer Road, WDFW owns Quilcene Bay Tidelands, open for recreational and Tribal year-round clam, mussel, and oyster harvesting. Manila clams, native littleneck clams, eastern softshell clams, butter clams, Olympia oysters, and Pacific oysters live in the tidelands. The larger Pacific oysters were introduced to the region for aquaculture in 1902. The smaller, native Olympia oyster experienced a decline in abundance after overexploitation, especially between 1850 and 1900. The Olympia oyster has also seen declines from commercial aquaculture favoring Pacific oysters and artificially high salinity levels in proximity to rivers. Restoration efforts for oysters began in the 2000s, and Quilcene Bay is one of two primary restoration areas for Olympia oysters identified in Hood Canal (WDFW 2012).

Pacific Seafood (formerly Coast Seafood Co.) operates a commercial oyster hatchery at the end of Linger Longer Road that is advertised as one of the world's largest shellfish hatcheries and is one of the largest employers in Jefferson County. Shellfish operations at Pacific Seafood are impacted when Linger Longer Road is closed because of flooding on the Big Quilcene River or when the Big Quilcene River breaches its levee to the south, reducing salinity levels over shellfish beds containing Pacific oysters, which are particularly sensitive to lower salinity levels. The public WDFW-operated Quilcene Boat Ramp, located directly north of the Pacific Seafood facility in Quilcene, includes a parking lot, boat ramp, and small beach area. Herb Beck Marina, a public boat launch, marina, and beach owned by the Port of Port Townsend, is also located at the end of Linger Longer Road, south of Pacific Seafood.

2.3 Land Use Analysis

Development in the Big and Little Quilcene River watersheds is largely concentrated in and around the Rural Village Center (RVC) of Quilcene (see **Figure 4**). RVCs are one of Jefferson County's classifications for Limited Areas of More Intensive Rural Development, being defined as historically settled areas that serve the essential needs of a rural population with day-to-day services through commercial, residential, and community services, and civic land uses. Quilcene is one of two RVCs in Jefferson County (Jefferson County Department of Community Development 2018).

To reduce sprawl, the town of Quilcene has prioritized infill development in the RVC for future development. The Quilcene RVC includes 50.6 acres of developed land and 12.4 acres of undeveloped land as of the completion of the 2018 Jefferson County Comprehensive Plan (Jefferson County Department of Community Development 2018). While additional development increases the potential for stormwater runoff that can contribute to flooding, the RVC is largely outside of the 1% annual chance floodplain and the channel migration zones (CMZs) of the Big and Little Quilcene Rivers (see **Table 2** and **Table 3**). Prioritizing development within the existing RVC will minimize development in the areas of the lower basins at higher risk of flooding. Furthermore, concentrating development in the RVC can reduce development in areas with natural land cover, which provides the important function of infiltrating stormwater runoff.

Most of the real estate in the basins was developed prior to the adoption of the first Jefferson County Comprehensive Plan in 1979. From 1979 until 1996, one housing unit per acre was permitted in Jefferson County. In 1996, land use codes were updated to establish maximum densities of five units per acre in suburban areas, one unit per acre in rural areas, and one unit per 5 acres in resource production areas. These Land Use Code updates were reflected in the 1998 Jefferson County Comprehensive Plan (Jefferson County 1998). No subarea planning has been conducted in Quilcene, with the 2018 Jefferson County Comprehensive Plan Update reflecting the most current land use policies for the area (Jefferson County Department of Community Development 2018).

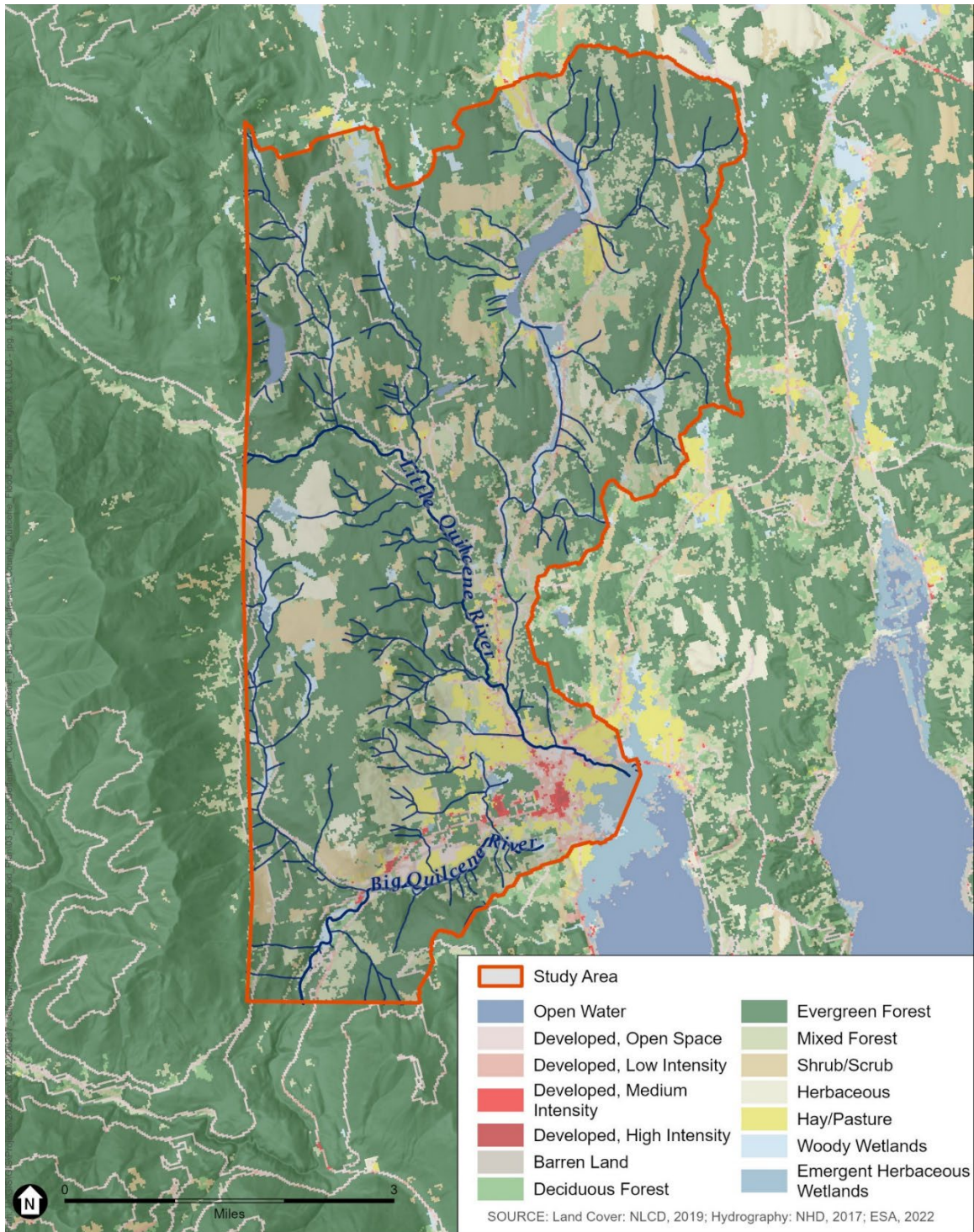


Figure 4. Land Cover in the Study Area.

TABLE 2
ZONING WITHIN THE LITTLE QUILCENE RIVER BASIN PORTION OF THE STUDY AREA

Zone	Acres	Percent of Basin
Forestry Zones	8,092	64.2%
Commercial Forest	5,524	43.8%
Inholding Forest	1,064	8.4%
Rural Forest	1,504	11.9%
Residential Zones	4,194	33.3%
Rural Residential – 5 acres	1,944	15.4%
Rural Residential – 10 acres	<1 acre	<0.1%
Rural Residential – 20 acres	2,250	17.8%
Other Zones	325	2.6%
Commercial Agriculture	196	1.6%
Local Agriculture	121	1.0%
Parks, Preserves, and Recreation	2	<0.1%
Rural Village Center	6	0.1%
Total	12,611	100%

NOTE: Totals may not match due to rounding.

SOURCE: Jefferson County Department of Community Development (2019)

TABLE 3
ZONING WITHIN THE LITTLE QUILCENE RIVER BASIN FLOOD RISK AREA

Zone	1% Annual Chance Floodplain		Channel Migration Zone (CMZ)	
	Acres	Percent of Floodplain	Acres	Percent of CMZ
Rural Forest	3	3%	5	3%
Commercial Forest	1	1%	2	1%
Rural Residential – 5 acres	85	66%	63	35%
Rural Residential – 20 acres	18	14%	22	12%
Commercial Agriculture	17	13%	87	48%
Local Agriculture	5	4%	1	<1%
Rural Village Center	0	0%	2	1%
Total	130	100%	181	100%

NOTE: Totals may not match due to rounding.

SOURCE: Jefferson County Department of Community Development (2019)

The land uses in the Big and Little Quilcene River watersheds that are within Jefferson County jurisdiction include commercial forestry, agriculture, light manufacturing and industrial, Rural Village Center, and residential (see **Figure 5**). Residential districts include maximum densities of one unit per 5 acres, one unit per 10 acres, and one unit per 20 acres, with the higher density zoning districts being primarily located along major roads and the Quilcene RVC (Jefferson County Department of Community Development 2018).

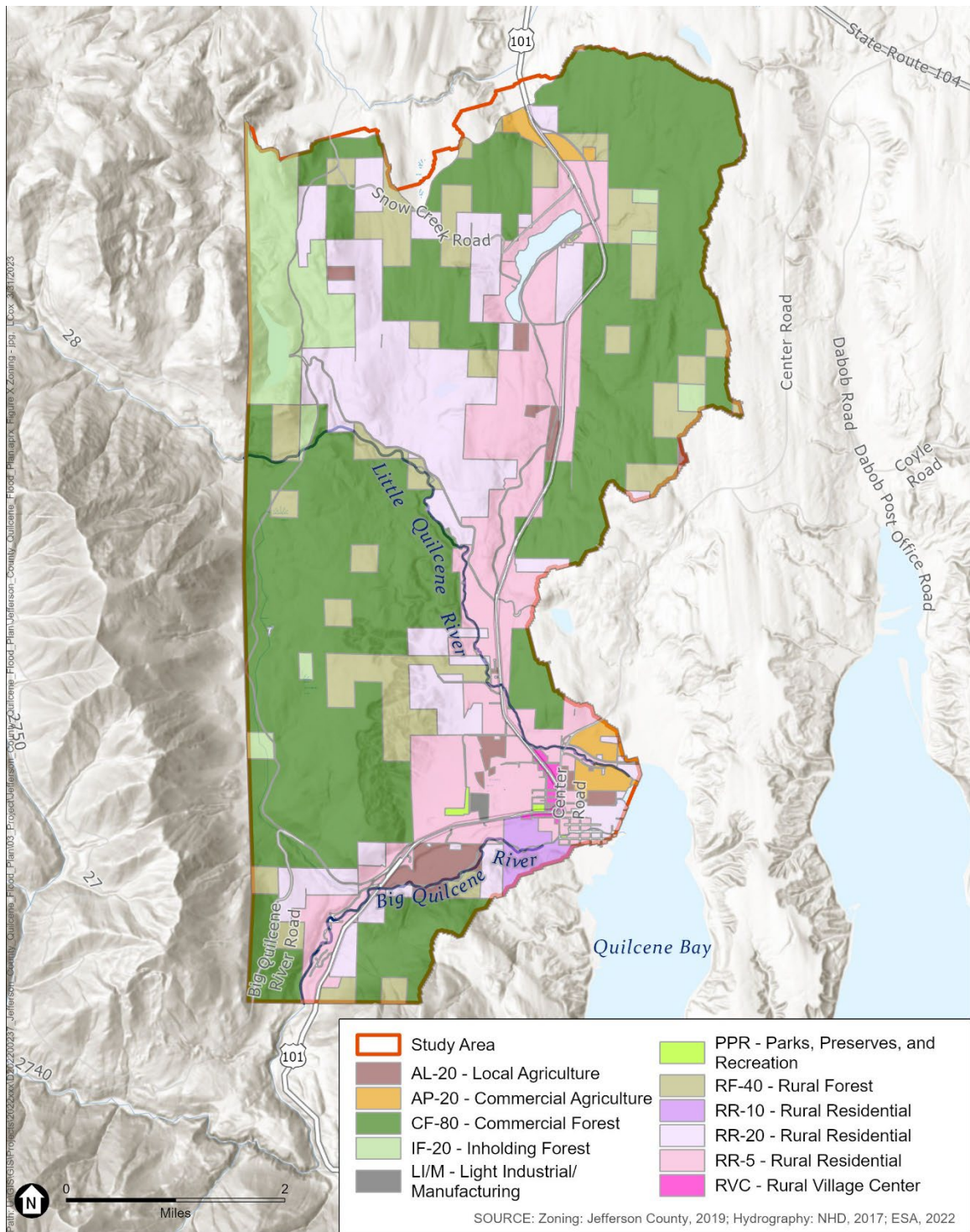


Figure 5. Jefferson County Zoning Districts in the Study Area (2019).

Little Quilcene River

The lower portion of the Little Quilcene River basin is primarily zoned for forestry and residential uses. Residential uses are primarily zoned for one unit per 20 acres, with a district of one unit per 5 acres established along the route of Highway 101 (see Tables 2 and 3). There is no intense development presence in the basin, with the largest developed areas typically consisting of concentrations of barns and accessory structures on agricultural properties. Roughly half of the Little Quilcene River watershed falls under U.S. Forest Service jurisdiction and, as such, is not regulated by the Jefferson County Land Use Code, nor is it within the study area of this plan.

The dominant disturbance in the basin has been timber harvesting and conversion of forest land to agricultural and residential uses. Commercial forestry in the area has declined since the 1980s, but retention of private forests to sustain the industry is still a major land use (Jefferson County Department of Community Development 2018). The Little Quilcene River basin has a higher proportion of forest clearing than the Big Quilcene River watershed, likely as a result of more of the Little Quilcene River watershed being privately owned and zoned for forestry than the Big Quilcene River watershed.

Clearing of forest land for development or agriculture alters the surface hydrology of the basin, which can result in greater rates of erosion and runoff. Erosion and runoff can contribute to sedimentation downstream, increased flood risk, and damage to infrastructure. While forest still accounts for a large percentage of the land cover in the Little Quilcene River watershed, surface hydrology will continue to be impacted and vary from natural runoff patterns as forestry activity proceeds or changes. Impacts on surface hydrology can lead to wide range of impacts on fish habitat and human environments.

Conversion of forested areas for residential development along Highway 101 has likely negatively affected wetlands in the area, especially in the areas around Leland Lake and Leland Creek, where significant clearing around waterbodies has occurred. Degradation of wetlands from development and the resulting runoff can limit their many ecological functions, including floodwater storage. Within the Leland Creek watershed, many wetlands and riparian areas have large quantities of reed canarygrass, an invasive weed of concern in Jefferson County (Jefferson County Noxious Weed Control Board 2023). Impacts from reed canarygrass include a reduction in botanical and biological diversity by creating a homogenized habitat structure and reducing environmental variability. Reed canarygrass can also impact hydrology by trapping silt and sediments, creating constricted waterways that are more prone to flooding. Tree regeneration in riparian areas can also be impacted by the presence of reed canarygrass as it can create shade and crowd out seedlings (Wisconsin Reed Canary Grass Management Working Group 2009). The presence of beavers (*Castor canadensis*) within the Leland Creek watershed has also created flooding issues, affecting agriculture and infrastructure from water impoundments associated with their dams.

Big Quilcene River

Most of the lower Big Quilcene River basin is zoned for commercial forestry and residential uses at varying densities (see **Tables 4 and 5**). It also includes areas of agricultural, light industrial and

manufacturing, and Rural Village Center zoning where the basin enters the more intensively developed area of Quilcene. A large majority of the Big Quilcene River basin falls under U.S. Forest Service jurisdiction and, as such, is not regulated by the Jefferson County Land Use Code, nor is it within the study area of this plan.

TABLE 4
ZONING WITHIN THE BIG QUILCENE RIVER BASIN PORTION OF THE STUDY AREA

Zone	Acres	Percent of Basin
Forestry Zones	2,750	69.9%
Commercial Forest	2,427	61.7%
Inholding Forest	58	1.5%
Rural Forest	266	6.8%
Residential Zones	985	25%
Rural Residential – 5 acres	451	11.5%
Rural Residential – 10 acres	162	4.1%
Rural Residential – 20 acres	372	9.5%
Other Zones	198	5%
Light Industrial/Agriculture	4	0.1%
Local Agriculture	170	4.3%
Parks, Preserves, and Recreation	6	0.2%
Rural Village Center	18	0.5%
Total	3,933	100%

NOTE: Totals may not match due to rounding.

SOURCE: Jefferson County Department of Community Development (2019)

TABLE 5
ZONING WITHIN THE BIG QUILCENE BASIN FLOOD RISK AREA

Zone	1% Annual Chance Floodplain		Channel Migration Zone (CMZ)	
	Acres	Percent of Floodplain	Acres	Percent of CMZ
Rural Forest	3	1%	2	<1%
Commercial Forest	<1	<1%	<1	<1%
Rural Residential – 5 acres	84	35%	121	36%
Rural Residential – 10 acres	30	13%	78	24%
Rural Residential – 20 acres	36	15%	47	14%
Local Agriculture	87	36%	80	24%
Parks, Preserves, and Recreation	1	<1%	1	<1%
Rural Village Center	1	<1%	3	1%
Total	241	100%	333	100%

NOTE: Totals may not match due to rounding.

SOURCE: Jefferson County Department of Community Development (2019)

There are no major residential developments in the basin, although densities of greater than one unit per 5 acres occur along Highway 101 and near the Rural Village Center. Hiddendale Drive, a 20-unit subdivision, lines the waterfront of the Big Quilcene River off Highway 101 at the upper end of Reach E (designated reaches of the rivers are defined and described in Section 2.7). Most of the properties are at least partially within the 1% annual chance floodplain. A concentration of homes also occurs in the southern portion of the 1% annual chance floodplain of Reach A. This concentration of homes is less dense than those at Hiddendale Drive, but the area has been more extensively cleared of forest and natural ground cover. Levees line the river through this low-lying area to reduce riverine flooding, but the levees do not provide sufficient protection to prevent inundation in the event of a 1% annual chance flood. Development and the restriction of the river flow by the levees limits the potential for these former wetlands to act as flood storage.

Other developments in the study area include the Jefferson County Transfer Station, Penny Creek Quarry, and the Quilcene National Fish Hatchery. In addition to clearing forest areas, these land uses have increased impervious surface area, which can contribute to a higher rate of stormwater runoff. Some agricultural land along the river east of Highway 101 is within the 1% annual chance floodplain.

2.4 Infrastructure Analysis

The Big and Little Quilcene River watersheds have a relatively low population base, and therefore relatively limited infrastructure development. The watersheds include the unincorporated community of Quilcene (a census-designated place), consisting of several small businesses, residences, and a public school campus, with an RVC designated by Jefferson County under the Growth Management Act. The community of Quilcene has a population of 598. Major infrastructure includes roads and their associated bridges or culvert crossings, water lines, septic systems, and power lines, including transmission lines owned by the Bonneville Power Administration (BPA) (see **Figure 6**). Penny Creek Quarry is located near the confluence of Penny Creek and the Big Quilcene River. The Quilcene National Fish Hatchery and associated hydraulic infrastructure are located on the Big Quilcene River, immediately upstream of the Highway 101 bridge.

The properties of East Quilcene are located outside the Big or Little Quilcene River watershed, approximately 1,000 feet east of the mouth of the Little Quilcene River. The houses and infrastructure associated with East Quilcene are outside the 1% annual chance floodplain of the Little Quilcene River.

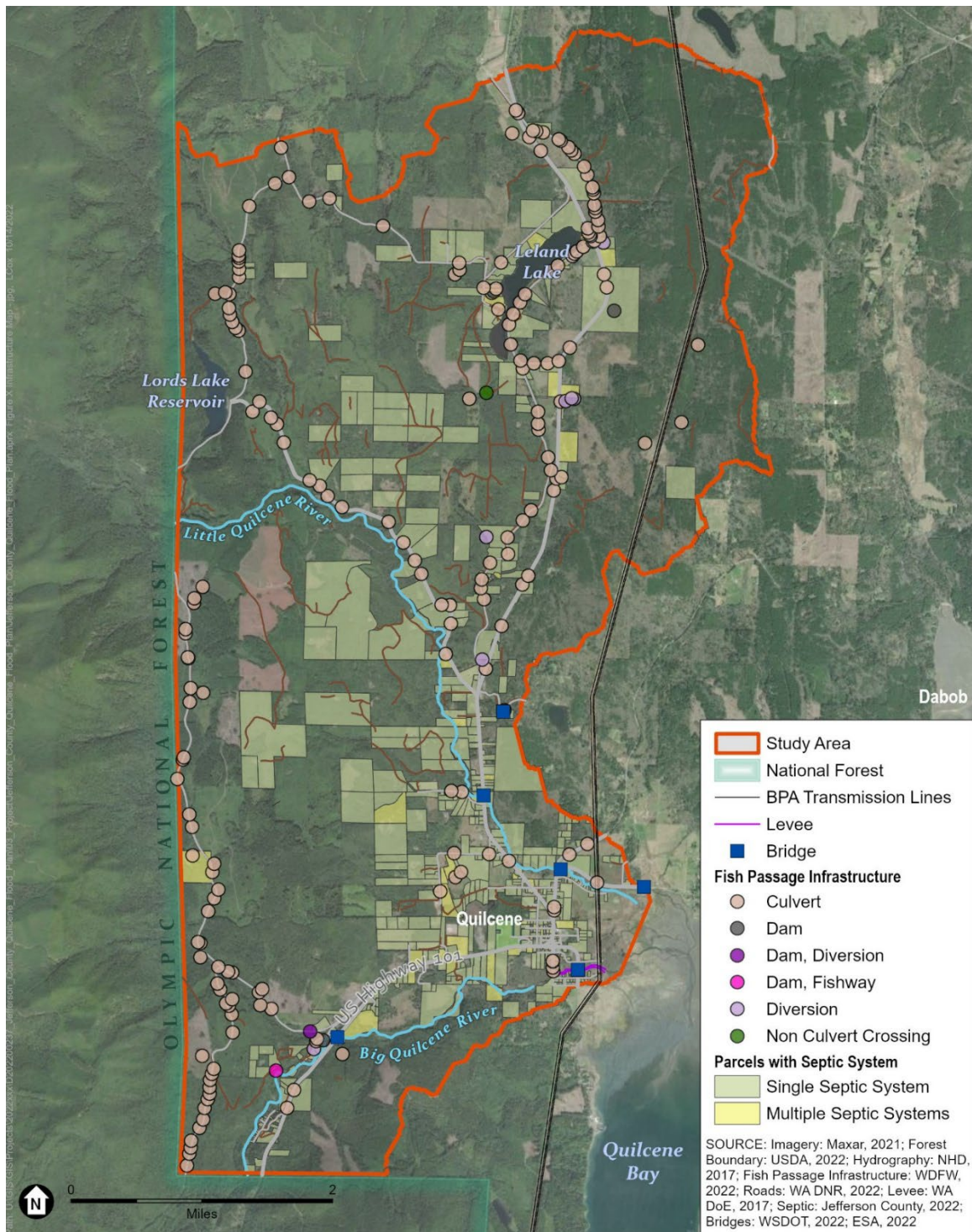


Figure 6. Infrastructure within the Study Area

Roads and Bridges

North-south running Highway 101 is the largest road in both watersheds and is managed by the Washington State Department of Transportation (WSDOT). It crosses the Little Quilcene River at RM 1.9 and milepost (MP) 293.5 and the Big Quilcene River at RM 2.7 and MP 296.6. Traffic on the highway peaks during summer months, as tourists travel up and down Hood Canal. According to the National Bridge Inventory (NBI), the two-lane bridge crossing the Little Quilcene River (see **Photo 1**) was built in 1938 and has an average daily traffic count of 2,682 vehicles (USDOT 2016). The concrete cast-in-place bridge is 28 feet wide and 104 feet long and supported by wooden timbers (WSDOT 2022). The WSDOT-owned bridge is number 101/254 and its overall condition is rated as fair (WSDOT 2022). The two-way, two-lane bridge crossing the Big Quilcene River (see **Photo 2**) was built in 1936 and has an average daily traffic count of 3,290 vehicles (USDOT 2016). The main span of the 244-foot long bridge is a 24-foot wide steel truss with concrete approach spans (WSDOT 2022). The bridge is WSDOT number 101/256 and is rated as being in fair condition (WSDOT 2022).



Photo by Environmental Science Associates 2022

Photo 1. Highway 101 bridge over the Little Quilcene River.



Source: Holth 2014

Photo 2. Highway 101 bridge over the Big Quilcene River.

The Center Road bridge (see **Photo 3**) crosses the Little Quilcene River northeast of the town of Quilcene at RM 0.9. This two-lane Jefferson County-owned bridge was built in 1955 and is 64 feet long and 26 feet wide (WSDOT 2022). The NBI gives its average daily traffic count as 2,504 vehicles (USDOT 2016). The concrete bridge consists of steel I-beams and steel side rails on concrete footings. It is number 16E and is in overall fair condition (WSDOT 2022). However, in 2021, Jefferson County approved the eventual replacement of the Center Road bridge over the Little Quilcene River due to structural deficiencies (The Leader 2021). Just upstream of the Center Road bridge is an abandoned concrete channel-spanning bridge. East Quilcene Road also runs parallel to the first mile of the Little Quilcene River, downstream of the Center Road bridge, along the left bank. Frank Beck Road runs parallel to the right bank of the Little Quilcene River, also downstream of the Center Road bridge.

The Linger Longer Road bridge (see **Photo 4**) crosses the Big Quilcene River at RM 0.5 southeast of the town. Like the Center Road bridge, it is a two-lane concrete bridge with steel I-beams, steel side rails, and concrete footings. The bridge, built in 1969, is Jefferson County number 23E and is 81 feet long and 26 feet wide and is in fair overall condition (WSDOT 2022). According to the NBI, it has an average daily traffic count of 752 vehicles (USDOT 2016).



Photo by Environmental Science Associates 2022

Photo 3. Center Road bridge over the Little Quilcene River.



Photo by Environmental Science Associates 2022

Photo 4. Linger Longer Road bridge over the Big Quilcene River.

Of these roads, Linger Longer Road, nearby Rodgers Street, Muncie Avenue, and East Quilcene Road are in or directly adjacent to the 1% annual chance floodplain and are the most susceptible to flooding from the Quilcene rivers, due to their proximity to Quilcene Bay. When precipitation events coincide with high tide events, these roads may overtop. In 2014, it was reported that Linger Longer Road flooded nearly every winter (Floodplains by Design 2014). However, in recent years, flooding of Linger Longer Road has not occurred with the same frequency. A newspaper article documents Linger Longer Road and Rodgers Street closed due to flooding in a December 11, 2014 event (Sullivan 2014). This event corresponded with a peak flow of 5,170 cubic feet per second (cfs) on the Big Quilcene River, the largest since 1996, and a high tide of 12.1 feet at Quilcene Bay. Frank Beck Road, parallel to the Little Quilcene River, was also flooded during this event. Linger Longer Road is the only access route for approximately 70 residences (as of 1998) as well as the Pacific Seafood hatchery and the Herb Beck Marina. Additionally, in 2020, a historic house on Rodgers Street was moved out of the floodplain of the Big Quilcene River (Kelly 2020). Flooding on Muncie Avenue is due to breaches of a small levee built of loose soil on the south side of the river that runs perpendicular to its flow.

Water Systems

The Big and Little Quilcene watersheds are part of the larger Quilcene-Snow WRIA 17. There is one publicly owned water system in the study area; Jefferson County Public Utility District (PUD) #1 acquired the Quilcene Water System from the U.S. Forest Service in 2005 (BHC Consultants 2020). The transfer was initiated to help alleviate groundwater quality problems, primarily the presence of benzene, associated with private wells in the area (Ecology 2004). The Quilcene Water System, given the Department of Health (DOH) number AB292N, is a Group A system with 40 connections and provides water to residents in the center of Quilcene. Group A systems have 15 or more service connections or regularly serve 25 or more people 60 or more days per year, while smaller Group B systems serve 2 to 14 households or very small businesses. There are multiple other privately owned Group A and Group B systems within the watershed that provide water to local businesses and homes. The water system is fed by a 165-foot deep groundwater well that supplies a 30,000-gallon steel elevated water tank, built in 1984. The old tank is being replaced with a 105,000-gallon concrete water reservoir (BHC Consultants 2020). The water tank is located outside of the 1% annual chance floodplain.

Residents in the watersheds also access water through private wells or surface water diversions. A water right is required for many water uses, including stream diversions. The Quilcene – Snow (WRIA 17) water management rule became effective in December 2009 (WAC 173-517). The rule protects existing water rights, guides decisions on new water uses to stretch supplies as far as possible, and establishes instream flows to protect streams and fish habitat. According to the 2011 Watershed Management Plan developed by the East Jefferson Watershed Council, wells within WRIA 17 do not consistently produce large well yields, with large well yields defined as 200 gallons per minute (gpm) and above. This is due to a complex series of hydrogeologic conditions related to periods of glacial advancement and retreat leaving laterally discontinuous aquifers of sand and gravel and significant deposits of less-productive silt, clay, and glacial till (East Jefferson Watershed Council 2011). In a mid-1990s study, Pacific Groundwater Group (PGG) found that East Jefferson County wells have a mean yield of 40 gpm and a median yield of

20 gpm (East Jefferson Watershed Council 2011). Center Valley Road (from the Little Quilcene River to Center) and along Highway 101 (Little Quilcene River crossing to Lake Leland) are considered problematic areas for permit exempt wells. These areas have shallow basement rock that commonly produces low quantity and low quality wells insufficient for a single home. However, as of 2011, the East Jefferson Watershed Council had found that there is adequate water supply to provide for 768 new residential wells in the Big Quilcene River watershed and 128 in the Little Quilcene River watershed (East Jefferson Watershed Council 2011).

While the Quilcene water system is the only municipal system in the basin, the Big and Little Quilcene Rivers also supply the City of Port Townsend's municipal water via the Olympic Gravity Water System (OGWS). In 1926, a wooden diversion dam was built on the Big Quilcene River at RM 9.5, with water diversion beginning in 1928. In 1995, the timber crib diversion was replaced with a concrete diversion structure. On the Big Quilcene River, the primary source of water for Port Townsend, the City can withdraw water at a rate of 30 cfs for a total of 19.4 million gallons per day. In 1956, a timber diversion dam was constructed near RM 7 on the Little Quilcene River to supplement the supply from the Big Quilcene River. The timber crib was replaced with a concrete structure in 1995. The City of Port Townsend can divert a maximum of 9.56 cfs or 6.2 million gallons per day from the Little Quilcene River. Water from both diversions is directed to Lords Lake Reservoir and City Lake for later use. Up to 500 million gallons of water can be stored at Lords Lake Reservoir for use when high turbidity or low flows prevent withdrawing water from the rivers.

Septic Systems

There are no public wastewater treatment systems in the study area. Most residents treat their wastewater and sewage through individual septic systems. In 2017, the Port of Port Townsend conducted a feasibility study on the cost of constructing a community septic system to serve the Quilcene RVC, but no further action has been taken to date (Tetra Tech 2017).

Private septic systems take up space, with a single drainfield requiring 12,500 square feet of land as well as certain setbacks from wells, buildings, and waterbodies. They require maintenance to prevent failure and release of human fecal matter into the surrounding waterways. Septic fields near the Big and Little Quilcene Rivers or within the 1% annual chance floodplain are prone to failure if they become inundated due to flooding. Septic systems within the study area are supposed to be inspected every 12 to 36 months based on the type of system, but according to the online Jefferson County Septic Status viewer, most fields around Quilcene and the study area are not up-to-date on their inspections.

Power

Transmission lines and electrical towers owned by BPA run through the eastern portion of the study area, crossing both the Big and Little Quilcene River estuaries. Multiple support towers are located within the 1% annual chance floodplain, primarily south of the Big Quilcene River. The 1998 Lower Big Quilcene River Comprehensive Flood Hazard Management Plan reported that a 1993 flood event breached a levee and almost reached the base of the BPA transmission lines (GeoEngineers 1998). There is also a BPA substation just north of the Little Quilcene River, outside of the 1% annual chance floodplain.

Levees

There are two United States Army Corps of Engineers (USACE)-recognized levees on the Big Quilcene River. The 2,000-foot long Old Quilcene River Levee (ID 2004000187) runs along the south bank and is categorized as locally operated and maintained, although Jefferson County does not appropriate funding for these activities. The Old Quilcene River Levee 2 (ID 2004000188) is approximately the same length and runs along the north bank. There is no information on when these levees were built, and neither is certified by the USACE. Both levees are centered around the Linger Longer Road bridge and extend upstream to just below Rodgers Street and downstream to the BPA transmission lines. The 1998 Lower Big Quilcene River CFHMP notes that a levee runs along the south bank for a short distance upstream of Rodgers Street. Although there is no mention of specific levees, in 2011, the Jefferson County Hazard Identification and Vulnerability Assessment reported that the remaining levees near the mouth of the Big Quilcene River are the same elevation as the channel bed (Jefferson County Department of Emergency Management 2011).

There are no USACE-recognized levees on the Little Quilcene River. However, during high-water events, development along portions East Quilcene Road acts as a berm, reducing flow from spreading northward up Donovan Creek. Additional discussion of existing levees and flooding events is provided in Section 2.8.

Quilcene National Fish Hatchery

The Quilcene National Fish Hatchery is located within the CFHMP study area. The hatchery has a water intake structure on Penny Creek, a few hundred feet upstream of the confluence with the Big Quilcene River. The hatchery relies on several systems, including a functioning water intake structure, pumping systems, and waste treatment systems to keep fish alive. Flooding events may threaten these structures and the electricity that powers them. The USFWS considers increased flood intensity and frequency to be the most threatening climate change impact for the infrastructure at this facility. Flooding can damage fish passage facilities, deposit sediment, erode water diversion structures, and inundate access roads (USFWS 2016).

Historically, the Quilcene National Fish Hatchery infrastructure has been affected by flooding in late fall, winter, and spring. In 2009, the intake structure was damaged by a large flood event that blew out upstream beaver dams and deposited large amounts of woody debris on the structure (USFWS 2009). A new intake structure on the Big Quilcene River was added in 2013 and modified to be National Oceanic and Atmospheric Administration (NOAA)-compliant in 2014, assigning the old intake structure to be an emergency backup. Flooding in late 2014 damaged the new intake and caused it to clog, with the emergency backup intake also clogging from flood impacts. Flood events also cause large amounts of sediment from Penny Creek to be deposited upstream of the fish ladder, which occasionally needs to be removed. Riprap designed to protect the facility is not equipped to handle high streamflow events and could pose risks to infrastructure on-site and downstream. The Quilcene National Fish Hatchery: Climate Change Vulnerability Assessment outlines potential adaptations for addressing these vulnerabilities and identifies a need for further analysis to determine appropriate infrastructural adaptations (USFWS 2016).

Public Facilities

Jefferson County's Quilcene Riverside Park is adjacent to the Big Quilcene River at RM 0.6, near the corner of Muncie Avenue and Rodgers Street. Riverside Park is 1 acre and is largely undeveloped. The park provides access to the river and is used for fishing and picnics (Jefferson County Parks and Recreation 2018). The park is located at the site of the former Rodgers Street bridge and several properties that were purchased from willing sellers and protected as open space. The park's amenities consist of dumpsters and portable toilets provided during the fishing season to protect water quality for shellfish resources in Quilcene Bay.

Other parks in the study area include the Quilcene Park and Campground, the Quilcene boat ramp, and Herb Beck Marina. Both the boat ramp and marina are far enough away from the rivers' mouths to escape fluvial impacts. Quilcene Park and Campground, an 8-acre park with 12 campsites, picnic areas, a playground, sport courts, and restrooms, is located in the Quilcene RVC, outside of the floodplain (Jefferson County Parks and Recreation 2018). There are several remote trails, trailheads, and campsites in the western portion of the study area, but most are outside of mapped floodplains. A well-used trail runs from the Highway 101 bridge down the north shoreline of the Big Quilcene River on a WDFW trail easement.

There is a single K-12 school, located in the center of Quilcene, outside the floodplains of either river. The Jefferson County Transfer Station is located west of Quilcene but is separated from the Big Quilcene River by Highway 101.

2.5 Planning and Regulatory Context

Land use activity within the Big and Little Quilcene River watersheds is guided by the goals and policies in the Jefferson County Comprehensive Plan and is regulated under the Jefferson County Code (JCC). In accordance with Washington's Growth Management Act, the Comprehensive Plan outlines priority land uses and sets the zoning for the jurisdiction. The JCC includes the codification of the zoning in the Comprehensive Plan and establishes other applicable development regulations.

The JCC has maintained regulations for floodplain management since 1982, with multiple updates since the adoption of the original ordinance. JCC Chapter 15.15 Flood Damage Prevention regulates activities in the Special Flood Hazard Areas (SFHA), which are delineated by the Federal Emergency Management Agency (FEMA). To mitigate and prevent flood damage, the Flood Damage Prevention Code limits development in areas at risk of flooding, sets building requirements for structures in the floodplain, provides for oversight of construction activities, and regulates alterations to the landscape that could impact floodwater management. Variances from the conditions of the Flood Damage Prevention regulations may be granted only under limited circumstances and with strong justification from the proponent.

Construction permitted under the Flood Damage Prevention regulations must use materials that are resistant to flood damage. Electrical, heating, ventilation, and other indoor utility equipment is strongly encouraged to be sited above the base flood elevation. Sewage systems must be designed to minimize infiltration of floodwater and discharges from the system. Wells are required to be sited on high ground outside of the floodway.

Residential structures must have their lowest floor at least 1 foot above the base flood elevation. New structures should be anchored to prevent flotation or movement of the structure that could be caused by floodwater. Manufactured homes and mobile homes, including vehicles, are also required to meet the Flood Damage Prevention standards for new residential construction.

In accordance with Washington’s Shoreline Management Act, Chapter 18.25 JCC (Shoreline Master Program [SMP]) establishes policies and regulations for the use and protection of freshwater and coastal shorelines. The standards in the SMP aim to preserve critical natural resources, support public access, and allow for water-dependent or other appropriate shoreline land use activities. All land uses and development affecting the shoreline area must comply with the SMP.

Land uses and development proposed within the shoreline jurisdiction must obtain all applicable shoreline permits prior to beginning the activity. Some activities may be exempt from the Substantial Development Permit (SDP) process. These include, but are not limited to, activities with a fair market value of \$8,504 (as of July 2022) or less (Washington Governor’s Office for Regulatory Innovation and Assistance 2022), construction of single-family homes, maintenance and repair of lawfully established structures, natural resource improvement, and emergency actions. Regardless of the applicability of SDPs, all uses in the shoreline area must comply with the regulations of the SMP, and conditions may be set to mitigate impacts on the shoreline.

The SMP regulates shoreline land uses and development to minimize adverse impacts on natural resources and ensure alignment with the goals of the SMP. Preferred shoreline uses include those that provide long-term benefits, preserve aesthetic qualities, are water-dependent, do not deplete natural resources, provide public access, or support recreation, tourism, and economic development. Provisions outlined in the SMP to advance its goals include:

- Any use that causes a net loss of ecological functions and processes is prohibited.
- Dredging, filling, construction of structural shoreline armoring, and installation of numerous types of utility transmission and distribution lines may not be conducted in shoreline areas unless other alternatives are infeasible.
- Preservation of native shoreline vegetation is strongly encouraged and must comply with buffer zone protections and follow prescribed management techniques.
- An additional 10-foot setback landward on top of existing critical area setbacks.
- All development proposals must demonstrate compliance with the no net loss provisions.

Shoreline environmental designations have been mapped along all County shorelines, and these designations provide a system for regulating development relative to existing environmental conditions. The Priority Aquatic and Aquatic designations are assigned to land waterward of the ordinary high-water mark (OHWM). Development in these areas is limited and some activities may be prohibited. Above (or landward of) the OHWM, there are four shoreline designations, with the Natural environmental designation requiring the most protection. The Natural environmental designation is for undeveloped and largely intact natural resource areas, with the intent of continued protection from development. Conservancy areas are designated for areas that are intended for low-intensity development only and aim to protect ecological functions. Shoreline Residential areas are

assigned to environments that are within an Urban Growth Area or are primarily high-density residential development. High Intensity areas are designated for areas that have current or future commercial or industrial uses that would be inappropriate for more sensitive environments.

Jefferson County's current SMP was enacted in February 2014 and is in the process of being updated, which may result in changes in the regulations detailed above.

In accordance with the Growth Management Act, Jefferson County has established a Critical Areas Ordinance (CAO) JCC that protects ecologically significant and sensitive environments (Chapter 18.22 JCC). The CAO regulates activities within the following critical areas and their designated buffers: Critical Aquifer Recharge Areas, Frequently Flooded Areas, Geologically Hazardous Areas, Fish and Wildlife Habitat Conservation Areas (FWHCA), and Wetlands.

Each critical area designation has established protection standards and restrictions specific to various land use types and activities. These regulations protect the functions and resources of critical areas, typically through minimizing runoff, contamination, pollution, or direct disturbance of the resources within the area. The CAO utilizes an adaptive management approach, offering numerous options for flexibility and conditional uses in permitting, allowing for monitoring various protection strategies, and adjusting regulatory approaches based on findings.

The CAO regulations for Frequently Flooded Areas apply to any development within the 1% annual chance floodplain or that may be subject to flooding due to high groundwater, except for land use activities exempted under Chapter 15.15 JCC (Flood Damage Prevention). In addition to compliance with the Flood Damage Prevention regulations, developments within Frequently Flooded Areas are required to provide a habitat assessment, and they must ensure that there will be no impacts on protected listed fish and wildlife habitat as required by the National Marine Fisheries Service September 22, 2008 Final Biological Opinion under the Endangered Species Act on the National Flood Insurance Program in Puget Sound (NMFS 2008).

Critical Aquifer Recharge Areas are regulated under the CAO to minimize impacts on drinking water from land-disturbing activities (such as development), saltwater intrusion, wastewater, and stormwater runoff. As floodwaters have a high potential for carrying contaminants, mitigating the potential for floodwaters to enter Critical Aquifer Recharge Area is important for maintaining drinking water quality.

Geologically Hazardous Areas are identified as areas with environmental conditions that would make them susceptible to landslides, erosion, earthquakes, river avulsion, and tsunamis. The protection standards in Geologically Hazardous Areas limit the extent of clearing, grading, and vegetation removal; require stormwater plans to control stormwater runoff; and encourage development outside of the hazardous area.

FWHCAs are intended to protect fish, wildlife, and their habitats, through regulating activities within the FWHCA and buffer. Bank stabilization, forestry and vegetation management, changes in hydrology, and stream crossings are all regulated within FWHCAs, due to potential impacts on habitat. Activities that have the potential to impact FWHCAs or buffers require mitigation.

Wetlands are regulated to protect ecological functions, with protection standards applying to both wetlands and wetland buffers. Activities that have the potential to impact the wetland or the buffer require mitigation. Vegetation removal, alteration of wetland hydrology, placement of fill, and excavation are examples of development that would be regulated.

Critical areas regulations prioritize avoidance. However, if avoidance is not possible, impacts on critical areas and associated buffers are to be minimized and compensatory mitigation is required. Property owners conducting activities under the CAO within FWHCAs and wetlands may elect to develop a site-specific Critical Areas Stewardship Plan (CASP), if certain permitting and physical property conditions apply. A CASP is a detailed mitigation and natural resource management plan that is intended to provide an equal or higher level of protection to critical areas as prescribed by CAO standards. A CASP may be pursued when the CAO's prescribed standards are infeasible or burdensome, or the proposed land use requires special mitigation. If the CASP protection standards cannot be met, a Reasonable Economic Use Variance is available that allows development to be permitted if the variance standards are met. Agricultural land uses, as a vital resource to Jefferson County, may also use performance-based standards for mitigating impacts on critical areas, as opposed to the prescribed standards. Performance-based standards vary by agricultural activities, but typically include a management plan that addresses stormwater runoff, drainage, erosion and sedimentation, and natural vegetation management.

2.6 Demographics Analysis

Demographics data were collected from the 2020 Decennial Census and the 2020 American Community Survey 5-Year Estimates. The Quilcene Census Designated Place (CDP) was selected for the demographics study area because it encompasses a majority of the 1% annual chance floodplain and the CMZs of the Big and Little Quilcene Rivers, without including significant areas that are outside of the basins that would be represented in Census Block Groups and Tracts. Small portions of the 1% annual chance floodplain and CMZs fall outside of the Quilcene CDP, where the Big Quilcene River extends upstream west of Highway 101 and where the Little Quilcene River extends downstream east of Highway 101, although only the floodplains on the north side of the Little Quilcene River are outside of the CDP (see **Figure 7**).

The CDP had a population of 598 across 299 housing units in 2020, with 40 of those houses being vacant (U.S. Census Bureau 2021). Notably, this is a decrease in the number of households from 312 in 2010 (U.S. Census Bureau 2011). An estimated 23% of the population are under 18 years of age, and 19% are 60 years and over, with a median age of 35.4 years of age. The median household income was \$55,547 (see **Table 6**), with 10.8% of the population living below the poverty level (U.S. Census Bureau 2022). The poverty rate in Quilcene is high relative to other localities in Washington State and can be an indicator of heightened vulnerability to environmental health risks and hazards, such as flooding. The DOH ranks the vulnerability of populations to environmental health risks based on poverty as a seven out of 10 and an eight out of 10 for hazards (DOH 2022).

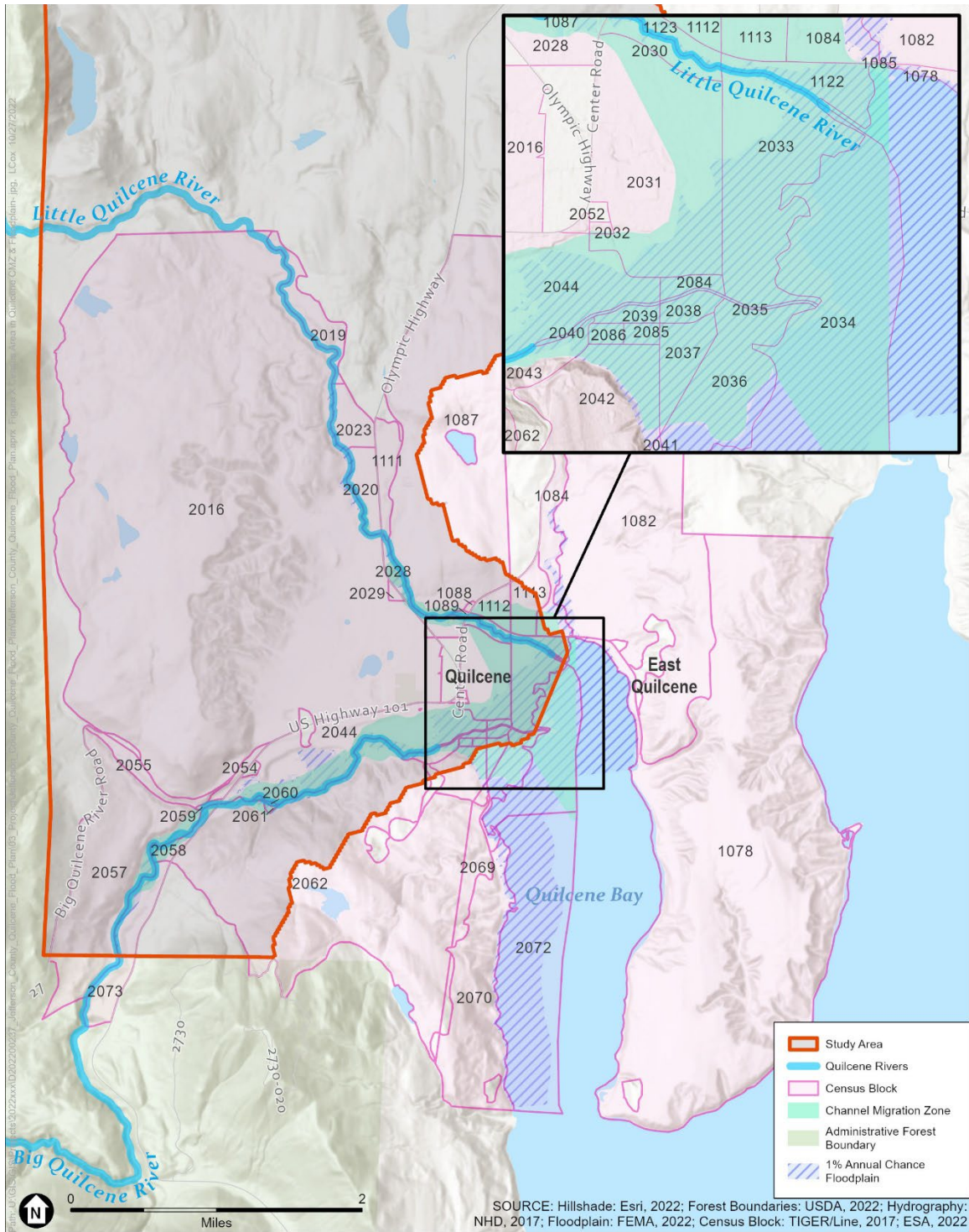


Figure 7. Census Areas, with Study Area in Red

TABLE 6
HOUSEHOLD INCOMES IN THE QUILCENE CDP (2020)

Income	Percent	Number of Households
Less than \$10,000	2.0%	5
\$10,000 to \$14,999	6.0%	16
\$15,000 to \$24,999	22.1%	57
\$25,000 to \$34,999	4.4%	11
\$35,000 to \$49,999	12.4%	32
\$50,000 to \$74,999	16.9%	44
\$75,000 to \$99,999	26.5%	69
\$100,000 to \$149,999	9.6%	25
\$150,000 or more	0.0%	0
Total		259

The population is 89.1% White, 0.3% Black, 1.3% American Indian or Alaska Native, 1% Asian, 2.5% other, and 5.7% two or more races. None of the population were identified as Hispanic or Latino (U.S. Census Bureau 2021). While 1.8% of the population speak a language other than English, no households were identified as having an occupant that speaks English less than “very well” (U.S. Census Bureau 2022).

Of the 299 households, 16.9% are occupied by someone living alone (U.S. Census Bureau 2021). An estimated 28.1% of householders are 65 years or older. Non-permanent, non-stationary housing, such as mobile homes, tents, recreation vehicles (RVs), vans, or boats account for 25.3% of the total housing units. There is at least one occupant with a disability in 28.5% of households in the area. Among all households, 84.7% have internet service and 96.8% have phone service. All households were estimated to have a car or other personalized motor vehicle (U.S. Census Bureau 2022). The percentage of the population with a disability and the percentage of homes that are mobile homes are key indicators of social vulnerability to hazards. The DOH ranked Quilcene’s percentage of population with a disability as a seven out of 10 for indicating vulnerability to hazards and the percentage of mobile homes as a nine out of 10. Very few people over 65 years old live alone, which makes that a low indicator of vulnerability for Quilcene (DOH 2022).

Demographic data can be a useful indicator for identifying heightened vulnerabilities to disaster and other emergencies among the population. For example, senior populations or people with physical disabilities may have a reduced ability to evacuate their homes or withstand the impacts of certain disasters. Similarly, people who live alone may lack the assistance needed during a disaster event, and factors such as age and physical disabilities can increase their sensitivity to disaster. The percentage of mobile homes is relatively significant and could function as an indicator for a higher risk of property damage from floods or other disasters. Quilcene’s demographic characteristics do not indicate a high potential for communication issues during an emergency, due to high levels of English fluency and access to communications technologies. With the high rates of access to communications technology, Jefferson County has a significant opportunity to share information with and alert vulnerable populations to potential hazards. Beyond identifying the populations in the area that are vulnerable, establishing networks and

methods for engaging with these populations is critical for ensuring equitable protection from flood hazards and management of those flood hazards.

2.7 River Reach Descriptions

In September 2004, the U.S. Department of the Interior, Bureau of Reclamation completed a CMZ study for Jefferson County (BOR 2004). This study focused on defining flood hazard zones along four rivers in the County: the Duckabush, the Dosewallips, the Big Quilcene, and the Little Quilcene. To facilitate development and planning around the rivers, the study defined the historical CMZs and identified areas of potential lateral migration or avulsion.

Study reaches extend from the mouth of each river to the U.S. Forest Service boundary for the Olympic National Forest. While this plan has been prepared for approximately 6.6 river miles (the full length included within the study area), the CMZ study area for the Little Quilcene River ends upstream of the Highway 101 bridge, near RM 2.8, at a point where the channel narrows, preventing mapping of historical channel locations. The study area for the Big Quilcene River terminates at the Olympic National Forest boundary, near RM 4. It is assumed that conditions have not changed too substantially to preclude the reaches developed in the CMZ study from being appropriate for use in this CFHMP. Detailed descriptions of the study reaches for the Big and Little Quilcene Rivers are provided below.

Little Quilcene River

The lower Little Quilcene River can be split into four reaches, as defined in the 2004 CMZ Study.

- Reach A – RM 0.0 to RM 0.9
- Reach B – RM 0.9 to RM 1.6
- Reach C – RM 1.6 to RM 1.9
- Reach D – RM 1.9 to RM 2.4

See **Figure 8** for locations of these reaches.

Reach A

Reach A extends from the mouth of the river at Quilcene Bay to the Center Road bridge, at approximately RM 0.9. This reach is the most extensively leveed portion of the river and has been artificially straightened to limit channel migration into the surrounding agricultural fields. Restoration efforts have been conducted within this stream reach.

Reach B

Reach B extends upstream from the Center Road bridge to RM 1.6, approximately 1,500 feet below the Highway 101 bridge. There are fewer revetments in this section and the channel varies between wide and narrow, as it flows through a low, vegetated floodplain. In fall of 2011, the Hood Canal Salmon Enhancement Group completed the Brush Plant Road Reach Restoration project, installing five log jams and 1,000 native plants in between the Center Road bridge and Highway 101. This stream reach flows through areas that have been developed for rural residential uses and much of the forested vegetation along the river has been cleared.

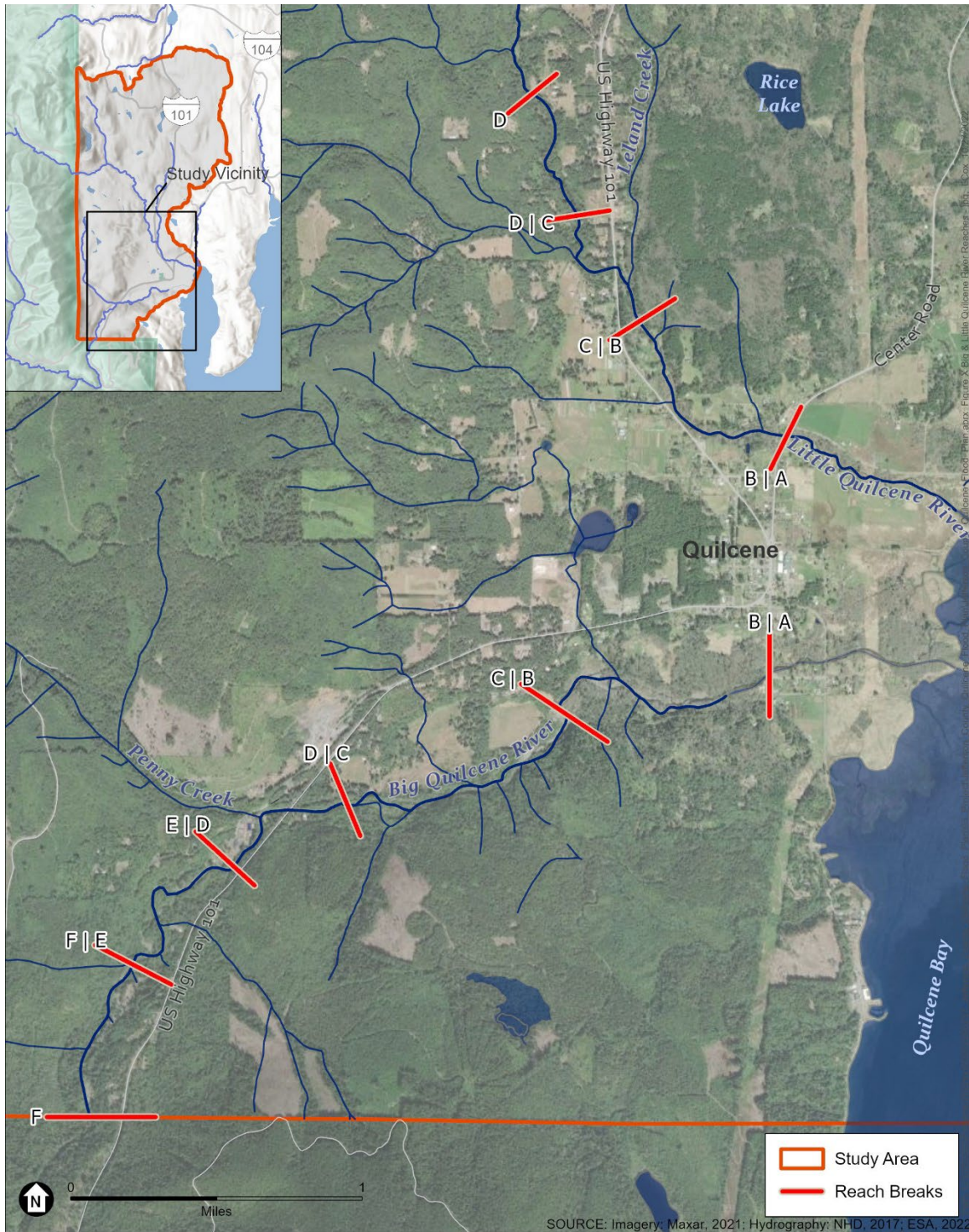


Figure 8. Study Reaches in the Little Quilcene and Big Quilcene River Basins

Reach C

Reach C is centered around the Highway 101 bridge, extending 1,500 feet upstream and downstream of the bridge to RM 1.9. Within this reach, the channel is narrow and confined by high banks and bedrock bluffs. There has been little historical lateral migration in this reach. Residential development in the vicinity of the bridge has reduced the amount of forested vegetation. Farther northwest, a greater proportion of the floodplain is vegetated, which provides better connectivity to other habitat types and decreases the potential for erosion during peak flow events.

Reach D

Reach D starts 1,500 feet upstream of the Highway 101 bridge. The reach ends where the channel becomes too narrow to accurately map historic channel location, near RM 2.4. The west side is unconfined, while the east bank is constrained by high banks. The channel is sinuous and alternates between wide and narrow, and there is more large wood than other reaches. This stream reach flows through relatively larger parcels where the development generally occurs farther from the floodplain, resulting in more intact vegetation along the river.

Big Quilcene River

The lower Big Quilcene River can be divided into six reaches, as defined in the 2004 CMZ study.

- Reach A - RM 0.0 to RM 0.6
- Reach B – RM 0.6 to RM 1.3
- Reach C – RM 1.3 to RM 2.2
- Reach D – RM 2.2 to RM 2.8
- Reach E – RM 2.8 to RM 3.7
- Reach F – RM 3.7 to RM 4.3

See Figure 8 for locations of these reaches.

Reach A

Reach A extends from the mouth of the river at Quilcene Bay to Rodgers Street at RM 0.6. This reach is the most extensively leveed portion of the river and has been artificially straightened to limit lateral migration. The Linger Longer Road bridge and the BPA transmission lines cross the river downstream of Rodgers Street. This river reach flows through relatively small parcels, some of which are in rural residential use. Development in the vicinity of the floodplain has resulted in the loss of forested vegetation that could reduce flow velocities and decrease the potential for erosion during peak flow events.

Reach B

Reach B extends 3,800 feet upstream from Rodgers Street to RM 1.3. The channel in the downstream portion of the reach is narrow and straight, constrained by a levee on the south bank of the river that extends into Reach A. Upstream, the channel is more meandering and has

historically experienced lateral migration. Parcel size in this stream reach generally allows for development outside the floodplain. The reach consists of native and non-native woody vegetation.

Reach C

Reach C extends from RM 1.3, 4,500 feet upstream to RM 2.2. This expansion reach contains abundant large wood, gravel bars, and multiple channels. According to the Salmon Recovery Portal (SRP), two engineered log jams have been constructed within this reach. Much of the floodplain has some native trees and shrubs along the floodplain to serve as a wildlife corridor and to reduce the potential for erosion during peak flow events.

Reach D

Reach D is incised, steep, and narrow with revetments along both banks. The revetments protect the Highway 101 bridge, the Quilcene National Fish Hatchery, and private residences. There is limited lateral migration upstream of the Highway 101 bridge, but some historical meanders downstream of the bridge that were last active in the 1950s.

Reach E

Reach E begins at the Quilcene National Fish Hatchery at RM 2.8 and extends to the Hiddendale Drive community at RM 3.7, along the right bank of the river. In this reach, the river is wide and sinuous, with plentiful gravel bars, large wood, and multiple channels. A channel-spanning diversion in the middle of the reach diverts water to the fish hatchery. Riprap has been placed upstream of the diversion along the right bank to direct flow toward the left bank. According to the 2004 CMZ study, flows frequently overtop the riprap, leading to aggradation behind the revetment and the formation of a new channel at the same elevation as the riprap. Aerial photographs from 2021 show that this area has developed into an active side channel that bypasses the hatchery intake structure. As there are no nearby structures other than the intake structure, this does not pose a flooding issue. Reach E displays extensive historical lateral migration and parallels Highway 101 a few hundred feet to the east.

Reach F

Reach F begins at the Hiddendale Drive community along the right bank of the river at RM 3.7 and extends until the Olympic National Forest boundary at RM 4.3. Several riprap barbs along the bank provide bank protection for the community, which is almost entirely within the 1% annual chance floodplain. The upstream portion of the reach narrows to approximately 30 feet, confined by high terraces and bedrock. This reach runs parallel to Highway 101, approximately 800 feet to the east.

2.8 History of Flooding and Flood Hazard Analysis

Little Quilcene River

The Little Quilcene River runs approximately 12.2 miles from Mount Townsend to Quilcene Bay. Elevations range from 6,300 feet at the peak of Mount Townsend to sea level at Quilcene Bay. The river is free flowing until a diversion dam near RM 7.0 directs drinking water to Lords Lake

Reservoir and eventually Port Townsend. With no other structures controlling flow, the river frequently floods during the winter rainy season from October through March after periods of prolonged rain. In the spring, rapidly melting snowpack from the Olympic Mountains in the upper reaches of the watershed also contributes to flooding. Flooding can also occur at the river mouth when these high flow events coincide with coastal storm surges or high spring tides that hold back floodwaters from the river.

Leland Lake has a delineated Special Flood Hazard Area that covers small areas around the perimeter of the lake and in wetland areas just upstream and downstream of the lake. Only one residential structure appears to be within the 1% annual chance floodplain. Anecdotes of basement flooding in houses around Leland Lake were described during data collection, but no documented instances of flooding were identified. Instances of flooding in the area could potentially be attributed to beavers, which have historically been active upstream and downstream of the Leland Lake (Wild Fish Conservancy 2008).

There are currently no active U.S. Geological Survey (USGS) streamflow gages on the Little Quilcene River. Former USGS gage 12052000, located at the Highway 101 crossing over the Little Quilcene River, has mean daily discharge for a period of record between September 1926 and January 1957. A second gage in the upper watershed, directly below the diversion dam, recorded mean daily discharge between April 1994 and July 1994. Ecology operates active gage 17D060 at the Center Road bridge, with discharge measurements at 15-minute intervals spanning from August 2002 to the present. See **Figure 9** for the location of the gage.

FEMA calculated flood frequencies for the Little Quilcene River in its 1982 Jefferson County Flood Insurance Study (FIS). Because gage data at the time of their study were inadequate, FEMA used the USGS regional method to calculate flood-frequency returns, listed in **Table 7** below. Discharges were calculated for two locations: at the river's mouth and at its confluence with Leland Creek, at RM 1.8. FEMA published a second FIS for Jefferson County, effective June 7, 2019, but did not update any of the flood frequencies for the Little Quilcene River. There is little recorded information on flood events on the Little Quilcene River, although flooding likely occurs at the same time as for the Big Quilcene, described below. Jefferson County reports that between 1974 and 1982, the Little Quilcene River flooded seven times.

TABLE 7
FLOOD FREQUENCIES ON THE LITTLE QUILCENE RIVER

Recurrence Period	Peak Discharge at Mouth (cfs)	Peak Discharge at Confluence with Leland Creek (cfs)
10-Year	1,370	990
50-Year	1,960	1,410
100-Year	2,210	1,590
500-Year	2,880	2,060

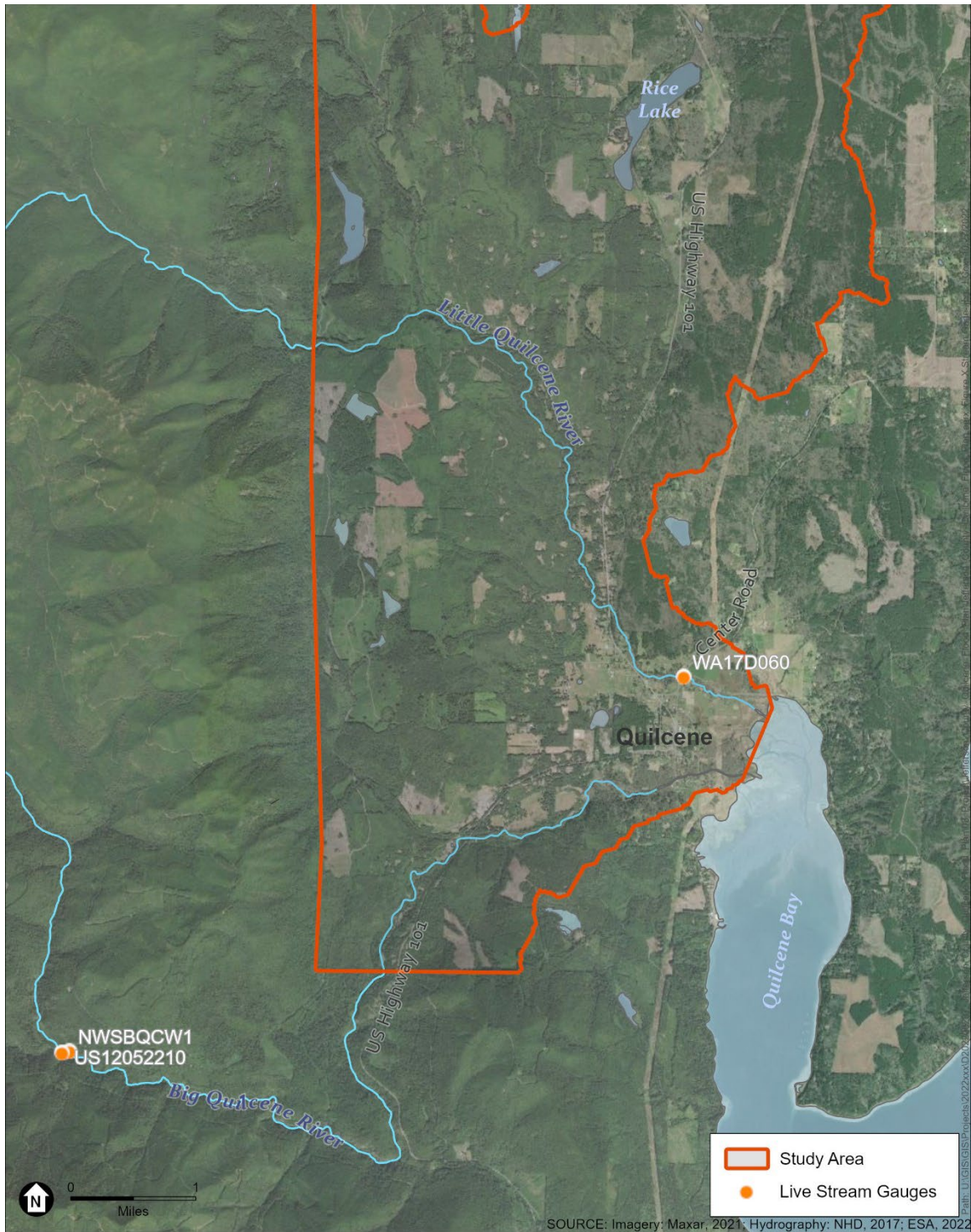


Figure 9. Active Stream Gages

Big Quilcene River

The Big Quilcene River watershed is approximately 69 square miles located on the east side of the Olympic Mountains, directly southwest of the Little Quilcene River basin. Its headwaters flow out of the Buckhorn Wilderness (where elevations in the southwestern portion of the basin exceed 7,000 feet) into Quilcene Bay at sea level. The highest peak in the watershed is Mount Constance, at 7,750 feet. The mean annual precipitation in the basin is 64.3 inches, with annual rainfall at the town of Quilcene, near the river's mouth, averaging 51 inches, and rainfall in the upper reaches of the watershed averaging 76 inches (USGS 2023). Most of the basin is forested with coniferous trees and steep, with extensive areas in the upper watershed being prone to mass wasting (GeoEngineers 1998).

The Big Quilcene River is a 30-mile long, free-flowing river until RM 9.5, where a small dam diverts water to the City of Port Townsend. Downstream, there is an additional diversion dam associated with the Quilcene National Fish Hatchery, as well as a fish ladder that redirects fish to the hatchery. However, neither dam is designed to act as a flood control structure and they do not regulate the flow of the river.

Historical streamflow data are limited for the Big Quilcene River. Active USGS stream gage 12052210, which sits at RM 9.5 directly below the diversion dam, has recorded the mean daily discharge from January 1994 to present day for a drainage area of 49.4 square miles. The NOAA-operated gage NWSBQCW1 is a few hundred feet below the USGS gage and also records stage and discharge. Inactive gages include USGS gage 12052500 at the Highway 101 crossing of the Big Quilcene River at RM 2.7, which kept mean daily discharge records for a period of 1 year from August 1971 to August 1972, and USGS gage 12052200 at RM 9.5, directly above the diversion dam, which recorded mean daily discharge from May 1993 to November 1993. Another USGS gage, Station 12042400, recorded streamflow and water quality data from February 1949 to January 1968 on Penny Creek immediately above its confluence with the Big Quilcene River near the Quilcene National Fish Hatchery. An inactive Ecology gage also recorded flows on the Big Quilcene from 2000 to 2014 at the Linger Longer Road bridge. The Linger Longer Ecology gage did not appear to accurately record peak flow rates above approximately 3,000 cfs.

USGS staff collect streamflow data manually from two sites near the Quilcene National Fish Hatchery at irregular intervals, although data are typically collected 2 to 3 months apart. The measurement sites are USGS 12052390 Big Quilcene River Above Penny Creek Near Quilcene, which has data from June 1993 to the present, and USGS 12052398 Penny Creek Above Hatchery Near Quilcene, which has data from August 2015 to the present (USGS 2023). The measurement locations are both below water intakes at the Quilcene National Fish Hatchery and may be used to inform or validate seasonal water right withdrawal limits, which are based on maintaining minimum flow volumes in the Big Quilcene River and Penny Creek (Magneson 2014).

FEMA calculated flood frequencies for the Big Quilcene River in its 1982 Jefferson County Flood Insurance Study (FIS). Because gage data at the time of the study were inadequate, FEMA used the USGS regional method to calculate flood-frequency returns, listed in **Table 8**. Discharges were calculated for two locations: at the river's mouth and at its confluence with Penny Creek,

near the Quilcene National Fish Hatchery at RM 2.8. FEMA published a second FIS, effective June 7, 2019, but did not update any of the flood frequencies for the Big Quilcene River.

TABLE 8
FLOOD FREQUENCIES ON THE BIG QUILCENE RIVER – USING 1982 REGIONAL REGRESSION

Recurrence Period	Peak Discharge at Mouth (cfs)	Peak Discharge at Confluence with Penny Creek (cfs)
10-Year	3,580	3,130
50-Year	5,200	4,540
100-Year	5,900	5,140
500-Year	7,800	6,780

In 2018 and 2020, Anchor QEA published a Preliminary Design Report and 30% Design Report for the Lower Big Quilcene River Restoration Project (Lower One Mile Project), respectively. The peak discharges in their reports generally match FEMA's flows. In their 2020 30% Conceptual Design Report for the Moon Valley Restoration Project, Cardno modeled five recurrence flows in the vicinity of Moon Valley, just below the Highway 101 bridge crossing of the Big Quilcene River. These flows are higher, but likely more accurate, than those calculated by FEMA using regression equations. Results are shown in **Table 9** below. Additional details on these two restoration projects are described in Section 2.10.

TABLE 9
STEADY-STATE FLOWS MODELED IN TWO DIMENSIONS FOR THE LOWER BIG QUILCENE RIVER

Recurrence Period	Modeled Flow (cfs)
6-Month	1,552
2-Year	2,622
5-Year	4,078
25-Year	6,478
50-Year	7,523

Source: Cardno (2020)

The 1998 Lower Big Quilcene Flood Plan documented major flood events occurring in the following months and years:

- December 1926
- November 1951
- February 1954
- January 1959
- January 1960
- December 1966
- January 1968
- March 1971
- December 1979
- November 1986
- November/December 1990, 1993
- November/December 1995
- December 1996
- January 1997
- March 1997

In the 1993 event, the river breached the Old Quilcene River levee downstream of Linger Longer Road and formed a new channel until repairs were made on the levee. During the March 1997 event, a landslide on the south bank of the Big Quilcene River at RM 1.8 directed flow toward the north bank, destroying a recently completed log barb bank protection. The USGS gage at RM 9.5 documented flow of 5,620 cfs associated with the December 1995 event and 4,990 cfs with the March 1997 event. Since then, flows have only exceeded 4,000 cfs in December 2014 (5,170 cfs) and October 2016 (4,200 cfs).

The greatest recorded peak daily discharge is 5,620 cfs on December 12, 1995 at gage 12052210 (see **Figure 10**). This gage is located 6.7 miles upstream of the Big Quilcene River's confluence with Penny Creek and drains only 49.4 square miles compared to 66.5 square miles at Penny Creek. The gage is unable to make accurate high-flow discharge measurements, and any flows greater than 900 cfs are rated as having poor accuracy (USGS 2022). The December 2014 flood event reportedly closed the Linger Longer Road bridge and Rodgers Street, adjacent to the Big Quilcene River, and Frank Beck Road along the Little Quilcene River (Sullivan 2014). According to FEMA's 1982 FIS for Jefferson County, residents reported floods on the Big Quilcene River in January 1960, December 1966, and January 1968.

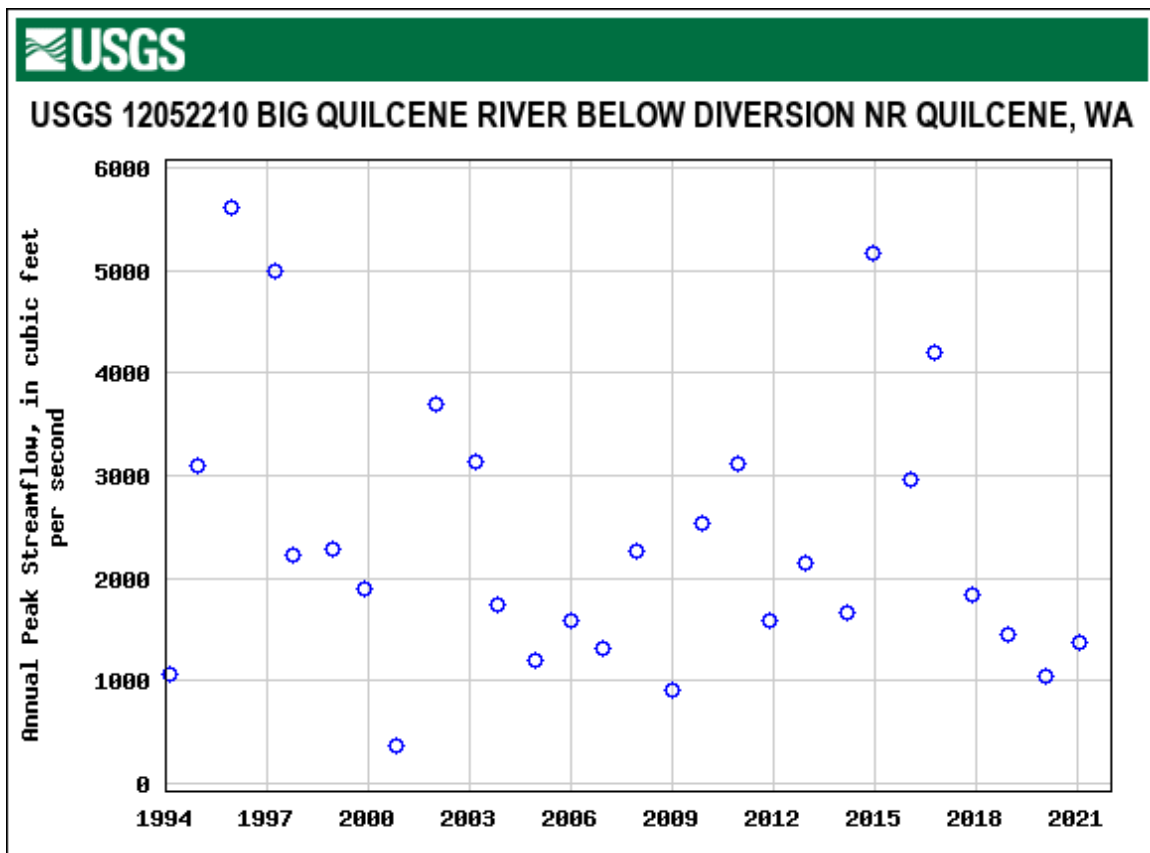


Figure 10. Annual Peak Discharges on the Big Quilcene River

Figure 11 shows the Special Flood Hazard Area and floodway area (as mapped by FEMA) and the channel migration zone (as mapped by Jefferson County).

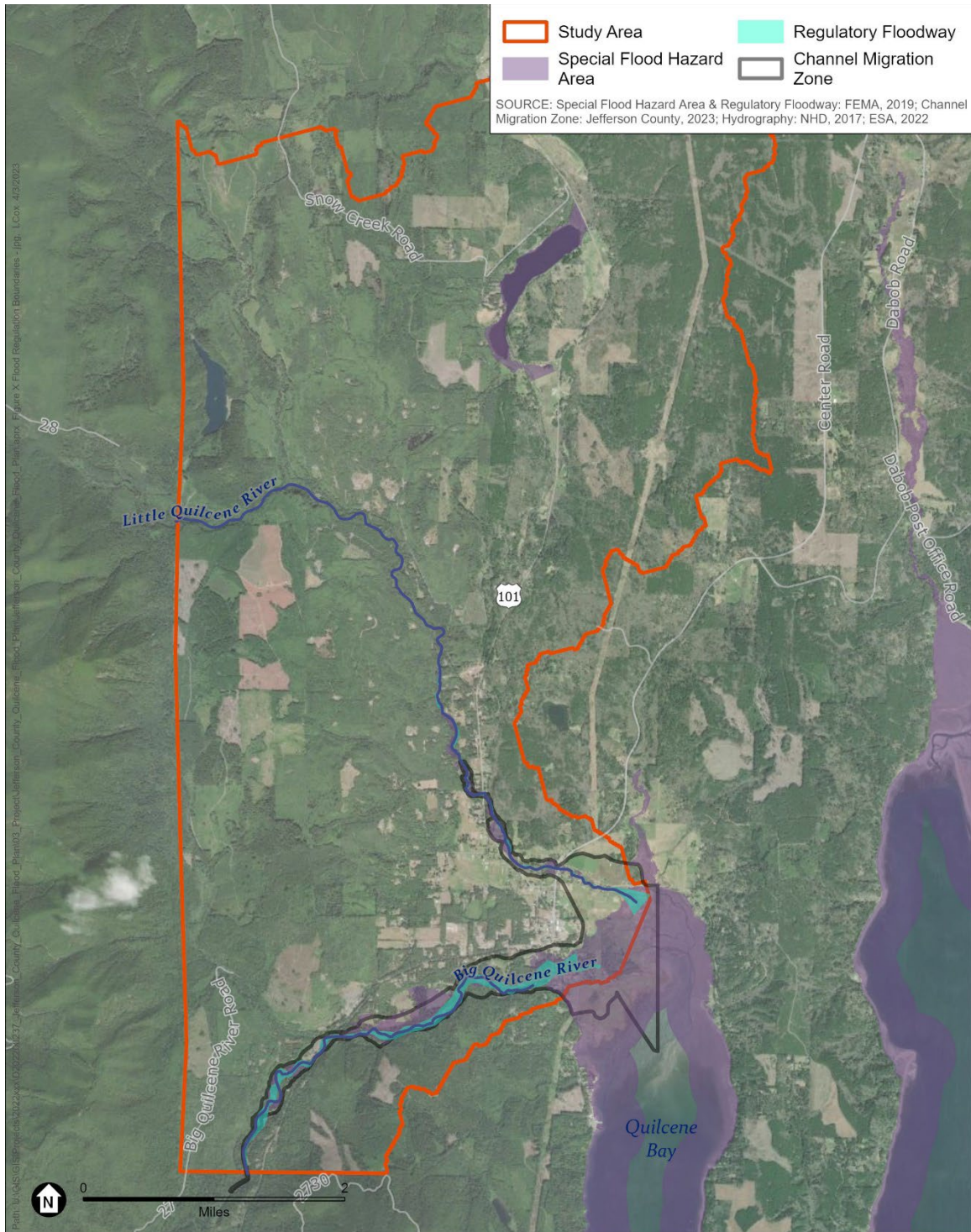


Figure 11. Floodway and Channel Migration Zone.

2.9 Potential Future Conditions

Climate is a key factor for flood frequency and intensity, with changes to the climate having the potential to impact watershed ecosystems and topography. Shifts in precipitation patterns on the Olympic Peninsula are expected to affect the frequency and intensity of heavy flows in the Big and Little Quilcene Rivers that could potentially worsen flood hazards. As a result, the developed areas of Quilcene in the low-lying reaches of the two rivers may experience increased inundation, deposition of debris and sediment, property damage and disruption, and overall exposure to flooding over time.

Changes in Hydrology

The Big and Little Quilcene Rivers are largely fed by precipitation falling on the Olympic Mountains in their upper watersheds and by high elevation snowpack melting through the warmer months of the year. Historically, the rivers have had relatively stable streamflow throughout the year from gradual snowmelt. However, increases in temperature can result in shifts in the timing of precipitation as well as faster snowmelt, or rain-on-snow events, leading to less stable streamflow that is more significantly influenced by precipitation events. Historically, precipitation volumes vary substantially from year-to-year in Puget Sound, which presents challenges in accurately estimating climate change's effect on total precipitation to-date. However, precipitation patterns have shifted toward less frequent but higher volume heavy rain events, which increases the potential for hazardous flooding (Mauger et al. 2015).

The northwest United States has experienced an average temperature increase of 2 degrees Fahrenheit since 1900 (May et al. 2018). Warming temperatures have contributed to reduced snowpack in the Olympic Mountains, with an estimated 20% reduction in average snowpack since 1950 (EPA 2016). Increased temperatures also result in more precipitation falling as rain in high elevations (as opposed to snow), including in winter months. The impacts of warmer winters have year-round implications, as high elevation snowpack has been melting faster, resulting in less stable streamflows throughout the year. As a result of faster snowmelt, some snowmelt-influenced rivers in the Puget Sound region saw average peak flow dates shift up to 20 days earlier from 1948 to 2002, although some rivers experienced no substantial change (Stewart et al. 2005).

Climate change projections vary considerably by the source of the information and the scientific model used to make the projections. Estimates of future climate conditions may be best understood through a range of possible future greenhouse gas emissions scenarios, ranging from a low greenhouse gas emissions scenario, which would result in less significant climate impacts, to a high greenhouse gas emissions scenario, which would result in more significant climate impacts. Projections for each scenario are averaged from estimates produced by multiple models.

In a low-emissions scenario, the average annual temperature in Puget Sound is projected to increase 4.5°F by the end of the century, in contrast to a projected 8.5°F for a high-emissions scenario (Mauger et al. 2015). These increased temperatures will have significant effects on precipitation patterns, snowpack, and streamflow as well as soils and vegetation. The total precipitation in fall, winter, and spring may increase by 2% in a low-emissions scenario or by up to 11% in a high emissions scenario by the 2050s (relative to 1970 to 1999) (Mote et al. 2015). In

their 2020 Hydrodynamic Modeling Report for the Big Quilcene River Restoration Project, Anchor QEA evaluated the effect of increased precipitation and sea level rise (SLR) on hydrologic flows in the vicinity of Linger Longer Road. Using projected 2050 SLR values, the 100-year flood was estimated to be 6,900 cfs. This is a 1,000 cfs increase from FEMA's current estimates of the 100-year flood (5,900 cfs).

While the increases in total precipitation during the wet months are smaller than historical year-to-year variability in precipitation, the increases in extreme precipitation events are projected to be more substantial. By the 2080s, the heaviest 24-hour rainfall events in winter (often caused by "atmospheric river" events) will increase in volume by 22% on average (relative to the period from 1970 to 1999), with these events projected to occur on average seven times per year (Warner et al. 2015). Atmospheric rivers are columns of water vapor that move with the weather, often carrying an amount of water vapor that is equivalent to the average flow of water at the mouth of the Mississippi River. They are especially common in the western United States. Atmospheric rivers can create extreme rainfall events and cause floods, often stalling over watersheds that are already vulnerable to flooding. These events can induce mudslides, disrupt travel, and cause catastrophic damage to life and property from flood events (NOAA 2017). Across Puget Sound watersheds, peak flow volumes during the 1% annual chance flood event under a moderate-emissions scenario are projected to increase by an average of 18% to 42% by the end of the century (Mauger et al. 2015).

Hydrology can also be impacted by wildfires, which are expected to increase in frequency and severity with climate change. Changes in precipitation and hydrology are expected to increase drought conditions in summer months. Snowpack on April 1st (typically the peak time for snowpack) is projected to decrease by 42% in a low-emissions scenario or 55% in a moderate emissions scenario, when compared with snowpack at the end of the 20th century. Under the same conditions, the volume of the 10-year 7-day low flow extreme would decrease anywhere from 16% to 55% (Mauger et al. 2015). Drought conditions potentially increase the risk of wildfires, which can destabilize the landscape from a loss of vegetation and increase the potential for flood conditions to cause erosion and debris flows (May et al. 2018). Wildfires can make soils less permeable to water, which can enable flash floods from increased runoff (Mauger and Vogel 2020).

The impacts of these climate changes will include greater variability in streamflow and flood events, defined by more intense extremes. Quilcene, as a developed area in the lowest reaches of the Big and Little Quilcene Rivers, will experience the impacts of these rain and flood events with the addition of debris from upriver and potential increases in speed from downhill flows. This will make floods more damaging through movement of debris, such as large wood, which could impact structures or block roads. Debris may also include sediment that can cover floodplains, impacting the viability of agriculture in the lower reaches of the Big and Little Quilcene Rivers. While the sediment deposited by historic floods has led to high quality agricultural soils, sediment deposits from current flooding tend to negatively affect agricultural operations due to debris, contamination, and impacts on livestock. Faster, higher volume floods will have a greater potential for eroding the landscape and causing avulsion or channel migration. Similarly, the increased volume of the flood events will inundate larger areas, which could be

quite extensive due to the relatively flat topography of the land in the lowest elevation reaches of both the Big and Little Quilcene Rivers (Reach A for each river).

The year-round impacts of these climate change effects can be understood in the context of Washington's 2015 drought season. In the 2014-2015 winter, precipitation totals were normal relative to historic climate data, but warmer weather led to precipitation falling as rain, leading to a record low snowpack, which would normally be relied on for downstream water resources in spring and summer months. While the rain created high streamflows in the spring, the snowpack deficit in combination with higher summer temperatures enabled a historic drought and the state's largest wildfire season on record, in terms of acres burned (Anderson et al. 2016). These conditions can enable a feedback loop where drought and wildfire can enable potentially more significant impacts from the flood season, while the rapid snowmelt creates more significant drought conditions. Without adaptation to improve resilience or variations in the climate to reduce these impacts, the feedback loop can continue and worsen.

Sea Level Rise

From 1907 to 2007, Puget Sound has risen 0.7 foot on the Seattle shoreline, which likely varies from Quilcene Bay, but is a useful indicator of the pattern of sea level rise across the region (Raymond et al. 2018). The effects of sea level rise on coastal flooding in Puget Sound have been minor to-date, with less than five documented high tide flooding days each in Seattle and Port Townsend in 2000, reaching seven and six high tide flooding days in 2021, respectively. Both cities are estimated to have nine to 10 annual high tide flood days by 2050. Flat coastal areas on Quilcene Bay, especially around the mouth of the Big Quilcene River, are estimated to experience similar exposure to high tide flooding in the future (Sweet et al. 2022). Sea level rise in Puget Sound is projected to range from 1.2 feet in a low-emissions scenario to 4.5 feet in a high-emissions scenario by the end of the century (Mauger et al. 2015), but will vary by location based on geologic factors.

Sea level rise not only contributes to coastal flooding, but it can also cause backups in rivers that empty into coastal waters, resulting in inland flooding, referred to as the coastal squeeze effect. The combination of sea level rise with higher streamflow and more extreme floods in the future could cause riverine flooding to be more extensive and damaging in the future. For example, the combined effects of sea level rise and increased peak flows are expected to increase the flood area of the snowmelt-fed Skagit River by 74% during a 1% annual chance flood by the 2080s (relative to 1970-1999) (Hamman 2012; Hamman et al. 2015). The coastal squeeze can affect groundwater, in addition to surface water, and may contribute to higher groundwater levels, which can destabilize soils, making them more susceptible to erosion and impacting their ability to store surface floodwater.

In Quilcene, sea level rise is likely to inundate low-elevation areas near Quilcene Bay and may extend to areas that historically had the capacity for floodwater storage. The coastal squeeze effect will increase the potential of floods to overtop levees, especially those in the Reach A areas of both the Big and Little Quilcene Rivers, putting the surrounding low-lying neighborhoods at increased risk. While sea level rise alone is not projected to inundate significant portions of developed areas in the near future, as a chronic impact combined with seasonal concentrations of

high streamflow, there is potential for areas in Quilcene to experience extended periods of flood impacts, as opposed to separate flood events. King tides and coastal storm events should be accounted for when considering potential riverine flood impacts, as the coastal squeeze effect could cause backups in lower reaches even when precipitation or streamflow volumes upstream are not significant enough to cause flooding on their own.

2.10 Flood Management Activities

Historic Flood Management Activities

The study area was first inhabited by the native Quil-ceed-a-bish people, which means “salt water people.” The Quil-ceed-a-bish people are one of the three bands of the Twanas and inhabited the western shores of Hood Canal. They were often found in small groups connected by a common language and located near the mouths of salmon-bearing streams and rivers. The Twana had at least one permanent winter village and several neighboring campsites near where the current town of Quilcene is located (Correa 2002). European settlers arrived in the area in the second half of the 19th century, and the first homestead in Quilcene was established in 1860. The railroad and lumber industries began expanding into the area in the 1880s, coinciding with the beginning of flood management activities on the Big and Little Quilcene Rivers. There is limited information about these early flood management activities prior to modern permitting requirements.

Levees were first constructed along the lower half mile of the Big Quilcene River beginning sometime in the late 1800s. Levees, referred to as the Old Quilcene River Levee 1 and 2, run along both banks from Rodgers Street down to the mouth of the river, channelizing and straightening its channel. These levees were likely first built to protect agricultural fields from the saltwater estuary by preventing channel migration. The existing levees along the Big Quilcene River protect residential areas from floods with low to moderate flows, but today, these levees overtop during floods with 2- or 3-year recurrence. The Little Quilcene River has also been channelized by levees as it enters the north end of Quilcene Bay, but there is little information on the origin of these levees.

Historical dredging in the Big Quilcene took place downstream of Rodgers Street, although there is no documentation on the frequency of dredging. In 1992 and 1993, the lowermost section of the river, between the BPA transmission line crossing and the mouth of the river, was dredged, removing 3 to 6 feet of sediment from the channel bottom (GeoEngineers 1998). However, the channel refilled with sediment during the next major storm event. Between 1994 and 1998, relatively small gravel traps were excavated along the river. These gravel traps are typically less than 2,000 cubic yards. Material has also been removed from gravel bars that lie above the water surface (GeoEngineers 1998).

Modern Flood Management Activities

Floodplain Reconnection

In more recent years, several efforts have been made to reconnect floodplain areas to the river to increase flood storage and restore habitat. Efforts to remove levees on the Big Quilcene River

began in the early 1990s. In 1998 and 1999, the Hood Canal Coordinating Council Lead Entity and Jefferson County Public Works led the Big Quilcene Lower Mainstem Levee Removal Phase 1 project (SRP 2022). Between 2002 and 2006, the Hood Canal Salmon Enhancement Group led the Big Quilcene Lower Mainstem Levee Removal Phase 2 project, removing 1,100 feet of levee along the north bank of the river along with the placement of LWD (SRP 2022).

In 2008, HCSEG led the removal of 3,000 feet of the Schinke Levee on the Big Quilcene River. A section of levee just south of the mouth of the Big Quilcene River was removed as part of efforts to restore 38 acres of estuarine marsh (HCSEG 2022a). Also in 2008, HCSEG led the removal of 2,200 feet of levee on the Little Quilcene River. Levees along the mouth of the river were removed and 800 feet of river channel was reconfigured, restoring 25 acres of estuarine habitat (HCSEG 2022b). The large number of restoration projects on the Big and Little Quilcene Rivers and Quilcene Bay have helped protect vital estuarine habitat. Compared to many major estuaries in Puget Sound, Quilcene Bay has experienced relatively little loss. It is reported that Quilcene Bay historically had approximately 126 hectares of historical vegetated tidal wetlands and currently has around 110 hectares (Arthur 2020), although it should be noted that currently the estuary is prograding, which is negatively impacting salmon species.

Two major ongoing projects are underway in the Big Quilcene River watershed that will have significant impacts on flood management in the basin. These projects are the Lower One Mile Project, focusing the lowest 1-mile stretch of the Big Quilcene River, and the Moon Valley Restoration Project, located downstream of the Highway 101 bridge crossing of the Big Quilcene River.

Lower One Mile

The Lower One Mile Project is being led by HCSEG. This project has multiple goals: reducing flood risk, restoring salmon habitat, and ensuring compatibility with shellfish resources in Quilcene Bay. In 2023, 60% design documents were finalized that depict the plan to replace the Linger Longer Road bridge with a slightly realigned, floodplain-spanning bridge. The levee on the north bank of the river would be removed and a new diversion point and mainstem channel would be excavated north of the river, beginning east of Rodgers Street and extending east through what is currently Linger Longer Road. Levee improvements would be made to the levee on the south bank and several log jams would be installed. Project objectives are to:

- Remove approximately 1,500 linear feet of hard-armored levee embankment on the north side of the river.
- Remove the existing Linger Longer bridge and install a full-floodplain-spanning vehicle and pedestrian bridge over the river, wide and high enough to pass flood waters and LWD.
- Restore natural sediment transport processes and allow the river to meander dynamically over time, creating diverse, high-quality habitat within as much of the historical floodplain as allowable.
- Restore approximately 5 acres (2.6 river miles) of river riparian buffers using native trees and shrubs.
- Restore instream habitat conditions by placing LWD in the lower river and restored estuary.

- Address public safety issues associated with pedestrian and vehicle access, sediment, and flooding.
- Enhance environmental education opportunities, including providing recreational features such as trails with interpretive signage, and obtain support from local Quilcene middle and high school students and teachers.
- Address ESA-listed Hood Canal summer chum salmon habitat limitations.

Moon Valley

The Moon Valley Restoration Project is being led by HCSEG and the Jamestown S’Klallam Tribe and consists of 12 low-lying parcels in Moon Valley, which is located immediately east of the Highway 101 bridge crossing of the Big Quilcene River and extends 1.2 miles downstream. Conceptual 30% design plans prepared by Cardno in 2020 include re-meandering of the Big Quilcene River into the floodplain terrace primarily north of the existing channel. The project will also include floodplain grading and the addition of large wood to the river corridor. The project objectives are to decrease channel slope, encourage aggradation of spawning-sized gravels in previously incised areas of the river, and increase habitat quantity and diversity. HCSEG has completed much of the property acquisition necessary for the project, in part utilizing the Jefferson County Conservation Futures Fund, and the project will be advancing to preliminary design and construction in the coming years.

Open Space Land Acquisition, Protection, and Restoration

Jefferson County has demonstrated that it values access and preservation of open space through a variety of planning and programs. Implementation of open space priorities in the study area has frequently been pursued in conjunction with flood hazard management and habitat restoration initiatives. Jefferson County participates in the Conservation Futures Program (Chapter 84.34 RCW and Chapter 3.08 JCC), which uses a tax levy to fund open space projects, primarily through fee simple acquisition and the purchase of conservation easements. The County has funded projects through Conservation Futures annually since 2003, including contributing funds to acquisitions for the Moon Valley Restoration and Lower Big Quilcene River Riparian Protection projects (Jefferson County 2023). The Conservation Futures Program has largely been used to supplement larger grants from the Salmon Recovery Funding Board for acquisition along the Big Quilcene River. Salmon Recovery Funding Board grants have also been used to acquire developed properties in the floodplain (SRP 2022).

Jefferson County’s open space and recreation priorities are established in its 2015 update to the Parks, Recreation, and Open Space Plan. Open space priorities in the study area are focused on protecting habitat on the Big and Little Quilcene Rivers, as well as tributaries, such as Leland Creek. The Parks, Recreation, and Open Space Plan also emphasizes protecting land in proximity to urban areas and Rural Village Centers, such as Quilcene, to enable access to open space, protect natural resources, and minimize sprawl (Jefferson County 2015).

Jefferson County Floodplain Management Regulations

On July 19, 1982, FEMA published a Flood Insurance Study (FIS) and accompanying Flood Insurance Rate Maps (FIRMs) for Jefferson County. This allowed the County to become eligible for FEMA's National Flood Insurance Program (NFIP). Participation in the NFIP required that Jefferson County adopt a floodplain regulation ordinance (Chapter 15.15 JCC), which provides regulatory requirements for development in the floodplain. The purpose of this code is to promote public health, safety, and welfare; reduce the annual cost of flood insurance; and minimize public and private loss due to flood conditions. FEMA FIRM panels map much of the study area adjacent to the Big or Little Quilcene Rivers as floodplain. Development within the floodplain, with the exception of select maintenance activities, requires a flood development permit. Some of the key provisions in this ordinance are:

- A development permit is required for all construction or development in the mapped floodplain.
- New construction or substantial improvement of residential construction shall have the lowest floor, including basement, elevated 1 foot or more above the base flood elevation.
- New construction or substantial improvement of non-residential construction shall have the lowest floor, including basement, elevated 1 foot or more above the base flood elevation or shall be flood-proofed to at or above this elevation.
- New construction or substantial improvement of residential structures is generally prohibited within the floodway.

By enforcing the regulations established in Chapter 15.15 JCC, Jefferson County is managing the amount of damage associated with flooding. A new FIS and set of FIRMs for Jefferson County was adopted on June 7, 2019.

Other Flood Hazard Management Activities

Jefferson County has also been active in the following types of flood hazard management activities:

- Mapping floodplains.
- Studying floodplain hydrology, channel migration, and natural resources.
- Developing and implementing floodplain management policies and regulations.
- Developing flood hazard management plans, including the development of this CFHMP.
- Designing and constructing flood hazard mitigation projects.
- Purchasing or contributing to the purchase of properties that support implementation of the Lower One Mile and Moon Valley Projects.

2.11 Vulnerability Assessment

Vulnerability—The extent to which resources or people are susceptible to and unable to cope with the adverse effects of flooding, including increased flooding due to climate change. Vulnerability is a function of *exposure*, *sensitivity*, and *adaptive capacity*.

Exposure—The degree of flooding that occurs or is likely to occur (e.g., extent/depth of inundation from flooding).

Sensitivity—The degree to which a resource is affected by a given amount of exposure.

Adaptive capacity—The degree to which a resource is able to respond to or recover from impacts.

Exposure

The study area has a documented history of flooding from the Big and Little Quilcene Rivers, which presents hazards to people, the built environment, natural resources, and industry in the area. Major flood events have been recorded at intervals of less than 10 years since the 1950s. Flooding has overtopped dams, inundated roads, and affected homes in the floodplain. Four flood events between 1995 and 2016 had streamflow volumes at RM 9.5 that exceeded the 10% chance annual flood event streamflow estimates for the mouth of the river, which could indicate a future pattern of more frequent, more intense flood events.

Climate change will increase the intensity of extreme precipitation events, which will be compounded by more rapid snowmelt from increased temperatures. These factors will result in increased exposure to flood hazards both through an increase in the frequency of flood events and an expansion of the area that will be inundated during flood events. As a result, the 1% annual chance floodplain, delineated by FEMA, has a greater likelihood of being inundated than a 1% chance each year. Flatter areas, such as those in the floodplains of Reach A for both rivers, will see greater expansions of the area inundated. The 0.2% annual chance flood area will be a useful reference when planning for future flood hazard extremes, as the probability of a 1% annual chance flood increases over time.

Sensitivity

The Quilcene CDP's population of 598 people includes populations that may be more sensitive to flood impacts (U.S. Census Bureau 2021). The 28.5% of households that have an occupant with a disability may face greater challenges related to evacuation or have cost burdens that limit their capacity to incorporate resilience measures into their homes. The 28.1% of householders who are 65 years or older may face similar mobility and financial challenges (U.S. Census Bureau 2022). While the percentages of households in poverty or with a householder living alone are not significant, these are also indicators of potential vulnerability that should be considered in proactive and reactive flood hazard management activities.

In the lower reaches of both rivers, as well as concentrated areas upriver like the Hiddendale Drive community, houses are located within the floodplain. Many of these houses are older, pre-dating the County's Flood Damage Prevention regulations. Older homes that have not been renovated to be more resilient may be more significantly impacted by flooding and flood damage including the growth of mold and mildew, but age alone is not a reliable measure of sensitivity. However, the high percentage of mobile homes in the study area provides a strong indication of the sensitivity of the housing stock, as mobile homes have lesser structural integrity and may be more easily swept up by floodwaters.

There are 290 residential parcels, 35 agricultural or resource extraction parcels, and 29 commercial or manufacturing parcels that are at least partially within the 1% annual chance floodplain or CMZ. An additional 353 undeveloped parcels are at least partially within the 1% annual chance floodplain or CMZ. Insufficient data are available to evaluate the exact value of property at-risk of loss to flooding. The total assessed value of developed properties at least partially within the floodplain or the CMZ is \$38,412,467 in land value and \$59,419,173 in building value, for a total of \$97,831,640 (CIO 2022). While these numbers are higher than the value of property that is currently at-risk of loss to flooding, this value does offer insights into the extremes of potential of losses, if current property uses became unviable under future conditions.

All properties in the study area use on-site wastewater treatment, primarily septic systems, which can face issues during flood events, as inundation can disrupt their functionality or disrupt the soil they reside in. Most of the properties in the study area draw water from permit-exempt wells. While Jefferson County's Flood Damage Prevention regulations aim to minimize illicit discharges from wastewater systems and require that wells be placed above the floodplain, most of the properties in Quilcene were developed prior to the adoption of these regulations in 1982. Additionally, the potential future increases in flood volume and extents could affect wells that were historically unaffected by floods. Further investigation of wastewater infrastructure locations in relation to well locations and future flood hazards extents would help to identify potential risks posed to the drinking water supply during flood events.

There are four bridges in the Quilcene area, two crossing the Big Quilcene River (Highway 101 and Linger Longer Road) and two crossing the Little Quilcene River (Center Road and Highway 101). The Federal Highway Administration rates all four of the bridges as being in fair condition, using a rating system of good, fair, and poor (Federal Highway Administration 2022). Jefferson County plans to replace the Center Road bridge due to structural deficiencies. Jefferson County stakeholders also offered anecdotal evidence of significant scouring under the Highway 101 bridge over the Big Quilcene River. The Linger Longer Road bridge appears most affected by flooding, being overtopped every 2 or 3 years in recent history. Overtopping of the Linger Longer Road bridge in the future due to the coastal squeeze effect could make the area inaccessible during emergencies, eliminating a potential evacuation route for approximately 70 people. The bridge inspection data do not indicate a high level of sensitivity for the structural integrity of the bridges, which makes bridge failure less likely. However, if the Highway 101 bridge over the Little Quilcene River were overtopped or damaged either at the same time as the Center Road bridge or while the Center Road bridge was being replaced, this could present significant emergency service access or evacuation challenges. These two bridges over the Little Quilcene

offer a key access route to areas north and east of Quilcene, such as the County seat of Port Townsend, as well as locations of state and federal agencies that provide emergency services.

The Big and Little Quilcene River watersheds rely on Quilcene Fire Rescue, the volunteer fire department for Jefferson County Fire District 2. Calls to the fire department have significantly increased in recent years. As a volunteer fire department, there is potential for emergency scenarios that affect large areas, such as floods, to overwhelm the department. Supporting services from adjacent fire districts or other emergency management departments could be impacted by road blockages due to flooding or other hazards. Similarly, volunteers for the fire department may reside in affected areas or be unable to access Quilcene due to road blockages. Increasing education around flood resilience and at-home safety during flood events could help to mitigate the demand on the fire department during emergencies. The current high demand on the department could be identified as a supporting reason to pursue grants or other funding that could increase the capacity of the department.

Most of Quilcene's civic buildings are in the RVC, outside of the floodplain. Notable community use properties in the RVC include the fire department, Jefferson County offices, Quilcene Community Center, Quilcene Public Schools, and public open space areas. This allows for the provision of shelter and public services during emergency scenarios, helping to minimize vulnerabilities to government flood hazard responses. Barring the Highway 101 bridges or other portions of the road becoming impassable, these community buildings should be accessible via Highway 101 during flood events.

Adaptive Capacity

Jefferson County has adopted regulatory measures that will minimize risk to the community, including those who reside in the vicinity of the Big and Little Quilcene Rivers. The 2018 Jefferson County Comprehensive Plan prioritizes infill development in the RVC for new development, discouraging sprawl. Jefferson County has the capacity to further prioritize or incentivize development in the RVC or other developed areas outside of the floodplain through reduced regulatory standards for development. While Jefferson County lacks the ability to change state laws that establish sewer and drinking water standards, the County can work with developers, property owners, and utility providers to identify community solutions to sewer and water needs.

Environmental regulations in the JCC also aim to prevent the creation of new flood risks through discouraging new development in the floodplain and other critical areas that support natural flood hazard management. However, new development in the area has been negligible in recent years. The greatest risks in the area are to existing properties and their residents, especially those in the floodplains of the lower reaches of both rivers. In these areas, acquiring flood-prone properties and supporting environmental restoration in the floodplain have been important efforts in enabling a more resilient floodplain.

Reflecting the benefits of information collected from outreach, having data on flood hazards is critical to adaptive capacity. This CFHMP provides information on flood hazards that affect people, property, and environment of the Big and Little Quilcene River watersheds. However, the ability to address future conditions under climate change will partly rely on the availability and

utilization of data that provide reliable projections of future conditions and environmental monitoring of the current conditions. While informative climate projection data are publicly available, not all flood hazard information accounts for projected changes under climate change, for example, FEMA flood maps. Flood hazard and climate data specific to a locality can be especially useful. The lack of active gages in the lower reaches of the Big and Little Quilcene Rivers, as well as the inaccuracy of gage 12052210 at Big Quilcene RM 6.7, limit the ability of Jefferson County to anticipate and adapt to high streamflow events. As high streamflow events will increasingly be influenced by rapid snowmelt, it will be critical to have informative streamflow data, in addition to precipitation forecasts.

The ability of households to recover from frequent flooding requires financial resources to pay for recovery activities (such as replacing damaged belongings or repairing a flooded home). As described in Section 2.6, the poverty rate in the Quilcene CDP is high relative to other areas of Washington State, which could point to lower adaptive capacity to recover from flood events. Flood insurance is another important tool for adaptive capacity. Because Jefferson County is in the NFIP, all residents of the County can purchase a flood insurance policy from the federal government.

Vulnerability

The residential areas in Reach A of the Big Quilcene River, Reaches A and B of the Little Quilcene River, and the Hiddendale Drive community on the Big Quilcene River are some of the areas with the most vulnerable people and private property. These areas include high concentrations of residential properties within the 1% annual chance floodplain. Numerous properties in the lower reaches of both rivers serve residential and agricultural functions, which present the potential for economic losses to residents' livelihoods, in addition to losses from property damage. The vulnerability of agriculture in the floodplain will likely increase over time as climate change affects the timing of flood season and the growing season and increases flood the frequency and severity of flood inundation.

The lower reaches have the broadest CMZs, spanning more than 1 mile from north to south, where the rivers' CMZs overlap at their mouths. CMZs present the potential for the rivers and the floodplain to shift closer to properties and could result in increased property losses over time without adaptation to the changing environment. The channel migration zones in the upper reaches of the rivers are less significant, but a small number of the Hiddendale Drive properties are within the channel migration zone, as well.

Infrastructure in the study area is moderately vulnerable. Many roads are outside of the floodplain and channel migration area. The roads in the lower reaches, especially Linger Longer Road and surrounding roads, East Quilcene Road, and Center Road have heightened vulnerabilities due to their presence in, or proximity to, the floodplain and CMZs. The potential for the Linger Longer Road and the Center Road bridge to overtop during major flood events increases the vulnerability of this infrastructure and the people who depend on it for evacuation. The significance of the Linger Longer Road's vulnerability is most notable, as 70 properties rely on this road as the lone access route to areas outside of the floodplain.

Emergency operations during flood events have a low vulnerability for the most part. Many public buildings and spaces are outside of the floodplain, which can support shelter, public services, and staging areas for emergency operations.

CHAPTER 3

Determination of Need

The information collected for Chapter 2, *Existing Conditions*, of this CFHMP was used to evaluate the current conditions in relation to flooding in the Big and Little Quilcene River basins. Through the inventory and analysis of existing conditions, flood hazards that present risks to people and property were identified in the study area. The findings of the existing conditions assessment have informed the determination of need for flood hazard management planning and projects in the CFHMP study area to reduce both the current and future risks posed by flood hazards.

Both the Big and Little Quilcene River basins originate in Olympic National Forest, with the rivers flowing generally east. Both rivers pass under Highway 101 near the Quilcene RVC and terminate within 1 mile of each other in estuaries near the northern tip of Quilcene Bay. The Little Quilcene River basin has more developed land, agriculture, and forestry in its study area than the Big Quilcene River basin, which has most of its land area in Olympic National Forest outside of the study area. Both rivers provide critical habitat for numerous salmonid species and drain areas that are important for forestry and agriculture in the region.

Flood risks in both basins are largely concentrated in the lower reaches as the river basins are largely undeveloped upriver from the study area. Flood risks in the study area are typically influenced by heavy rain from late fall through winter and into spring, with snowmelt from the Olympic Mountain Range contributing to higher streamflows, especially in the spring. Flooding and flood impacts in the basins have been exacerbated by development, past river and floodplain management activities, and climate change. Documentation of historical flooding is inconsistent, as the locations and operations of stream gages have changed over time and other observational records are limited. The lack of consistent and accurate streamflow data for both rivers over the years presents challenges in comparatively understanding and preparing for major flood events.

Historically, flooding has been most impactful in the lower reaches of the Big and Little Quilcene River basins. For both basins, the areas below RM 1.5 are more densely developed than in the upper reaches, with houses along the riverfront and groupings of houses on floodplains and historical wetland areas. Dozens of homes in these areas are flood-prone. Linger Longer Road, which is the sole access route for a neighborhood along the lower half-mile of the Big Quilcene River, floods every few years during major flood events, making sections of the study area impassable and putting local populations at-risk of further flood impacts. In addition to restricting access, flooding in the Linger Longer Road neighborhood causes direct flood damage to a number of homes and properties. There is limited documentation of flood impacts along the lower Little Quilcene River, but concentrations of homes within the 1% annual chance floodplain in Reaches A and B are exposed to flooding. In particular, properties north of East Quilcene Road have been reported to flood from high flows in the Little Quilcene River. East Quilcene Road, in

the lower reaches of the Little Quilcene River, is reported to become impassable during major flooding events.

Many fewer properties are at-risk in upper sections of the basins within the study area. However, in Reach E of the Big Quilcene River, flooding can occasionally disrupt activities at the Quilcene National Fish Hatchery, posing threats to operations and the terminal fishery they support. In Reach F of the Big Quilcene River, numerous houses on Hiddendale Drive are concentrated along the riverfront and have been repeatedly impacted by flooding over the years.

The projected future increases in frequency and intensity of rain events during the fall, winter, and early spring months will result in higher volume flood events, as will earlier snowmelt in the spring. Alternatively, spring runoff may be diminished over time by reduced snow accumulation. Higher volume floods will increase the potential for erosion and transit of debris downriver, which can increase the damage caused by flooding. Larger floods will exacerbate flooding in historically affected areas, as well as increase the extent of inundation, leading to a greater number of people and structures being affected by flooding. Projected sea level rise will contribute to increased impacts from riverine flooding, as heightened sea levels will backwater water surface elevations in the Big and Little Quilcene Rivers during flood events. These effects from sea level rise will result in longer periods of floodwater inundation and deeper flood depths in affected areas, increasing the potential for damage to buildings and infrastructure in the floodplain.

Flooding in the study area has previously caused disruptions to utility services and damaged infrastructure from inundation. The BPA transmission line corridor along with several access roads run through portions of the floodplain and estuary. As flooding becomes more intense in the future, flood risks to infrastructure and the services in the floodplain (including the BPA transmission line) become greater. The transmission line towers could be damaged or access needed for maintenance could be impaired due to flooded roadways.

Future floods will produce higher flood elevations and more extensive inundation due to both sea level rise and changes in hydrology (Mauger et al. 2015). Higher elevations and increased inundation could impact infrastructure that was historically above flood elevations, such as bridges and utility infrastructure as well as on-site septic systems. Infrastructure designed to manage flooding, such as levees on the lower Big Quilcene River or riprap near the fish hatchery and Hiddendale Drive, may not be equipped to mitigate impacts from the higher intensity floods of the future. Erosion worsened by higher intensity floods will increase the potential to expose and destabilize structures, such as building foundations and underground utilities. Exposure to erosion risks will be higher in the lower Big and Little Quilcene River basins where there is a relatively high density of residential properties and high potential for channel migration. The relatively high number of seniors, disabled people, and households in poverty heighten the social vulnerability of exposed populations in the Quilcene area, which affects the ability of the population to recover from these flood hazards for financial, health, or other reasons. The overall impacts and limited ability of current infrastructure to mitigate future flood hazards necessitate further examination of strategies to reduce flood risks.

Jefferson County maintains environmental and land use regulations that mitigate the intensity of development in floodplains, establish requirements for flood-resilient design of structures and utilities, and preserve the ecological functions of critical environmental areas (see Section 2.5). In the last two decades, flood hazard management activities on the Big and Little Quilcene Rivers have focused on ecological restoration, habitat protection, minimizing environmental impacts of flood hazard management, and reducing future risks of flood damage through cost-effective means. This work has included levee removal, channel and floodplain restoration, acquisition of flood-prone properties, and designing more resilient infrastructure for the future, such as a new Linger Longer bridge. While these efforts have reduced development in areas at risk of flooding, improved resilience of at-risk structures, and restored natural flood management capacity to the floodplain, some people and properties continue to face flood risks. A visual assessment of the study area provided an estimated 60 residential structures within the 1% annual chance floodplain and 50 residential structures within the high-risk CMZs for the Big and Little Quilcene Rivers. Based on average household size in Quilcene, an estimated 120 people live on properties within the 1% annual chance flood area, and 100 people live on properties in the CMZs. Projected climate changes will increase the number of people and properties exposed to flood risks.

Figure 12 shows the location of flood hazards in the study area as well as the project areas for ongoing restoration projects.

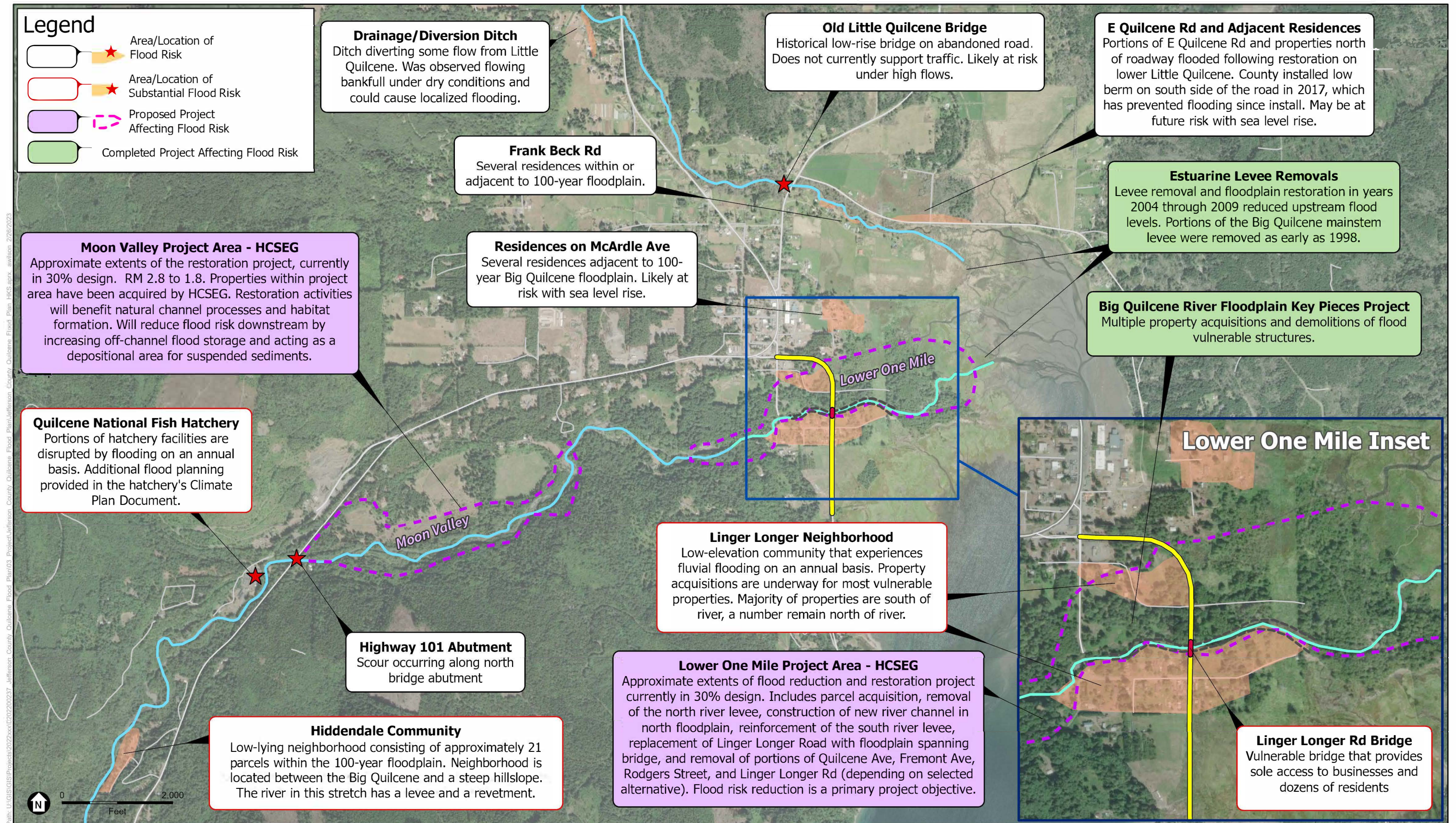


Figure 12
Flood Risk Concerns and
Flood Risk Management Projects

CHAPTER 4

Flood Hazard Management Alternatives and Recommended Actions

4.1 Identification of Alternatives

Through the inventory of existing conditions in the study area, the project team identified numerous flood hazards that pose risks to public health and safety. The flood hazards identified in the Big and Little Quilcene River basins informed the development of a list of flood risk reduction and flood control alternatives. These alternatives also serve to advance the planning and natural resource management initiatives being pursued by Jefferson County, Tribal governments, nonprofits, and other entities working in the study area.

Flood hazard management activities are categorized as either structural or non-structural alternatives, based on definitions outlined in the Department of Ecology’s *Comprehensive Flood Hazard Management Planning: A Guidebook*:

- **Structural alternatives:** Actions that physically modify river processes to reduce flood risk.
- **Non-structural alternatives:** Actions that prevent the creation of new flood risks, remove people and property from harm’s way, or promote land uses that are compatible with flooding in flood hazard areas.

The Ecology *Guidebook* states that “*comprehensive flood hazard management requires a focus on non-structural alternatives and ecological restoration.*” As noted in Chapter 1, the goals of this CFHMP also emphasize non-structural alternatives and ecological restoration.

4.2 Evaluation of Alternatives

Alternatives were evaluated based on a list of criteria that were selected to determine the appropriateness of alternatives for recommended future action and prioritize them. Evaluation criteria were developed for this CFHMP by the project team, with input from Jefferson County staff and the Advisory Team. The final list of evaluation criteria aligns with the goals and objectives of the flood plan and the guidelines established for CFHMPs by Ecology. All evaluation criteria are ranked qualitatively with the categories of low, medium, or high.

The following criteria were considered in the evaluation and prioritization of alternatives:

- **Environmental benefits** – This evaluation criterion indicates the positive environmental effects of a particular alternative for both the natural and built environment, including

benefits for habitat, fish resources, wildlife resources, aesthetics, historic resources, navigation, transportation, water quality, hydrology, and recreation.

- **Environmental impacts** – This criterion indicates the severity of any negative environmental impacts from a particular alternative to the natural and built environment, including habitat, fish resources, wildlife resources, aesthetics, historic resources, navigation, transportation, water quality, hydrology, and existing recreation.
- **Consistency with CFHMP goals and objectives** – This criterion indicates the extent to which a particular alternative would support the goals and objectives outlined in Section 1.5 of this CFHMP, including goals and objectives related to climate change, ecosystem restoration, and equity.
- **Permitting complexity** – This evaluation criterion considers the time and resource requirements for meeting regulatory standards, producing materials, and obtaining needed approvals for implementation of a particular alternative.
- **Cost** – This evaluation criterion indicates the estimated relative cost of implementation of a particular alternative relative to other alternatives.
- **Effectiveness** – This evaluation criterion describes the capacity of a particular alternative to reduce flood risks, with consideration to the resources and inputs required to fully implement the alternative.
- **Operation needs (ongoing inspection, maintenance, and repair requirements)** – This evaluation criterion describes the monetary costs and resources needed to operate and maintain functionality of an alternative throughout its operational life.

Each alternative was also assessed based on the timeframe needed for implementation, and was qualitatively determined to be short-, medium-, or long-term in duration. If a potential funding source is applicable, this has been noted.

These evaluation criteria are applied to each of the identified alternatives at the end of Section 4.4. This evaluation details an array of flood hazard management alternatives that were considered for potential implementation in the future to protect people, property, and infrastructure from flooding. Alternatives that have exceptionally substantial benefits, ranking highly among the evaluation criteria, were supported by County staff and the Advisory Team, and/or address a pressing flood risk issue are recommended as high-priority actions in Section 4.6.

Alternatives Considered but Not Recommended

Most of the alternatives considered in this CFHMP were determined to be worth including based on the evaluation criteria listed above. However, other structural alternatives were considered in the process but were not carried forward. A structural approach to reducing flood risk in the Hiddendale Drive community (such as a levee or flood wall) was considered, but would likely have significant adverse impacts on the environment, would be difficult (if not impossible) to permit due to the location of the Hiddendale Drive community in the floodway; would be very costly; would not be successful in meeting a benefit-cost analysis to receive funding; and would have limited effectiveness, again due to the location of the community in the floodway. Structural alternatives to flood control (new levees or enhanced levees) in other problem areas (see

Figure 12) were briefly considered but also not carried forward for similar reasons (e.g., environmental impact and difficulty to permit and fund). Overall, these structural alternatives are not consistent with the CFHMP goals and objectives described in Section 1.5. As this CFHMP focuses on non-structural alternatives and ecological restoration, all proposed actions that would involve instream work are primarily focused on restoration of natural processes (while also providing flood hazard reduction benefits).

4.3 Ongoing Programs

Jefferson County has been a leader and supporting partner for numerous ongoing programs that could reduce flood risks, in addition to providing multiple benefits to the ecology of the Big and Little Quilcene River basins.

- Jefferson County is performing a Sea Level Rise (SLR) Study, which will assess risks to people, property, and the natural environment from sea level rise, as well as provide recommendations for future planning and climate adaptation. This study, along with a planning report, will be completed by June 2023. The results of this study will guide future floodplain and natural resource management.
- Ecological restoration efforts on the lower Big Quilcene River have been ongoing for years, with the Lower One Mile project design recently being undertaken as a collaboration between the HCSEG, Jefferson County, and their partners. Final designs for the channel and floodplain restoration have not been established yet, but the intended project outcomes will improve and expand salmon habitat, restore ecological functions, and protect properties in the Linger Longer Road neighborhood from flooding, particularly those along Muncie Avenue and Leadville Avenue. The implementation of this project will have substantial flood resilience benefits and is part of the recommended priority actions.
- The Moon Valley Restoration Project, also on the lower Big Quilcene River, is an acquisition, ecological restoration, and flood resilience project being led by the HCSEG. The implementation of this project will have numerous benefits, including increasing floodwater storage capacity, and, as such, is included in the recommended priority actions described in this chapter.

4.4 Description of Alternatives Recommended for Action

The following describes 25 flood hazard management and risk reduction alternatives. Each alternative was evaluated by the project team and supported for inclusion in this CFHMP by Jefferson County staff and the Advisory Team. Evaluation criteria for each alternative are summarized in **Table 10** (presented in Section 4.5).

1. Develop a community-based emergency flood response plan for the Hiddendale Drive community

Location: Hiddendale Drive community.

Description: Many of the homes on Hiddendale Drive are within the regulatory floodway, which indicates a very high level of flood risk. Development of a community-based emergency flood

response plan for the Hiddendale Drive community would bring the community together to better understand and plan for flood risks. The plan could address emergency warning, evacuation, and recovery following a flood. Developing a flood response plan could be an initial step toward long-term planning for flood risk reduction solutions in this community, which will likely see an increase in recurring flood impacts as climate change worsens. Future flood hazard management solutions in the Hiddendale Drive community (such as property acquisition) would be necessary to reduce risks to property and public safety, but a preferred solution should be reached through engagement and consensus-building with the community.

Flood Risks Addressed/Effectiveness: Completing this action would increase the ability of the Hiddendale Drive community to respond to a flood event, thereby lowering their sensitivity to flooding. The process of developing the plan would also increase awareness of flood risk. However, this action would not reduce the community's exposure to flooding.

Environmental Considerations: This action would not have any negative impacts on the natural or built environment.

Implementation Considerations: This action would not require permitting, design, construction, or maintenance. The planning process would need to be funded and would require buy-in from members of the community. Future initiatives that may arise out of this planning process, such as property acquisitions, would require more substantial funding.

2. Develop a flood warning system for the Linger Longer Road neighborhood

Location: Linger Longer Road neighborhood

Description: The Linger Longer Road neighborhood represents the highest concentration of residences within the floodplain, which is especially vulnerable because it has only one access road. Jefferson County should determine the flood stage at which Linger Longer Road overtops or becomes unsafe to navigate, in order to guide projections for when the flood warning system should be triggered. A flood warning system could be established using Jefferson County's existing alert system, which could be set up to allow subscribers to opt into flood alerts for particular basins or areas. If Jefferson County does not adopt its own flood alert system, providing the public with information on the National Weather Service's flood warning system could be used to initiate a dialogue around specific actions for developing a flood warning system.

The Lower One Mile Project will reduce flood risks to property and public safety in the Linger Longer Road neighborhood, especially south of the Big Quilcene River. The floodplain reconnections, enhancement of the south levee, and improvements to the Linger Longer Road bridge will also reduce flood exposure for some people and structures. While the risk of flooding in residential areas will be reduced, a flood warning system would be beneficial, as residual flood risk will remain and flood conditions will appear different after completion of the project.

Flood Risks Addressed/Effectiveness: Completing this action would increase the ability of the Linger Longer Road neighborhood to prepare for and withstand flood events, thereby reducing

potential risks to health and safety. Alerting residents to upcoming or current flood conditions should limit exposure to flood impacts.

Environmental Considerations: This action would not have any negative impacts on the natural or built environment.

Implementation Considerations: This action would not require permitting, design, construction, or maintenance. This action could require additional funding to implement and would require outreach to the neighborhood.

3. Provide training and education for County staff about flood hazard management

Location: Study area or Countywide.

Description: Resource constraints are a significant limitation on emergency services in the study area, especially as emergency management service calls have increased in recent years. Identifying funding opportunities to provide additional training will be critical to implementing this action and supporting emergency response to flooding into the future.

Flood Risks Addressed/Effectiveness: Training for current and future flood risks will aid continued success in emergency response, flood hazard planning, and resilience efforts. This action will reduce the risks to people and property in preparation for, during, and after flood events.

Environmental Considerations: This action would not have any negative impacts on the natural or built environment.

Implementation Considerations: Most training and educational opportunities will require funding, although this is a relatively low-cost action. Training and education may be best focused on topics and skills that could be applied with Jefferson County's current staff and time resources.

4. Explore opportunities for Little Quilcene River wetland and side channel restoration

Location: Lower Little Quilcene River basin, Leland Creek, unnamed tributaries.

Description: Ecological restoration of wetlands and side channels would increase hydrologic connectivity and provide opportunities for increasing floodwater storage and slowing floodwaters. There are numerous tributaries and adjacent wetlands along Reaches A, B, and C (river reaches are described in Section 2.7) of the Little Quilcene River, which would be strong candidates for ecological restoration and process-based solutions for flood hazard management. Low-tech, process-based restoration techniques, such as the installation of beaver dam analogs (BDAs), brush mattresses, or stabilizing bank plantings may be completed without heavy equipment or extensive grading. Tributaries include Leland Creek, which joins the Little Quilcene River directly below the Highway 101 bridge, and multiple unnamed tributaries upstream of the bridge. Sections of Reach A where the channel has been modified may benefit from restoration,

especially as sea level rise worsens; however, there are opportunities to reestablish historic channels and associated habitat benefits, which may reduce flood risks to East Quilcene Road.

In 2023, WSDOT will remove barriers to fish passage in the study area on Leland Creek and two unnamed tributaries north of the Highway 101 bridge. These projects will provide access to a total of 18 miles of upstream salmonid habitat. While larger culverts will improve flow capacity and fish passage, these projects do not have the same flood resilience benefits that wetland and side channel restoration would have. As such, areas along Leland Creek remain an option for this alternative, in addition to the Little Quilcene River and other tributaries.

Flood Risks Addressed/Effectiveness: Floodplains and tributaries along the Little Quilcene River have been restricted by development and the presence of Highway 101, which can limit floodwater storage and other ecological functions. Restoring wetlands and historic channels would enhance natural functions of the floodplain, increasing floodwater storage capacity and potentially slowing streamflow and runoff.

Environmental Considerations: This action would be beneficial to the natural environment. It could have impacts on land use, such as property acquisition and demolition of existing structures.

Implementation Considerations: This action would likely require permitting, construction or land-disturbing activity, and funding, although small-scale restoration efforts (such as native plant installation) may be simpler to implement.

5. Full habitat restoration in Frank Beck Road and Hiddendale Drive areas

Location: Little Quilcene River floodplain near Frank Beck Road and Big Quilcene River floodplain near Hiddendale Drive.

Description: Previous restoration work has been completed near the mouth of the Little Quilcene River. Restoration at Frank Beck Road would extend these efforts upstream to return the river channel to its historical locations. The Little Quilcene River is currently confined by East Quilcene Road to the north and Frank Beck Road to the south. Property acquisition along Frank Beck Road could be combined with the creation of side channels and large wood installation to reestablish a natural floodplain, increase habitat complexity, and increase flood storage.

Development along Hiddendale Drive has led to the construction of various forms of bank protection along the Big Quilcene River, including riprap barbs. Removing these forms of artificial bank stabilization and conducting selective grading in the floodplain to create side channels would widen the floodplain and increase flood storage within the reach. This restoration would need to be pursued in combination with property acquisitions, as the floodplain mostly extends onto the developed east side of the Big Quilcene River, although exploration of more limited restoration efforts without property acquisition may be appropriate. Projects in the Hiddendale Drive area should be informed by long-term flood planning dialogue with this community (see Action 5).

Flood Risks Addressed/Effectiveness: Along both Frank Beck Road and Hiddendale Drive, homes are concentrated within or close to the 1% annual chance floodplain, which puts people and property at risk and reflects past development in critical floodplain habitats. Large-scale habitat restoration could entail property acquisitions and substantial increases in habitat and floodwater storage capacity, in addition to reducing the number of people and properties in the floodplain. Small-scale habitat restorations could increase habitat and focus on resilience for existing development. Small-scale habitat restoration may be insufficient to provide significant flood resilience benefits to developed parcels in the floodplain, but it has the benefit of habitat improvement.

Environmental Considerations: This action would be beneficial for the natural environment. It could have impacts on land use, such as property acquisition and demolition of existing structures. By allowing space for natural floodplain processes to reestablish, upstream flood risk may be lessened as hydraulic constrictions are reduced or removed.

Implementation Considerations: This action would require willing landowners to implement. Engaging with Hiddendale Drive residents during the process of developing a flood response plan under Action 1 would provide opportunities to discuss long-term flood vulnerability and resilience in the Hiddendale Drive community.

6. Provide funding to low-income households for making resiliency improvements to their homes or support their relocation outside of the floodplain

Location: Study area or Countywide.

Description: Providing low-income residents with funding or resources would aid in increasing the resilience of homes that are affected by flooding occupied by residents with heightened vulnerabilities to flooding. Flood-resilient improvements could include elevating houses, elevating utility equipment, or adding flood-resilient building materials. Establishing flood risk thresholds that prioritize houses in the floodplain that are at a low risk of recurring flood impacts would reduce the number of people and properties at risk of flood impacts. Pursuing funding opportunities (such as FEMA Hazard Mitigation grants) or increasing permitting fees for certain land use activities that increase flood risks could help fund this program. A methodology should be used to prioritize structures that are at low risk and would not require significant improvements to reduce flood risk. Structures at higher risk should be acquired and removed (if landowners are willing), not improved (see Action 18). Because housing outside of the floodplain tends to be more expensive, programmatic options to support the relocation of low-income households to safer locations should be identified or developed. If a choice exists between on-site resilience or relocation, relocation should be the preferred option.

Flood Risks Addressed/Effectiveness: Low-income residents often have a heightened sensitivity to flooding and other hazards, which can result from financial or other barriers to adapting to flooding, recovering from flooding, or relocating outside of the floodplain. This strategy reduces risks to people and property, but it does not discourage people from building or living in the floodplain.

Environmental Considerations: This action could involve construction in critical areas, including the floodplain.

Implementation Considerations: The outreach portion of this action would not require permitting, design, construction, or maintenance by Jefferson County. Staff time would be needed to develop the program(s), apply for grant funding, and conduct outreach to low-income residents. If implementation of the program resulted in funds being used for construction of residential improvements, permitting would be required. As with most development within a floodplain, a number of other reviews would be required (such as shoreline, stormwater, and critical areas), and funding would have to cover the costs of preparing permitting documents.

7. Work with regional utility providers to ensure that assets are protected in a way that is compatible with CFHMP objectives

Location: Entire study area.

Description: Establishing a dialogue with BPA about channel migration, flood risks, climate adaptation, and recovery planning could improve coordination on asset protection in the future. Jefferson County could share findings from this CFHMP and the upcoming SLR Study.

Flood Risks Addressed/Effectiveness: Reducing damage to utilities and business disruptions are objectives of this CFHMP. Although flooding has not damaged critical utility infrastructure in the past in the study area, the proximity of the BPA transmission lines and East Quilcene Road substation to the floodplain could present future vulnerabilities to the power grid. Coordinating with utility providers is a key first step toward addressing vulnerabilities in utility infrastructure and starting a dialogue about future resilience needs due to climate change.

Environmental Considerations: This action would not have any negative consequences to the natural environment.

Implementation Considerations: This action would not require permitting, design, construction, or maintenance by Jefferson County. This action would not require funding or substantial staff resources.

8. Conduct a study to evaluate flood risks to properties on Leland Lake and surrounding areas of Leland Creek

Location: Leland Lake and Leland Creek.

Description: Leland Lake is located within the delineated 1% annual chance floodplain, which extends onto more than a dozen residential properties, although the floodplain does not appear to directly affect any residential structures. Beaver dams and the widespread infestation of invasive reed canarygrass in Leland Creek, which drains the lake and drains into the Little Quilcene River, can exacerbate flood conditions, but recent data are limited on flooding on Leland Lake and Leland Creek. Further analysis of the localized impacts near Leland Lake and Leland Creek, with more targeted outreach to residents in these areas, could provide additional insight into flood risks in the area. Actions to address flood issues in the area would be determined based on results of

the analysis, but could include restoration, instream invasive species management in Leland Creek, and actions to address impacts from beavers (such as installation of beaver deceivers and beaver relocation).

Flood Risks Addressed/Effectiveness: This study could provide recommendations for mitigating localized flood issues and potential opportunities for improving floodplain management around water resources that drain into the Little Quilcene River.

Environmental Considerations: This action on its own would not have any negative consequences to the natural environment.

Implementation Considerations: This action would require additional funding and the commitment of time from existing County staff. Responsive engagement from Leland Lake residents would be critical to effectively completing a study of flood risks in the area. This action would not require permitting, design, construction, or maintenance, although they could be required for future actions identified through the study.

9. Proactive landowner outreach and communication about flood risks and strategies

Location: Entire study area.

Description: Increasing awareness of flood risks can help to mitigate vulnerabilities and guide property owners toward adopting flood resilience measures. Balancing the interests and welfare of property owners with allowing natural flood processes to occur can be difficult, which makes establishing a dialogue with stakeholders a critical component of having productive discussions about flood safety and floodplain management. Outreach could include providing information to new homeowners, sending mailers to residents prior to flood season, digital education campaigns, tabling at public events, and/or direct invitations to participate in engagement activities.

Flood Risks Addressed/Effectiveness: Increasing awareness of flood risks can help to mitigate vulnerabilities, guide property owners toward adopting flood resilience measures, and encourage residents to engage with Jefferson County flood planning.

Environmental Considerations: This action would not have any negative impacts on the environment.

Implementation Considerations: Increasing outreach beyond existing efforts would require additional funding and County staff time. This action does not require any permitting and operating costs, and would be limited to updating or developing new communications materials.

10. Conduct survey of drainage ditches and tributaries to understand flow pathways and connections

Location: Entire study area, with attention to particular issues noted in the Little Quilcene River basin.

Description: Hiring a consultant or utilizing Jefferson County staff to conduct field investigations and property record research would provide insights into the conditions of drainage infrastructure in the study area. This survey could be used to identify maintenance needs, drainage inputs, illicit connections to drainage systems and streams, and opportunities for ecological restoration. A two-dimensional (2D) hydraulic model could be developed to evaluate flood patterns and flood damage reduction strategies. The survey should also identify culverts that may be undersized, particularly for expected increased flows with climate change. If issues are identified with drainage ditches or infrastructure (such as culverts), actions to address those issues could be undertaken by Jefferson County. Identification of actions to address drainage issues could be part of adaptive management of the plan (see Section 6.4).

Flood Risks Addressed/Effectiveness: Research into the conditions of hydrological systems that drain into the Big and Little Quilcene Rivers, including the extent of invasive species that affect hydrology, can be used to inform floodplain management. This action would be a first step toward policy, enforcement, or floodplain restoration actions that could improve the functions of critical areas and drainage infrastructure during flood events.

Environmental Considerations: This action would not have any negative impacts on the environment.

Implementation Considerations: The survey process would likely require funding to hire a consultant or involve significant County staff time and resources. This action requires landowner permission to access private property, and obtaining access to a number of parcels would be essential for getting reliable survey results. This action would not require permitting, design, construction, or maintenance.

11. Improve monitoring and documentation of flood events and impacts

Location: Entire study area.

Description: A lack of reliable and consistent data from stream gages produces challenges for flood planning in the Big and Little Quilcene River basins. Streamflow data are useful for evaluating patterns in flooding, setting benchmarks, and hydrological modeling, which are used for FEMA flood mapping and insurance studies. Installing stream gages that can accurately measure high streamflow events below major tributary confluences on the Big and Little Quilcene Rivers would help to maintain data that reflect the volumes of water flowing through the most populous portions of the basins. Stream gages that upload data online in real time could be used to supplement a flood warning system and indicate when a river has entered a flood stage. Adding these new gages to the Northwest River Forecast Center will provide forecasting capabilities, aiding in flood fight activities and evacuations.

In conjunction with improving streamflow monitoring, creating opportunities for the public to report on flood conditions in the study area would provide supplemental qualitative data on flood risks and increase public engagement with flood issues. Establishing a form on the Jefferson

County website or email address for people to submit flood observations would be a low-cost strategy for data collection.

Flood Risks Addressed/Effectiveness: Accurate and current streamflow data would help Jefferson County plan for future flooding and improve its ability to warn residents about flooding. The overall effect of this action is improving adaptation to flooding and resilience in the long term.

Environmental Considerations: This action would not have any negative impacts on the environment.

Implementation Considerations: Adding stream gages would require funding for the cost of the equipment and maintenance costs. Funding support may be available from federal or state entities. This action would not require detailed designs or significant construction, but may require permitting if new gages are installed.

12. Evaluate and raise awareness of risks that septic systems pose to public health and safety during flood events

Location: Entire study area.

Description: Septic systems may fail or discharge untreated waste when a septic field is inundated by flooding, presenting public health and safety risks, in addition to potential environmental impacts. Jefferson County's online inspections data indicate that most of the septic systems in the study area are past due for inspections. Determining the accuracy of these data and need for septic inspections will be critical for evaluating the risk posed by septic systems in the floodplain and study area. Outreach to property owners with septic systems in violation can be used both to schedule inspections and educate property owners on flood risks and proper septic system maintenance.

Flood Risks Addressed/Effectiveness: Addressing septic system risks could improve flood resilience among property owners and reduce public health risks from septic system failures. The overall effect of raising awareness of risks to septic systems and maintenance needs would be reduced septic system failures and backups during flood events.

Environmental Considerations: This action would not have any negative impacts on the environment.

Implementation Considerations: This action would require County staff resources and could involve minor costs related to outreach. This action would not require permitting, design, or significant construction.

13. Adopt higher regulatory standards for development, resource management, and other land use activities to align with the objectives of the CFHMP

Location: Entire study area.

Description: Updating regulatory standards that affect the floodplain can reduce the creation of new flood risks. Evaluating outcomes of land use permitting within floodplains in recent history, with a focus on whether land use activity aligns with the goals of this CFHMP, would help to determine the need for adopting higher regulatory standards.

Examples of higher standards that could be implemented include:

- Increasing fee structures for permitting in SFHAs to cover review costs for additional application review time.
- Require higher standards for mitigation or resilience in those segments of the shoreline designated as natural or conservancy.
- Increasing required freeboard above the base flood elevation.

Flood Risks Addressed/Effectiveness: Jefferson County maintains high regulatory standards related to reducing development in the floodplain, protecting critical areas, and mitigating impacts from land use activities. While development activity in the study area is low, updating regulations for potential future changes in development activity and accounting for redevelopment of flood-impacted properties will further prevent future flood risks. Adoption of stricter regulations by Jefferson County could also prevent flood risks in other parts of the County.

Environmental Considerations: This action would not have any negative impacts on the environment.

Implementation Considerations: This action would require County staff resources, some minor public engagement, and undergoing code update and adoption processes. This action would not require design or construction, but would trigger review under the State Environmental Policy Act (SEPA) and require local legislative approval (with Ecology approval for any revisions to shoreline regulations).

14. Utilize climate change projections to incorporate future risk considerations into the County Code

Location: Entire study area or Jefferson County as a whole

Description: This action would involve incorporating consideration of future climate change impacts or using reliable climate change projections to define risks and geographic areas in the Jefferson County Code or other regulations. This action could be pursued in coordination with Actions 13 and 16. Climate change projections could be used to establish boundaries for future risk with comparable regulations to existing SFHAs, account for higher volume precipitation in stormwater management standards, or inform decision-making for permittees and project proponents without additional requirements.

Flood Risks Addressed/Effectiveness: This action would address future flood risks, largely for new development, redevelopment, or expansion of existing structures. Accounting for the projected increases in intensity for extreme precipitation and flood events will help to maintain flood resilience in the study area for the long-term.

Environmental Considerations: This action would not have any negative impacts on the environment.

Implementation Considerations: This action would require County staff resources, public engagement, and undergoing code update and adoption processes. Additional funding may be required for climate change modeling or writing the code updates. This action would not require design or construction, but would trigger SEPA and local legislative approval.

15. Update FEMA Flood Insurance Study and Flood Insurance Rate Maps

Location: Entire study area and Countywide.

Description: This action would involve pursuing a new FEMA Flood Insurance Study to inform the development of new Flood Insurance Rate Maps. The most recent 2019 FEMA FIS Study has not updated the flood frequency flows (100-year, 50-year, etc.) since the original 1982 FEMA FIS was published, when regional regression equations were used to calculate the flood frequencies. Accurate flood frequency flows are essential for assessing when a historical flood event has occurred and analyzing how the frequency of flood events may be changing. A new FIS should be conducted using what gage records exist. If additional streamflow gages are installed, the data collected may also be used in the study.

Flood Risks Addressed/Effectiveness: Updating flood maps to more accurately depict flood hazard areas would enable better-informed land use decisions and floodplain management activities.

Environmental Considerations: This action would not have any negative impacts on the environment. It could affect land use if the mapped floodplain area changes; however, while some parcels would come under different regulations, this would reflect a more accurate understanding of flood risk and would reduce future damages on those parcels.

Implementation Considerations: This action would require funding for the Flood Insurance Study, as well as County staff resources to support the study. Minor updates to the Jefferson County Code may be needed to reflect the updated flood maps. This action would not require permitting, design, or construction, but would require local legislative action to incorporate revisions into the Jefferson County Code.

16. Monitor Highway 101 abutment scour and coordinate with WSDOT on bridge maintenance or improvement activities

Location: Highway 101 bridge, Big Quilcene River RM 2.4.

Description: WSDOT's latest Bridge Inspection Report (available online) states the following key findings: "*Bridge is scour critical; bridge foundations determined to be unstable for calculated scour conditions: 1) Scour within limits of footings or piles. 2) Scour below spread-footing base or pile tips.*" Communicating with WSDOT about scour issues would initiate a dialogue around resilience of Highway 101 infrastructure. Periodically observing the scour at the Highway 101

bridge or investigating its condition after flood events will allow for documentation of the progress of scour, which can be communicated to WSDOT to inform them of increased vulnerability of critical infrastructure.

Flood Risks Addressed/Effectiveness: Scour is a significant risk for bridges and can contribute to bridge failure. Debris hitting the bridge in a high volume streamflow could exacerbate the issue. Taking early steps to assess and discuss the issue with the appropriate authorities could drive the adoption of flood resilience measures and avoid disruptive construction or damage to the bridge.

Environmental Considerations: This action would not have any negative impacts on the environment.

Implementation Considerations: This action would not require permitting, design, or construction. County resources applied toward this issue would be minimal, unless substantial follow-up activity is needed. Hiring a consultant may be necessary to obtain a reliable evaluation of scouring.

17. Acquire properties and remove houses in the floodplain

Location: Big and Little Quilcene River floodplains.

Description: Grants and other funds have been used to acquire numerous repetitive loss and at-risk properties in the floodplain over the years, especially in the areas around Linger Longer Road. The practice of acquiring repetitive loss or substantially damaged properties in the floodplain should continue where the benefits of acquisition appropriately outweigh the costs.

Flood Risks Addressed/Effectiveness: Acquiring residential properties from willing property owners in the floodplain is one of the most effective strategies for reducing flood risk without negative environmental and equity impacts. This action also has the benefit of reducing strain on public emergency response resources.

Environmental Considerations: This action would not have any negative impacts on the natural environment. Property acquisition would be a land use impact, but properties would only be acquired from willing sellers.

Implementation Considerations: This action would require funding for acquisition and demolition, removal, or relocation of development on the property. Demolition or relocation of on-site structures would require permits and hiring contractors.

18. Raise elevations of homes at present or future risk of flooding, which are not being considered for acquisition

Location: Big and Little Quilcene River floodplains.

Description: Under this action, Jefferson County would provide support for residential structures at-risk of flooding to be elevated at least 1 foot above base flood elevation. This action should prioritize elevating homes that are not being considered for acquisition. Support for elevating

homes could entail financial support, raising awareness of this flood resilience strategy, or providing permitting assistance. Implementing this action may become more relevant as sea levels rise and peak flows increase.

Flood Risks Addressed/Effectiveness: This action would reduce direct risks to public health and safety for those occupying the floodplain; however, flooding may still impact other components of the property or limit access to the property.

Environmental Considerations: This action would have only minor environmental impacts related to construction and the continued occupation of floodplain areas.

Implementation Considerations: This action could require funding or staff resources from Jefferson County.

19. Install engineered log jams and bioengineered revetments where appropriate

Location: High-risk erosion areas and priority salmon habitat in the Big Quilcene and Little Quilcene Rivers.

Description: Engineered log jams and bioengineered revetments should be installed where they would be most effective in protecting river banks from erosion or channel migration. Engineered log jams may be also installed where the river is lacking LWD. Installation of these structures should be coordinated with Tribes with treaty rights in the area, HCSEG, The Nature Conservancy, and other groups with interests in fish habitat conservation to identify mutually beneficial locations.

Flood Risks Addressed/Effectiveness: Engineered log jams and other forms of LWD can be strategically placed to direct flow away banks, increase bank stability, stabilize the channel, and reduce channel incision. LWD also adds channel roughness and slows streamflow velocities during floods. Together, these actions reduce erosion. However, engineered log jams and bioengineered revetments are not flood control infrastructure and do not generally mitigate the risks of inundation from flooding.

Environmental Considerations: This action would not have negative long-term impacts on the environment, but would have construction-related impacts that would need to be mitigated. Best management practices (BMPs) would need to be implemented to mitigate disturbances to critical areas and manage runoff from construction areas.

Implementation Considerations: This action would require permitting, design, construction, and funding.

20. Complete Moon Valley Restoration Project

Location: Big Quilcene River RM 1.2 to 2.4.

Description: This action entails continued coordination with the HCSEG and Jamestown S’Klallam Tribe by Jefferson County and other stakeholders on the final design phase, permitting, and construction of the Moon Valley Restoration Project. This project involves restoring the river channel to a meandering path, regrading channel slopes and floodplain areas, and installing large wood.

Flood Risks Addressed/Effectiveness: The Moon Valley Restoration Project is designed to reduce the excessive erosion and incision seen in this project reach and promote aggradation of sediment. It will also restore and activate large areas of the floodplain, effectively slowing streamflow velocities in areas of the Big Quilcene River upstream of more densely populated floodplain areas.

Environmental Considerations: This action would not have any negative impacts on the environment beyond potential minor construction impacts, which could be mitigated with BMPs. Property acquisition would impact land use, but property acquisitions for this project are already under way.

Implementation Considerations: This action would require permitting, design, construction, and funding.

21. Explore flood resilience improvements to the Quilcene National Fish Hatchery in coordination with the U.S. Fish and Wildlife Service

Location: Quilcene National Fish Hatchery.

Description: Coordinate with the USFWS to implement recommended flood resilience improvements at Quilcene National Fish Hatchery and identify opportunities for improvements with upstream and downstream flood resilience benefits. A vulnerability assessment conducted by USFWS (2016) identified opportunities to re-engineer riprap, replace the electric weir (which is no longer electrified as of 2014), and improve water intake to be more resilient to high-volume floods in the future. Downstream impacts should be considered for re-engineering riprap and replacing the electric weir. An Obermeyer spillway gate, sometimes called inflatable or removable dams, could also be considered for replacing the electric weir. This would allow a portion of the dam to be removed/lowered during flood season, improving sediment transport downstream.

Flood Risks Addressed/Effectiveness: The current riprap arrangement at the hatchery may divert debris toward the center of the channel, creating threats from debris to areas downstream, such as the Highway 101 bridge. The existing electric weir, which is no longer operated to open and close, is likely holding back upstream sediment and potentially contributing to increased upstream aggradation and the associated increase in flood levels. Improving or replacing the weir with an Obermeyer spillway gate would improve sediment transport in the reach.

Environmental Considerations: This action may involve minor negative impacts on the natural environment related to construction activity and the continued use of a barrier on the river, but could be designed to reduce the severity of environmental impacts relative to existing conditions.

Implementation Considerations: This action would require permitting, design, construction, and funding.

22. Complete Lower One Mile Project

Location: Big Quilcene River RM 0 to 1.2.

Description: The Lower One Mile Project is an ongoing project described earlier in this chapter and in more detail in Section 2.10. This project would involve floodplain reconnection via removal of portions of the Big Quilcene River north levee, developing pilot channels, removing portions of multiple roads in the floodplain, riparian buffer restoration, and replacement of the Linger Longer Road bridge with a floodplain-spanning bridge. Continued coordination between Jefferson County and HCSEG will be critical to the success of this project, as it enters later design phases, permitting, and construction.

Flood Risks Addressed/Effectiveness: This project will substantially increase the potential for floodwater storage in the floodplain of the lower Big Quilcene River, protect properties to the south of the river, and improve resilience of critical transportation infrastructure to floods.

Environmental Considerations: This project may result in temporary disruptions to the built environment and surrounding natural environments, but the outcome of the project will have substantial benefits to the natural environment.

Implementation Considerations: This action would require significant permitting, design, construction, and funding. Design for this project is currently at 60%.

23. Evaluate joining the Community Rating System (CRS)

Location: Countywide.

Description: Jefferson County is not currently a member of the Community Rating System (CRS). CRS is a program within the NFIP under which “*communities can be rewarded for doing more than simply regulating construction of new buildings to the minimum national standards*” (FEMA 2017). Flood insurance policy holders within jurisdictions that participate in CRS receive a discount on their flood insurance premiums; the higher the community’s classification within CRS, the higher the discount, up to 45%. Communities receive credit for public information activities, mapping and regulations, flood damage reduction activities, and warning and response.

If Jefferson County joined CRS, it would provide financial benefits to floodplain residents (in the form of reduced premiums) and would encourage the County to maintain and increase BMPs for the floodplain. However, CRS also requires a substantial investment of staff time in documenting and tracking CRS activities and participating in verification visits from FEMA. Therefore, Jefferson County should evaluate the costs and benefits of joining CRS, determine what CRS class the community would be based on current activities, and evaluate what additional activities could be undertaken to receive increased CRS credit.

Flood Risks Addressed/Effectiveness: Participating in CRS could potentially increase the number of residents and landowners in the study area who purchase flood insurance policies by lowering the cost. Participation in CRS would also encourage maintaining County activities that reduce flood risk and adopting new activities that promote best practices for floodplain management.

Environmental Considerations: Participation in CRS would not negatively impact the environment. CRS provides credit for (and therefore encourages) actions that preserve open space and protect natural floodplain functions.

Implementation Considerations: This action would require substantial staff time to document CRS activities and participate in verification visits from FEMA.

24. Coordinate with Public Works on transportation projects

Location: Study area, Center Road.

Description: Jefferson County Public Works' Six-Year Transportation Improvement Program includes a project to replace the Little Quilcene River Bridge on Center Road (MP 14.55 to 14.70). The 64-foot bridge, built in 1955, has structural deficiencies, and Public Works will replace the bridge with a bridge program grant from the Federal Highway Administration. The Jefferson County Department of Community Development should coordinate with Public Works as the project moves forward to ensure that the new bridge is designed to be flood resilient, taking climate change into account, and that it is otherwise aligned with the goals and objectives in this plan. Future transportation projects in the study area should also be reviewed for flood resilience.

Flood Risks Addressed/Effectiveness: Replacement of a bridge over the Little Quilcene River provides an opportunity to increase flood resilience of the bridge.

Environmental Considerations: While bridge replacement can have negative environmental impacts (which will be addressed by Public Works), coordinating to ensure the new bridge design is flood resilient would be beneficial to the environment.

Implementation Considerations: This action would require staff time to coordinate across departments.

25. Support improvements to Port Townsend dam as necessary

Location: Little Quilcene River near RM 7 and Lords Lake Reservoir.

Description: The City of Port Townsend owns and maintains a diversion dam near RM 7 on the Little Quilcene River, which diverts water to Lords Lake Reservoir for water supply. Port Townsend has secured FEMA funds to investigate the stability of the dam. Depending on the results, a dam retrofit project may be recommended. Support of retrofits or improvements to the dam, as recommended, would be consistent with the goals and objectives of this CFHMP.

Flood Risks Addressed/Effectiveness: Dam failure, while unlikely, would cause flooding impacts on downstream areas on the Little Quilcene River, so any recommended retrofits or other improvements to the dam should be implemented to reduce this risk.

Environmental Considerations: Environmental considerations would depend on the specific recommendations of the study of dam stability. Retrofits would likely have some environmental impacts, which could be mitigated with BMPs.

Implementation Considerations: Any retrofits to the dam would be implemented by Port Townsend, not Jefferson County, but supporting retrofits (if needed) would be consistent with the goals and objectives of this CFHMP.

4.5 Alternatives Evaluation Table

TABLE 10
EVALUATION OF ALTERNATIVES

No.	Location	Action	Consistency with Goals and Objectives	Effectiveness	Environmental Benefits	Environmental Impacts	Cost	Permitting Complexity	Operating Needs	Timeframe	Potential Grant Funding Sources
1	Hiddendale Drive community	Develop a community-based emergency flood response plan for the Hiddendale Drive community	Medium	Medium	Low	Low	Low	Low	Low	Short-term	FCAAP
2	Linger Longer Road neighborhood	Develop a flood warning system for the Linger Longer Road neighborhood	Medium	Medium	Low	Low	Low	Low	Medium	Short-term	
3	Whole study area	Provide training and education for County staff about flood hazard management	Medium	Medium	Low	Low	Low	Low	Low	Short-term	
4	Lower Little Quilcene River basin	Explore opportunities for Little Quilcene River wetland and side channel restoration	High	Medium	High	Low	Medium	Medium to High	Low	Medium-term	FbD, SRFB, SR, CPF
5	Frank Beck Road, Hiddendale Drive	Full habitat restoration in Frank Beck Road and Hiddendale Drive areas	High	Medium	High	Low	High	Medium to High	Low	Long-term	FbD, SRFB, SR, CPF, NCRF
6	Whole study area	Provide funding to low-income households for making resiliency improvements to their homes	High	Medium	Low	Low	Low	Medium	Low	Short-term	HMG
7	Whole study area	Work with utility providers to ensure that assets are protected in a way that is compatible with CFHMP objectives	Medium	Medium	Low	Low	Low	Low	Low	Short-term	
8	Leland Lake and Leland Creek areas	Conduct a study to evaluate flood risks to properties on Leland Lake and surrounding areas of Leland Creek	Medium	Medium	Medium	Low	Medium	Low	Low	Medium-term	FCAAP
9	Whole study area	Proactive landowner outreach and communication about flood risks and risk reduction strategies	High	Medium	Low	Low	Low	Low	Low	Short-term	
10	Whole study area	Conduct survey of drainage ditches and tributaries to understand flow pathways and connections	Medium	Medium	Low	Low	Medium	Low	Low	Medium-term	
11	Whole study area	Improve monitoring and documentation of flood events and impacts	Medium	Medium	Low	Low	Medium	Low	Medium	Short-term	SR
12	Whole study area	Evaluate and raise awareness of risks that septic systems pose to public health and safety during flood events	Medium	Medium	Medium	Low	Low	Low	Low	Short-term	
13	Whole study area	Adopt higher regulatory standards for development, resource management, and other land use activities	High	Medium	High	Low	Medium	High	Low	Medium-term	
14	Whole study area	Utilize climate change projections to incorporate future risk considerations into Jefferson County Code	Medium	Medium	Medium	Low	Medium	High	Low	Medium-term	
15	Whole study area	Update FEMA Flood Insurance Study and Flood Insurance Rate Maps	Medium	Medium	Low	Low	Medium	High	Low	Medium-term	
16	Big Quilcene River RM 2.4, Highway 101 bridge	Monitor Highway 101 abutment scour and coordinate with WSDOT on bridge maintenance or improvement activities	Medium	Medium	Low	Low	Low	Low	Medium	Short-term	
17	Big and Little Quilcene River Floodplains	Acquire properties and remove houses in the floodplain	High	High	High	Low	High	Medium	Medium	Long-term	FbD, SRFB, HMG

TABLE 10 (CONTINUED)
EVALUATION OF ALTERNATIVES

No.	Location	Action	Consistency with Goals and Objectives	Effectiveness	Environmental Benefits	Environmental Impacts	Cost	Permitting Complexity	Operating Needs	Timeframe	Potential Grant Funding Sources
18	Big and Little Quilcene River Floodplains	Raise elevations of homes at present or future risk of flooding, which are not being considered for acquisition	High	High	Low	Low	High	Medium	Low	Medium-term	HMG
19	High-risk erosion areas and priority salmon habitat	Install engineered log jams and bioengineered revetments where appropriate	High	Medium	Medium	Low	High	High	Low	Medium-term	FbD, SRFB, SR, CFP
20	Big Quilcene River RM 1.2 to 2.4	Complete Moon Valley Restoration Project	High	High	High	Low	High	High	Medium	Long-term	FbD, SRFB
21	Quilcene National Fish Hatchery	Explore flood resilience improvements to the Quilcene National Fish Hatchery	High	High	Low	Low	High	High	Medium	Medium-term	
22	Big Quilcene River RM 0 to 1.2	Complete Lower One Mile Project	High	High	High	Low	High	High	Medium	Long-term	FbD, SRFB, HMG, NCRF
23	Countywide	Evaluate joining CRS	High	Medium	Medium	Low	Medium	Low	Medium	Medium-term	
24	Study area, Center Road	Coordinate with Public Works on transportation projects	High	Medium	Medium	Low	Low	Low	Low	Short-term	
25	Little Quilcene River at RM 7	Support improvements to Port Townsend dam as necessary	High	High	Low	Medium	TBD	TBD	Low	TBD	HMG, PA

Funding Abbreviations: Floodplains by Design (FbD); Salmon Recovery Funding Board (SRFB); FEMA Hazard Mitigation Grants (HMG); Flood Control Assistance Account Program (FCAAP); Streamflow Restoration grants (SR); FEMA Public Assistance (PA); Coastal Protection Fund (CPF); National Coastal Resilience Fund (NCRF).

4.6 Summary of High-Priority Actions

While all of the actions described in Section 4.4 (and in Table 10 in Section 4.5) are recommended actions, some actions should be considered high-priority because they would achieve the highest benefit and/or would address the most severe or urgent flood risks. While not all of the high-priority actions are short-term actions, it is recommended that all be initiated and advanced in the near term. High-priority actions are:

- #1: Develop a community-based emergency flood response plan for the Hiddendale Drive community.
 - Note: This action is high-priority because of the high risk to the Hiddendale Drive community, which is located within the floodway. However, pursuing this as a high-priority action is contingent on community interest in participating.
- #9: Proactive landowner outreach and communication about flood risks and risk reduction strategies.
- #11: Improve monitoring and documentation of flood events and impacts.
- #17: Acquire properties and remove houses in the floodplain.
- #20: Complete Moon Valley Restoration Project.
- #22: Complete Lower One Mile Project.

CHAPTER 5

Implementation and Funding

This CFHMP identifies priority flood hazard management actions that Jefferson County could implement as funding and other resources become available. Many of these actions would not be feasible within the limited resources and time available to Jefferson County staff. Additional funding and partnerships with outside organizations will be necessary to successfully implement the vision for flood hazard management that has been outlined in this plan.

5.1 Roles and Responsibilities

Jefferson County has jurisdictional authority over the study area, although large portions of the upstream Big and Little Quilcene River basins are within U.S. Forest Service jurisdiction. Jefferson County provides services and manages some public facilities and parks in the study area, while some infrastructure and facilities are operated by state entities (such as Highway 101) and federal entities (such as the Quilcene National Fish Hatchery).

Jefferson County is responsible for the development of local regulations and for permitting development based on these regulations. The County has regulatory oversight of activities that could impact public health and safety, including development and land-disturbing activities. This oversight includes potential off-site impacts from these activities, such as controlling sediments and pollutants transported in stormwater runoff. The County helps to sustain the ecological functions of floodplain areas and the public's safety around floodplains through regulations and plans that include:

- Flood Damage Prevention Ordinance
- Comprehensive Plan
- Shoreline Master Program
- Critical Areas Ordinance
- Unified Development Code

Numerous alternatives that are recommended for priority action depend on Jefferson County's ability to update the County Code. Climate change, state and federal laws, and the capacity for river avulsion to alter existing environmental conditions will necessitate adaptive management, which may entail updates to the Jefferson County Code. Revisions to the code are intended to maintain natural processes and to protect public health and safety.

Coordination with government and non-governmental partners will be critical for implementing recommended actions where Jefferson County lacks capacity or jurisdiction, as well as for projects where interests overlap. Continuing to work with partners, such as the HCSEG, state agencies, and tribes, can help to increase capacity and resources, provide outcomes with multiple benefits, and improve engagement with issues related to flooding. Tribes, conservation nonprofits, and other organizations with related interests will continue to be crucial partners for implementing recommended actions, such as floodplain restoration projects at future property acquisition sites and bioengineering opportunities, in addition to ongoing lower Big Quilcene River restoration projects.

5.2 Potential Funding Sources

Floodplains by Design

Floodplains by Design (FbD) is Washington's major integrated floodplain management grant program, which is administered by Ecology. The program supports a multi-benefit approach to living in flood-resilient communities, while restoring habitat and natural floodplain functions. Floodplains by Design grants can be used for a wide range of flood hazard reduction projects with an ecological restoration component, including studies, design, construction, and land acquisition. FbD is currently funding restoration efforts being developed within the lower 1 mile of the Big Quilcene River (i.e., the Lower One Mile Project).

Funding for the program is administered on the state's biennial legislative cycle. During the program's limited history, pre-applications have been due at the beginning of the year preceding the award year, applicants present their projects to evaluators shortly thereafter, full applications are submitted in the spring, and funding is administered after the biennial budget is adopted.

Salmon Recovery Funding Board

The Salmon Recovery Funding Board (SRFB) provides salmon habitat grants administered by the Washington State Recreation and Conservation Office (RCO). The SRFB prioritizes protecting existing salmonid habitat, expanding fish passage, and restoring natural habitat-forming processes, although the restoration of habitat and ecological functions can have flood risk reduction benefits, as demonstrated by the many SRFB-funded projects on the lower Big Quilcene River.

Jefferson County's continued collaboration with HCSEG to achieve multiple objectives through SRFB-funded projects is recommended to successfully complete the Lower One Mile and Moon Valley projects. SRFB grants typically involve a project application early in the year, followed by site visits in the spring, and revised applications based on input submitted in later summer. There are no limits on the amount of funding that can be requested (except for design-only projects), but the project award cannot exceed the regional allocation, and applicants are normally required to provide a 15% match.

Conservation Futures Program

Conservation Futures is a funding program adopted by Jefferson County, which uses a tax levy to generate funds to support the protection of open space, agriculture, forests, and habitat. Conservation Futures would be particularly applicable to the recommended actions in this CFHMP that focus on property acquisition and habitat restoration. Specifics of the program vary by year, including availability of funds, maximum funding, and match requirements. Funding has historically been available annually, and applications are typically due in the first quarter of the year.

FEMA Hazard Mitigation Grants

Hazard Mitigation Grants (HMGs) are made available to affected areas under a Major Disaster Declaration by the governor or president. For funds to become available, a state agency or federally recognized tribe must submit a grant application to FEMA. Eligible projects include acquisition of flood-prone properties, hazard mitigation planning, code enforcement, retrofitting, reconstruction, drainage improvement, and flood protection facility development.

Jefferson County (or eligible governmental entities working with Jefferson County) would need to submit sub-applicant materials that detail planned hazard mitigation efforts. The Hazard Mitigation Grants have a 25% match requirement, which may be paid by the state or the sub-applicant. Eligible funding amounts are based on percentages of estimated total damage under the Major Disaster Declaration.

Flood Control Assistance Account Program

The Flood Control Assistance Account Program (FCAAP), administered by Ecology, provides grants for floodplain management planning and implementation of projects, including for CFHMPs, feasibility studies, federal project matching funds, flood control maintenance projects, and emergency projects.

FCAAP grant applications are accepted on a biennial basis, with applications typically due the year that Washington's biennial budget is adopted (applications for the 2023-2025 cycle were due in March 2023). Emergency project applications have a different timeline, and funding is available on a non-competitive basis until all funds are awarded. A 25% match is required for planning projects and 20% is required for emergency projects.

Development of this CFHMP was funded with an FCAAP grant awarded in 2021.

National Coastal Resilience Fund

The National Coastal Resilience Fund (NCRF) is a public-private partnership funding source provided through the National Fish and Wildlife Foundation, which provides grants to coastal communities for climate change and other hazard resilience. Funding can be used for a wide variety of costs through planning, assessment, design, permitting, and implementation stages of a project. All projects must address nature-based solutions, community resilience, and fish and wildlife benefits.

Funding has been available annually since 2018. Pre-applications are typically due in early or mid-spring, with full applications due in the summer. There are no maximum funding requests or match requirements.

Streamflow Restoration Competitive Grants

Streamflow restoration grants are administered by Ecology for projects, studies, and monitoring that support enhanced watershed management and ecological functions. Floodplain management is not the primary intent of these grants, but coordination with interested parties on water and aquatic resources projects could help to enhance flood risk reduction outcomes or serve other functions. For example, riparian restoration and streamflow monitoring would both be eligible projects and help to advance actions recommended by this plan.

Application schedules have varied. Applications for the 2022 funding round opened in November 2021 with submissions due in February 2022, and awards were granted in October 2022. Funding is made available based on the biennial state budget, but funding cycles may occur annually, if additional funds are available. Funding is prioritized for watersheds listed under Chapter 90.94 RCW. The Quilcene-Snow Watershed (WRIA 17) is not listed under this code, but projects in this watershed are still eligible for funding.

FEMA Public Assistance Grant Program

Public Assistance Grants are FEMA grants that can be administered to state or Tribal governments after a Major Disaster Declaration, which can be administered to subrecipients, such as county and local governments. As opposed to Hazard Mitigation Grants, which support projects that mitigate future risks, Public Assistance Grants support recovery efforts, such as debris removal, emergency protective measures, and infrastructure or utility repair.

Coastal Protection Fund

The Coastal Protection Fund, administered by Ecology, provides small grants for direct costs for watershed projects that enhance fish and wildlife habitat. Eligible projects include riparian restoration, wetland restoration, and stream bank stabilization.

Funding availability and application timelines vary, as funds are not appropriated through a state budget but are generated from fines. The maximum grant amount is \$50,000 with no required match.

Funding Support for Residents

Notifying homeowners in the floodplain of funding available directly to them could also be helpful in implementing recommended actions and increasing awareness of flood hazards. For example, Jefferson County Public Health has historically received funding from Washington's Clean Water State Revolving Fund, which has been used to share costs for septic system repairs. While Jefferson County is responsible for outreach to raise awareness of flood hazards, providing opportunities for property owners to make flood-resilient improvements enables site-scale

implementation of actions, as well as aiding low-income and environmental justice communities. FEMA Hazard Mitigation Grants may also be used to fund flood-resilient home improvements.

General Obligation Bonds

Jefferson County may issue general obligation bonds to fund long-term capital projects that are not expected to generate new revenue, such as property acquisition or infrastructure improvements. Limited tax general obligation bonds may be issued through a vote of the legislative authority, which only allows debt service to be paid from the general fund without new tax levies. An unlimited tax general obligation bond requires 60% of the district voters to approve a property tax levy to make debt service payments.

Washington State Legislature Appropriations

The study area is within the Washington Legislature's State District 24. Outreach to legislators can occur at any time, but dialogue about funding requests with legislators should be performed early in the budgeting season, if not prior to the budgeting season. Washington State House Democrats maintain a Member Requested Local Community Project Information form for requesting legislative funding or further communications to discuss legislative funding for community projects. Submission of this form was required by mid-February in 2023 for the 2023-2025 biennial budgeting session. Washington State House Republicans do not have an established process for project funding request intake, but may similarly be reached by Jefferson County staff or other stakeholders to advocate for projects.

CHAPTER 6

Plan Review, Revision, Adoption, and Maintenance

6.1 Plan Adoption

The final version of this CFHMP will be submitted to the Washington State Department of Ecology for review. Ecology will review the plan to determine whether the CFHMP sufficiently addresses comments, abides by state statutes, and meets the requirements of the FCAAP grant agreement. The CFHMP will then be presented to the Jefferson County Board of County Commissioners for adoption.

6.2 Plan Evaluation and Updates

Jefferson County staff will serve in the lead role for maintaining, evaluating, and updating this CFHMP. Jefferson County will direct available staff time and funding toward plan implementation and will seek additional funding for flood risk reduction actions described in Chapter 4. Other partners in the study area (such as those represented on the Advisory Team; see Section 1.3) will also implement actions described in the plan. Implementation actions include monitoring baseline conditions in the study area and conditions after implementation of recommended actions as well as communicating findings with staff, elected leadership, and stakeholders.

Recommended actions of this CFHMP should be considered in conjunction with existing Jefferson County programs and policies, in order to identify synergies and opportunities for implementation. Opportunities to incorporate recommendations from this plan into other planning initiatives may arise during updates to the County's Comprehensive Plan, Hazard Mitigation Plan, Critical Areas Ordinance, and Shoreline Master Program. Incorporating elements of this CFHMP into other planning initiatives will establish a consistent narrative of commitment to these efforts, which can be utilized to support grant applications or other requests for support in floodplain management. Engagement and collaboration with state, federal, Tribal, and nonprofit entities will also play an important role in implementing and reinforcing floodplain management best practices in the study area.

Updates to this CFHMP should be informed by the implementation of actions, monitoring of results, and decision-making based on an evaluation of these findings. This CFHMP incorporated thorough evaluations of existing conditions and use of the best available science to project future conditions within the scope. This information provides a strong basis for the recommended actions in this plan, which are expected to be accepted and effective means of flood risk reduction through the life of the plan. Reviews and updates to CFHMPs typically occur on a 5-year cycle,

but the actual need for updates varies based on watershed conditions, implementation schedules, and available resources. Updates to the plan that may be necessary could include supplemental studies or addenda based on unpredictable changes or new information.

6.3 Continued Public Involvement

Jefferson County will continue its work to engage the public in flood hazard management planning, including the incorporation of integrated floodplain management into other planning initiatives. Multiple recommended actions in this CFHMP would require public engagement to be advanced, in addition to the actions that primarily consist of engagement, outreach, and education. The public will be notified of the implementation of any major flood hazard management actions, as well as informed of opportunities to participate. Jefferson County social media and the County website may be used to provide informal updates on flood hazard management activity and educational materials about flood hazards to raise awareness and increase engagement with flood hazard management issues. Jefferson County staff will work to establish a dialogue and connections in the community, especially for neighborhood-based planning initiatives, to build consensus on the specifics for implementation of recommended flood hazard management actions or the development of new flood hazard management initiatives.

Advisory Team members and relevant Jefferson County staff will collaborate, where appropriate, to implement and monitor results of the CFHMP. Continuing coordination amongst Advisory Team members and with non-Advisory Team stakeholders will ensure an approach to flood hazard management that spans jurisdictional boundaries and is considerate of diverse interests in the community.

6.4 Adaptive Management

Adaptive management is an iterative approach to decision-making with emphasis on the uncertainty of the outcomes of management actions and the value of reducing that uncertainty to improve management. Through this approach, decision-making around management actions is structured to improve results over time, in order to effectively meet goals and objectives. This is achieved through learning from past and ongoing efforts by allowing involved parties to move forward with actions and respond to changed conditions accordingly. An adaptive management approach to using this CFHMP will enable adjustments to implementation that account for changes in flood conditions, challenges with past actions, and new information.

It is recommended that partners in the Quilcene watersheds (ideally including the members of the Advisory Team for this CFHMP; see Section 1.3) should meet once a year to discuss the advancement of projects, challenges that have prevented advancement, and results of in-progress or completed actions. It is further recommended that a more extensive collaboration among involved parties occur every 2 years. The more extensive biennial meeting may be best scheduled during even-numbered years to support collaborative organizing around funding requests for grants that will be appropriated in Washington's biennial budget of the following year. These meetings should focus on discussions among partners to identify new and adjust current funding

sources, identify new actions according to changes in conditions or outcomes of completed work, and adjust strategies where appropriate.

Adaptive management for this CFHMP is recommended for all actions, but the approach should especially be adhered to for the high-priority actions listed in Section 4.6, as they should be implemented or advanced in the near term and their completion may lead to additional follow-up actions. These actions should be continuously discussed with the purpose of advancing their implementation and identifying barriers to that advancement. Adaptive management is also highly recommended for those actions that involve studies and surveys, such as #8 (conduct a study to evaluate flood risks to properties on Leland Lake and surrounding areas of Leland Creek), #10 (conduct survey of drainage ditches and tributaries to understand flow pathways and connections), and #25 (support improvements to Port Townsend dam as necessary).

CHAPTER 7

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Appendix A.

Advisory Team Meetings

This appendix includes the following documents:

- Advisory Team Meeting Minutes – October 6, 2022
- Advisory Team Meeting Minutes – November 9, 2022
- Advisory Team Meeting Minutes – January 5, 2023
- Advisory Team Meeting Minutes – March 2, 2023
- Advisory Team Meeting Minutes – April 20, 2023

ADVISORY TEAM MEETING MINUTES
FLOOD PLAN FOR BIG QUILCENE AND LITTLE QUILCENE RIVERS
OCTOBER 6, 2022

Attendees:

Brent Butler, Jefferson County Department of Community Development
Donna Frostholt, Jefferson County Department of Community Development
Spencer Easton, ESA (Consultant)
Dan Beckley, ESA (Consultant)
Tami Pokorny, Jefferson County Environmental Health
Denise Hawkins, U.S. Fish and Wildlife Service
Nam Siu, Washington Department of Fish and Wildlife
Don Svetich, Quilcene Fire Rescue
Susan Beall, Olympic National Forest
Robin Shoal, Olympic National Forest
Gus Johnson, Hood Canal Salmon Enhancement Group
Glenn Gately, Jefferson County Conservation District
Randy Johnson, Jamestown S’Klallam Tribe
Lisa Belleveau, Skokomish Tribe
No members of the public were present for meeting.

Minutes (Virtual Meeting, Recorded):

Introduction

Attendees introduced themselves using Zoom chat. It was noted that Matt Gerlach, the Washington State Department of Ecology Project Manager for this Flood Control Assistance Account Program (FCAAP) grant, was unable to attend the meeting but is also part of the advisory team. The meeting was led by Spencer Easton.

Outline scope and timeline

Donna Frostholt stated that Jefferson County Department of Community Development (DCD) was interested in the FCAAP grant as a way to fund preparation of a Comprehensive Flood Hazard

Management Plan (CFHMP) for the Big- and Little Quilcene Rivers. The CFHMP is part of a comprehensive land use assessment that DCD needs for making land use decisions.

Using a Power Point presentation, Spencer showed a figure depicting the CFHMP project area, a figure outlining the process of preparing a CFHMP, and a figure showing the schedule for finalizing the plan by the end of June 2023. He summarized the work done to date on the CFHMP for the Big- and Little Quilcene Rivers, and provided an update on new guidance (2021) for items to be included in a CFHMP.

Goals and Objectives

Draft CFHMP goals and objectives were sent out to the advisory team prior to the meeting. Spencer reviewed the four drafted goals and all were accepted by the advisory team as is. Advisory team input included:

- Relevance of the CFHMP to Federal Emergency Management Agency Flood Insurance Rate Maps and Flood Insurance Study, both of which were updated in June 2019.
- Clarification on the role of the advisory team in developing strategies for the plan. The advisory team is providing input but is not recommending or endorsing the strategies included in the plan.
- Clarification that advisory team input will be used to identify potential strategies and actions that could be grant funded in the future.
- Discussion of whether engineered log jams are structural or non-structural. This is a 'gray area' that depends on how the log jams are designed and if that design alters how water moves. Discussion included using arrays of engineered log jams or placement of large woody debris to alter stream flows for fish enhancement.
- Rock barbs were installed about 20 years ago in the Big Quilcene River to deflect water and protect residential community.

Spencer also reviewed the 17 objectives and the advisory team discussed the following:

- What the strategies and actions incorporated into the CFHMP mean to those who reside in the project area. The process includes public meetings so local residents can ask questions of and give comments to the county. The intent of the plan is to develop strategies and actions that reduce flood risk. If the plan includes a policy recommendation, the county could discuss the ramifications of this with Quilcene residents.
- The importance of reducing buildings in the floodplain to minimize impacts to water quality and fish.
- Water quality should be specifically called out as an objective.
- Ways to reduce building in the floodplain include public education and purchasing land.

It was decided that objective #6 needed to be built up (to reduce building in the floodplain, relative to current FEMA standards) and that a new water quality objective should be added (or incorporate water quality into #14). Working at the watershed boundaries could be incorporated into #17.

Flood Problems

ESA is currently working on the existing conditions and would like to hear about flood problems within these two river basins. Spencer also noted that ESA and the county will be making a site visit soon and asked if there were any areas that should be looked at. The advisory team discussed:

- For homes in the Hiddendale community, the rock barbs direct floodwaters away from the shoreline but are insufficient for a large flood.
- Potential loss of salmon productivity during peak flood events in the Big Quilcene River. Fish eggs get washed into the river, which impacts a tribal resource.
- Potential problems of clear cutting higher in the watershed (National Forest confirmed the Forest Service does not log federal land in these two river basins).
- Issues for Linger Longer Road (flooding) and Highway 101 bridge (scouring) on Big Quilcene River.
- Tidal surge along the Little Quilcene River (and some scour).
- Emergency service calls have increased in the last 20 years.
- Emergency vehicles may have difficulty getting through if a major flood event occurs.
- Flooding can affect hatchery operations.
- Penny Creek culvert is undersized.

Denise Hawkins said the hatchery has a climate change vulnerability report and Robin Shoal said the USFS has a climate vulnerability assessment report. Both indicated that these documents could be shared with the team.

Next Steps

DCD noted that we want to improve ways to make Quilcene residents aware of these meetings and Don Svetich suggested some of the best ways to reach out to the community.

The next meeting date in November is yet to be determined. With the exception of November, advisory team meetings will be the first Thursday of the month at 3:00 PM.

Final note from Lisa Belleveau: It is important to keep in mind that restoration of natural process/river access to the floodplain is one of the best ways to mitigate flood hazard impacts.

ADVISORY TEAM MEETING MINUTES
FLOOD PLAN FOR BIG QUILCENE AND LITTLE QUILCENE RIVERS
NOVEMBER 9, 2022

Attendees:

Brent Butler, Jefferson County Department of Community Development
Donna Frostholt, Jefferson County Department of Community Development
Spencer Easton, ESA (Consultant)
Dan Beckley, ESA (Consultant)
Tami Pokorny, Jefferson County Environmental Health
Matt Gerlach, Washington Department of Ecology
Ben Cross, U.S. Fish and Wildlife Service/Quilcene Hatchery
Gus Johnson, Hood Canal Salmon Enhancement Group
Glenn Gately, Jefferson County Conservation District
Randy Johnson, Jamestown S’Klallam Tribe
Marla Powers, Port Gamble S’Klallam Tribe
Lisa Belleveau, Skokomish Indian Tribe
Michael Kingsley, Quilcene Resident
Judith [?], Quilcene Resident

Minutes (Virtual Meeting, Recorded):

Preliminary Information

Those in attendance verbally introduced themselves.

ESA prepared a power point presentation for the meeting and Spencer Easton reviewed the November meeting agenda.

The advisory team was asked if they had any comments on the minutes drafted for the first meeting. Hearing no comments, the October 2022 minutes were accepted as is.

Spencer provided project updates, including progress on drafting sections of the Comprehensive Flood Hazard Management Plan (CFHMP) and a summary of the site visit ESA and the county made to the project area on October 10, 2022.

Matt Gerlach asked about coordination with Hood Canal Salmon Enhancement Group as they have restoration efforts planned.

Existing Conditions Findings

Dan Beckley presented the findings used to write the Existing Conditions section of the CFHMP. As part of the presentation, he showed a map of the project area, reviewed the methods used and data sources available to prepare the findings, provided an overview of the river reach descriptions for each river, and recapped the history of flooding in the project area. He then summarized the following Existing Conditions sections of the Comprehensive Flood Hazard Management Plan (CFHMP):

- Natural Features (fish species use of project area/populations for some species is low or at risk)
- Land Use (comprehensive plan and development regulations/project area zoning)
- Infrastructure (county bridges at risk of overtopping due to low clearance/septic system concerns)
- Planning and Regulatory Context (Shoreline Master Program/Critical Area Regulations/development may pre-date regulations)
- Demographics (most densely populated areas occur in floodplain/segment of the population in the floodplain may be at greater risk and more susceptibility of flooding)
- Potential Future Conditions (Climate change/sea level rise/potential for more extensive flooding)
- Flood Management Activities (past use of levees/current priority is non-structural flood control/past and on-going restoration efforts)
- Vulnerability (review of cumulative effects for vulnerabilities/adaptive capacity)

Lisa Belleveau asked about the one-foot referenced in Dan's presentation and noted that if the area experiences a sea level rise of six-foot rise, flooding impacts will be greater.

Donna Frostholtm noted that the county also has a sea level rise grant (in which ESA is also the consultant) and that the preliminary results indicate that there will be more extensive flooding in the lower elevations.

Matt Gerlach followed up on pre-FIRM development and asked if we can get an idea of key areas that are more likely to be developed or redevelopment. He suggested a review flood development permits for the past few years to get a better understanding of what has been happening as of late. See if there is a potential for buying them out.

Brent Butler noted that the county requires development be constructed one foot above base flood elevations. He mentioned marginalized populations and asked Matt about potential options for funding to elevate structures.

Michael Kingsley asked about how often and how long the Linger Longer bridge is being overtopped. Or, if there is a risk of the bridge being completely washed out.

Marla Powers asked about culverts, many of which tend to be undersized.

Judith lived along the Big Quilcene River for 11 years. The bridge has never been inundated, but the levee has broken through. The dikes are of the most concern; they are not maintained and rock has been added. Most flooding occurs during higher high tides.

Ben Cross noted information from their climate change report had been used and reiterated that there are some concerns about culverts near the hatchery, including the one at Penny Creek.

Goals and Objectives

Spencer reviewed the four goals and 17 objectives that were revised based on input from the advisory team in October.

Michael Kingsley discussed forest practices and asked about efforts to encourage more sustainable practices. Spencer clarified that at the last meeting, the Forest Service said there is no tree harvesting on federal land upstream of the project area.

Ben Cross noted that there is infrastructure upstream of the project area.

Flood Reduction Strategies

Spencer noted that the team will begin identifying and analyzing strategies and actions soon. He noted there are a range of strategies that could be implemented and that the focus is on non-structural means of addressing flooding. To facilitate the discussions, Spencer reviewed some potential evaluation criteria and clarified the three categories of strategies and measures. The meeting was then broken down into two groups for about 15 minutes.

At the end we reported back, Spencer and Donna briefly recapped discussions from their groups. Marla said she agreed with the discussions.

Next Steps

Public meeting next Tuesday; hoping to get more input from those who reside in Quilcene.

Jefferson County is reviewing Existing Conditions section of the CFHMP drafted by ESA.

ESA is drafting a Determinations of Need for the CFHMP.

ESA will begin working on Strategies and Action.

Next meeting may be in December.

ADVISORY TEAM MEETING MINUTES

FLOOD PLAN FOR BIG QUILCENE AND LITTLE QUILCENE RIVERS

JANUARY 5, 2023

Attendees:

Brent Butler, Jefferson County Department of Community Development
Donna Frostholt, Jefferson County Department of Community Development
Spencer Easton, ESA (Consultant)
Dan Beckley, ESA (Consultant)
Don Svetich, Quilcene Fire Rescue
Ben Cross, U.S. Fish and Wildlife Service/Quilcene Hatchery
Gus Johnson, Hood Canal Salmon Enhancement Group
Randy Johnson, Jamestown S'Klallam Tribe
Marla Powers, Port Gamble S'Klallam Tribe
Lisa Belleveau, Skokomish Indian Tribe
Charles Swartley, Quilcene Resident

Minutes (Virtual Meeting, Recorded):

Introductory Comments

ESA prepared a power point presentation for the meeting and Spencer Easton reviewed the January meeting agenda.

The Advisory Team was asked if they had any comments on the minutes drafted for the last meeting. Hearing no comments, the November 2022 minutes were accepted as is.

Spencer reviewed the status of Comprehensive Flood Hazard Management Plan (CFHMP) preparation with the Advisory Team. Currently, the task of preparing goals and objectives has been completed, the review of Chapters 2 (Existing Conditions) and 3 (Determination of Need) has been completed by the county and ESA is making revisions, and the process of identifying and evaluating strategies and actions has begun. The intent is to complete a draft CFHMP in April 2023 and have a final version by June 30, 2023.

With the recent precipitation and king tides throughout the region, Spencer asked if anyone had any observations of inundation or flooding along the Big Quilcene and Little Quilcene Rivers that they wanted to share with the team. Comments included:

- Don Svetich stated that with the atmospheric river and king tides, both rivers were flowing at or above flood stage. On the Big Quilcene River, at the old Rogers Street crossing, concrete structures had previously been removed. Had they still been in place, the lower valley around Muncie Avenue would have flooded and it is possible that the river channel could have changed. Along the Little Quilcene River at East Quilcene Road (near the causeway), water was present on both sides of the road nearly to Center Road and up past McInnis Creek. Silt was being transported in the stream and, overall, it was a pretty significant event. He indicated that wave action overtopped the bridge and water was on the road only at the causeway.
- Randy Johnson asked about the Linger Longer Bridge. Don stated that to the north and south of the bridge, water was flowing over the road (approximately six inches deep where Leadville Avenue intersects with Linger Longer Road). For the most part, vehicles were able to drive through this area. Water did not breach the two dikes from Rogers Street to the Linger Longer Bridge; if it had, accessibility would have been an issue.
- Ben Cross addressed impacts to the hatchery infrastructure. A good bit of wood migrated downstream during the recent event. Most woody material was able to continue downstream without impacting hatchery infrastructure or the Penny Creek culvert. There were significant flows into the fishway, but it did not damage existing infrastructure. Channel migration may have occurred further upstream.

Flood Mapping

Spencer started the discussion by showing a draft of CFHMP Figure 3.1. Lisa Belleveau asked if she could have a copy of the figure, and it was agreed that a draft version could be sent out. The Advisory Team is encouraged to provide comments on the draft.

Gus Johnson noted that the Moon Valley and Lower One Mile project areas are shown incorrectly on the figure. He will send shapefiles to ESA.

Spencer reviewed flood-related mapping along the two rivers. This included the 100-year floodplains and floodways mapped by the Federal Emergency Management Agency, channel migration zones mapped by the county, and geologically hazardous maps that the county uses.

If Department of Community Development hears about any flooding issues for a water diversion from the Big Quilcene River to the City of Port Townsend reservoirs, we will let the Advisory Team know.

Strategy Development Process

Spencer reviewed the process of developing strategies and actions. ESA prepared a slide that addressed Advisory Team questions from the last meeting. The slide showed four steps in the process of identifying Strategies and Actions for the CFHMP and what inputs are used at each step. Advisory Team input occurs during the first step (Develop Evaluation Criteria) and second step (Identify Potential Strategies and Actions). The third step (Apply Evaluation Criteria) includes input from engineers. The final step is to have preferred strategies and actions identified.

Spencer reviewed Evaluation Criteria in the state handbook and what the Advisory Team recommended during the November meeting. He then reviewed the Evaluation Criteria that have been drafted. The Advisory Team was asked if they have any comments on the following criteria:

- Consistency with CFHMP Goals and Objectives;
- Effectiveness;
- Environmental Benefits and Impacts (both natural and built environments);
- Cost;
- Implementation Timelines;
- Funding Sources;
- Permitting Complexity;
- On-going Inspection, Maintenance, and Repair Requirements.

ESA will develop a matrix, based on the above criteria, that uses relative rankings, such as high, medium, low. Evaluation Criteria would not be quantitative. Spencer showed how the criteria would be presented in the matrix, using an example from an earlier Jefferson County CFHMP.

As an example of how the criteria would be used for this CFHMP, Dan Beckley showed a slide of the Lower One Mile project, which is a Hood Canal Salmon Enhancement Group (HCSEG) project. Dan summarized the details of the proposal, and Gus Johnson described the flood and transportation benefits of project. Dan then showed how a matrix could be presented for flood risk reduction in the Lower One Mile project area. The Advisory Team provided input on the risk reduction rankings for the HCSEG project, and these comments will be considered as the Big Quilcene and Little Quilcene CFHMP rankings are developed.

Spencer showed a slide that listed other potential strategies and actions, and some comments were received. The discussion included some of the pros and cons of potential strategies and actions as well as some concerns about finding funding sources to implement some of the actions.

Next Steps

Next meeting will be in February or March, on the first Thursday of the month.

ADVISORY TEAM MEETING MINUTES

FLOOD PLAN FOR BIG QUILCENE AND LITTLE QUILCENE RIVERS

MARCH 2, 2023

Attendees:

Brent Butler, Jefferson County Department of Community Development
Donna Frostholt, Jefferson County Department of Community Development
Spencer Easton, ESA (Consultant)
Dan Beckley, ESA (Consultant)
Ben Cross, U.S. Fish and Wildlife Service/Quilcene Hatchery
Gus Johnson, Hood Canal Salmon Enhancement Group
Randy Johnson, Jamestown S'Klallam Tribe
Tami Pokorny, Jefferson County Environmental Public Health
Glenn Gately, Jefferson County Conservation District
Chris Chappell, Washington Department of Natural Resources
Matt Gerlach, Washington Department of Ecology

Minutes (Virtual Meeting, Recorded):

Introductory Comments

ESA prepared a power point presentation for the meeting and Spencer Easton reviewed the March meeting agenda.

The Advisory Team was asked if they had any comments on the minutes drafted for the last meeting. Hearing no comments, the January 2023 minutes were accepted as is.

Spencer reviewed the status of Comprehensive Flood Hazard Management Plan (CFHMP) preparation with the Advisory Team. Currently, the task of preparing goals and objectives has been completed, the draft revisions of Chapters 2 (Existing Conditions) and 3 (Determination of Need) have been completed, the identification and evaluation of strategies and actions have been drafted, and the drafting of the CFHMP is in progress. The intent is to complete a draft CFHMP in April 2023 and have a final version by June 30, 2023.

Strategies and Actions

Spencer reviewed Figure 3-1, which shows the flood issues that have been identified.

Dan Beckley reviewed the Evaluation Criteria being used in the flood plan as well as the three categories of strategies and actions.

Dan discussed new and updated/ongoing strategies and actions for:

- Flood hazard information (5 new; 2 updated/ongoing);
- Non-structural alternatives (6 new; 6 updated/ongoing);
- Structural alternatives (2 new; 2 updated/ongoing)

Dan addressed strategies and actions that were identified but not proposed. Reasons why a strategy or action was not recommended included:

- Not aligned with the goals and objectives;
- Significant environmental impacts with no benefits to the natural environment;
- High cost with limited or no funding options;
- Complex permitting;
- Requires maintenance.

The following five strategies and actions that were identified as high priority actions:

- Develop a community-based flood response plan for Hiddendale Drive
- Proactive landowner outreach and communication about flood risks and actions
- Improve monitoring and documentation of flood events and impacts
- Complete Moon Valley Restoration project
- Complete Lower One Mile project

These were discussed by the Advisory Team to determine if these are the right priorities, if there are other actions that should be considered a priority, and if there are challenges to implementing these in the near term.

Brent Butler asked incorporating the CRS into the plan. Matt confirmed some language could be added to look at a cost/benefit ratio. Matt noted that being in the CRS is a staff capacity issue.

Randy Johnson asked about land management up higher in the watershed. Suggested decision-makers in the watershed have good communication, such as every two years.

Tami suggested treatment of invasive species that affects hydrologic conditions. Matt asked about specifics as having information about locations might be helpful.

As part discussion of strategies and actions, Dan provided an overview of 10 Updates and Ongoing Programs.

Matt asked for an update on the land use pieces, primarily as it pertains to sea level rise. There may be opportunities to incorporate some findings into our SMP. Donna noted that the sea level rise study would be used to assess hydrologic conditions and Brent confirmed that there will likely be revisions to our code once all the results are in.

Matt noted Thurston County has a successful program for capturing high water marks that led to better standards on some development in floodplains. This may be a good overarching concept that could be

used by Jefferson County. Brent, who worked in Thurston County, noted that they had a number of highly qualified staff to work on floodplain issues, and was able to coordinate with King County.

Ben Cross asked about culverts, some of which may be undersized and may not have the capacity for future flood risks as climate changes. ESA can look into this. Matt suggested communication moving forward, as it pertains to restoration efforts in these two river basins. Randy Johnson and Gus Johnson discussed future restoration efforts that could be good for flood resilience, especially along the Little Quilcene River.

Brent suggested changing the word 'strict' in the third from bottom bullet, as it could be a trigger from a regulatory perspective. He noted Public Works has been good at addressing flood resiliency.

Glenn Gately noted problems with beaver dams, notably at Leland Lake and Leland Creek.

Matt suggested getting parcels in the Special Flood Hazard Area be flagged to better manage flood development and working towards better coordinate with WSDOT as it pertains to culverts. Brent concurred that tagging parcels would be appropriate.

Additional Resources

Dan reviewed two additional sources of information that could be included in the plan. This could include fact sheets, flyers, or web resources.

Brent brought up the impacts of fires on flooding. Dan noted that this was briefly discussed in the Existing Conditions. Matt noted that state agencies are beginning to discuss this as an emerging issue. Spencer indicated there may be a way to connect this to an action.

Donna asked if information could be made available about cost savings for building more than one foot above base flood elevation. Spencer noted this may be difficult to summarize as it is no longer straight forward (due to FEMA Risk Rating 2.0).

Matt noted that there is a Chehalis Basin homeowner manual, which describes strategies to reduce flood damage reduction.

Tami suggested graphics for on-site septic systems and wells, and how that ties to shellfish and water quality.

Glenn discussed rotation cutting higher in the watershed, and noted the importance of prevention. Spencer noted the Forest Service participated early. Glenn asked if they have a written plan about retaining forested land.

Tami suggested Bonneville Power Administration has a wildfire prevention document that may be relevant to this plan.

Draft CFHMP and Comment Period

Spencer reviewed the outline of the CFHMP chapters. The draft will likely be released on or about April 4 with comment period ending about a month later.

Brent asked about any upcoming public meetings so that we can get an article in the local paper to increase public participation.

Next Steps

Next meeting will be in mid- to late April and the draft CFHMP will be reviewed at that time.

ADVISORY TEAM MEETING MINUTES

FLOOD PLAN FOR BIG QUILCENE AND LITTLE QUILCENE RIVERS

APRIL 20, 2023

Attendees:

Donna Frostholt, Jefferson County Department of Community Development

Spencer Easton, ESA (Consultant)

Dan Beckley, ESA (Consultant)

Siobhan Moreno, ESA (Consultant)

Don Svetich, Quilcene Fire Rescue

Denise Hawkins, U.S. Fish and Wildlife Service

Marla Powers, Port Gamble S'Klallam Tribe

Minutes (Virtual Meeting, Recorded):

Introductory Comments

ESA prepared a power point presentation for the meeting and Spencer Easton reviewed the agenda. The purpose of this meeting was to review the draft Comprehensive Flood Hazard Management Plan (CFHMP) that was sent out the previous week. The contents of the draft report have been presented and discussed with the Advisory Team during the previous four meetings so this final meeting gives the Advisory Team a chance to provide feedback and ask questions.

The Advisory Team was asked if they had any comments on the minutes drafted for the last meeting. Hearing no comments, the March 2, 2023 minutes were accepted as is.

Project Updates

Spencer noted that the draft CFHMP and State Environmental Policy Act (SEPA) documents were sent out for review and that the county is taking comments through May 3, 2023.

Also noted as part of the Advisory Team update was the virtual public meeting held on April 18, 2023, which 14 members of the public attended. Don Svetich asked about getting public input on the plan, and Spencer said that the plan is open to comments from everyone and that Don should feel free to forward it on to others in the community.

The CFHMP needs to be approved by Washington Department of Ecology (Ecology) and the Jefferson County Board of County Commissioners (BoCC). As part of this approval, the Advisory Team needs to recommend that the BoCC adopt the plan. Based on this, a proposed process for getting an Advisory Team recommendation was discussed. The three Advisory Team members in attendance did not object to the proposal. However, if objections to the plan are received within seven days of the final draft

being sent out, then we will schedule another Advisory Team meeting to address the objections. Denise Hawkins suggested a 'thumbs up' or 'thumbs down' on the plan. It was agreed we would ask for a reply, but if no response is received, the county will assume the plan is acceptable for adoption.

The intent is still to have a final plan by June 30, 2023.

Flood Plan Contents

Dan Beckley noted that we have reviewed the contents of the plan during previous Advisory Team meetings so he is intending to go over where to find information in the plan. Dan highlighted the information included in each chapter. He reviewed the contents of the existing conditions, determination of need, evaluation of alternatives, and implementation and funding chapters.

Dan reviewed the figure in the CFHMP that identifies the key flood risk locations in the county and how the locations noted in the figure corresponds to actions in the plan.

Dan reviewed 10 recommended existing and ongoing actions and 15 recommended new actions in the plan. Of these, five are considered to be high priority actions.

After this part of the presentation, the Advisory Team was asked if they had any questions or comments. Denise noted that the USGS/hatchery has two gages: one is along Penny Creek and the other is on the Big Quilcene River. The location of these gages can be gotten from the USGS. Denise noted that the weir at the hatchery is no longer electric so she wanted to know what was the best way to get comments to ESA and the county. Denise will add comments to the document. She asked about actions that included adding logjams and revetments. Spencer said this came from the vulnerability assessment and an ESA engineer. Denise does not disagree with recommendation but was curious about where the recommendation came from.

Marla Powers had questions about drainage ditches and asked about the recommended action of surveying drainage ditches. Spencer explained that during the site visit last fall, a heavy flow of water was observed in a roadside ditch even though there had not been any precipitation. The idea behind the action would be assess ditches and see if there are impacts that could trigger adaptive management. He noted that the recommended action could be revised and clarified.

Dan showed a slide pertaining to steps that could be taken in the future to implement some of the recommended actions. This included funding sources, coordination/outreach, and periodic updates to the county comprehensive plan and ordinances.

Next Steps

The draft flood plan and SEPA documents are out for review and comment; send comments by May 3, 2023.

Once Ecology has reviewed the final draft, the Jefferson County BoCC will hold a public hearing as part of the adoption process.

This is the last Advisory Team meeting.

Appendix B. Public Outreach

This appendix includes the following document:

- Public Meeting Minutes – November 15, 2022
- Public Meeting Minutes – April 18, 2023

PUBLIC MEETING MINUTES

FLOOD PLAN FOR BIG QUILCENE AND LITTLE QUILCENE RIVERS

NOVEMBER 15, 2022

Attendees:

DCD Staff: Donna Frostholt, Associate Planner/Wetland Specialist

ESA Staff: Spencer Easton, Environmental Planner; Dan Beckley, Environmental Planner

Public: One county resident was present for the virtual meeting and Tami Pokorny (Jefferson County Environmental Health) joined the meeting.

Minutes (Virtual Meeting, Recorded):

Introduction

The meeting was led by Spencer Easton with assistance by Dan Beckley. Spencer opened the meeting by introducing himself, Dan, and Donna Frostholt. Donna briefly noted that the county is interested in taking a comprehensive look at the shorelines in the county and that this grant would be used to identify strategies that could help protect people, property, and infrastructure in the Big and Little Quilcene floodplains.

Spencer then reviewed the agenda for the evening. He noted this meeting was intended to be a discussion and he paused several times during the presentation to allow for questions.

Overview of Flood Plan and Purpose

Spencer recapped the reasons why the county applied for the flood grant. He noted that there are state guidelines for how to prepare a flood plan, and he provided a 'high-level' overview that included a schedule to complete the plan by June 30, 2023.

ESA has started drafting sections of the flood plan and are hoping to get input from the public as they draft the plan.

A map of the study area was presented and Spencer noted that the plan would focus on areas within county jurisdiction.

Quilcene Flood Issues

Spencer reviewed flood history for both river basins. Lower reaches are generally the most flood prone, and a number of properties subject to flooding are zoned residential.

ESA described a site visit to several location in Quilcene on October 10, 2022 with the county, and he showed pictures of some of the bridges assessed during the site visit (as an example of one type of infrastructure evaluated by ESA engineers).

Spencer reviewed demographics and equity, and the rationale for why they need to be considered in flood plans.

Climate change is expected to affect flooding, including the Big and Little Quilcene River basins. Precipitation is more likely to come as rain rather than snow, which changes flood patterns. For example, rain events will likely be greater than they are now and sea level rise is expected to increase the extent of flooding over time.

Levees and dredging have occurred in the project area to control food risks. Now there is a focus on non-structural means of flood management that could include, for example, increasing flood water storage.

Restoration proposals in the lower reaches of the Big Quilcene River have been proposed that would increase flood storage within this river basin.

ESA conducted a vulnerability assessment. It was noted that the lower reaches were generally more likely to flood and that historic development has occurred in these floodplain areas (i.e., development that went in prior to land use regulations).

Someone asked about sea level rise and Donna provided information about that grant-funded study. The person asking the question about sea level rise was most interested in property near the Linger Longer Bridge.

Goals and Objectives

Spencer reviewed the four goals and 17 objectives that the Advisory Team identified for the flood plan being prepared for the Big and Little Quilcene Rivers.

Someone asked what options would be available for developing in the floodplain (e.g., elevating the house). Tami noted that the on-site septic systems could be compromised by flooding.

Next Steps

Draft flood plan will be out in April for comments.

Next public meeting will be in April.

Next advisory team meeting is January 5, 2023 and they are open to the public.

PUBLIC MEETING MINUTES

FLOOD PLAN FOR BIG QUILCENE AND LITTLE QUILCENE RIVERS

APRIL 18, 2023

Attendees:

DCD Staff: Donna Frostholt, Associate Planner/Wetland Specialist; Brent Butler, Director

ESA Staff: Spencer Easton, Environmental Planner; Dan Beckley, Environmental Planner

Public: Some attended for the entire meeting while some were present for a portion of the virtual meeting. The list of attendees below is based on the names that showed up on Zoom (i.e., the full name may not be known). Those attending included:

- Mark Baclawski
- Denise Dillman
- Craig Uchida
- Naomi Gebo
- Wan De
- Dan
- Erik
- Hank
- Dana Ward
- Worthington Woodlands
- Sarah Henneford
- Bruce Wendler
- Margot Hamilton
- Julie

Minutes (Virtual Meeting, Recorded):

Introduction

The meeting was led by Spencer Easton and Dan Beckley, consultants for this project. The consultants, ESA, prepared a Power Point presentation for the meeting. ESA staff (consultants) and Donna Frostholt (county project manager) introduced themselves.

Spencer reviewed the agenda for the evening. He let those attending know that a draft flood plan has been released and is out for comments. He noted this meeting was intended to be a discussion and ESA paused several times during the presentation to allow for questions.

Project Background

A Comprehensive Flood Hazard Management Plan (CFHMP) was prepared for the Big Quilcene River in 1998 that needs to be updated. There has been no CFHMP prepared for the Little Quilcene River. Flood frequency and intensity is increasing, which would be expected to affect flooding for both rivers.

Washington State Department of Ecology offers grants under the Flood Control Assistance Account Program, which has been used by the county to fund preparation of this CFHMP. The county CFHMP is being prepared based on state guidance.

Spencer reviewed the process and schedule for completing the CFHMP, which is set to be completed by June 30, 2023. He noted that the draft CFHMP is out for comment and that this public meeting has been scheduled to coincide with the comment period.

Spencer showed a figure of the two river basins being considered in the CFHMP.

CFHMP

Spencer reviewed the four goals and the 17 objectives developed for the plan.

Dan Beckley reviewed the history of flooding identified during preparation of the plan. He discussed the built environment and infrastructure that is most susceptible to flooding and some of the impacts flooding has had on existing infrastructure. Most flooding occurs in the lower portions of the floodplain.

The demographics indicate those residing in the lower areas of these river basins are most likely to be affected by flooding. There is a higher level (than state average) of vulnerable people residing within the floodplains, resulting in some Quilcene residents having a heightened level of vulnerability to flooding hazards.

Potential future conditions were reviewed. This included climate change effects, increasing frequency and intensity of precipitation, and sea level rise.

Past flood management activities were addressed, some of which has had negative environmental effects.

ESA conducted a vulnerability assessment. This identified people and infrastructure that will be more at risk as flood events get more severe. More monitoring data is needed to assess risk.

Dan reviewed a graphic that had been prepared to show areas along the Big and Little Quilcene Rivers that are currently most susceptible to flooding. This set the stage for discussing the management strategies and actions that have been developed.

An attendee asked about the ongoing flooding and then rebuilding in the floodplain, and wanted to know if this is within the purview of the plan. Spencer noted that the CFHMP does include acquisition of properties that flood (from willing property owners) and that the county has development regulations that would need to be met to build in the floodplain.

Another attendee noted the floodplains are in ancestral lands and asked about tribal involvement. Spencer said that there is an advisory team that has contributed to the plan and that the tribes have been providing input as advisory team members.

Dan noted that flood control structures are present above the hatchery. The actions include replacing structures to better address sediment transport.

One attendee asked about shoring up the river bank. The county indicated that this would be difficult to approve because it disconnects the river from the adjacent habitats. That is why the CFHMP focuses on non-structural ways to address flooding.

Dan reviewed the process of working with the advisory team to draft the CFHMP.

Dan discussed the evaluation criteria used to develop the strategies and actions in the plan. Based on the evaluation, five actions were identified as high priority. Dan then reviewed the new actions that are included in the plan and the ongoing actions in the plan that should be continued.

Attendees asked the following questions:

- Are any of the projects 'shovel ready'? Spencer noted that the two Hood Canal Salmon Enhancement Group (HCSEG) projects have some level of funding and are progressing. This CFHMP is intended to provide guidance to the county, the local agency that will be reviewing the evaluation criteria to determine which actions items can be implemented in the future, as funding allows.
- Is there any coordination with restoration organizations? It was confirmed that ESA and the county have been interacting with HCSEG, who has contributed to the plan.
- Are there any wild salmon left? Fish presence is documented in the flood plan, and there are some wild run stocks in both rivers.
- Is runoff into the bay being addressed? Actions proposed are not specifically addressing runoff but they are part of the plan, such as assessing flooding risks to septic systems. Stormwater management is regulated and addressed through the permitting process.
- Has rebuilding the Rodgers Road bridge been considered? The flood plan does not include a bridge at this location because building this type of infrastructure across a floodplain is difficult. It was noted that the potential for rebuilding a bridge was considered as an alternative under one of the HCSEG restoration plans.

Next Steps

Draft flood plan is out for review and comment. Comments are due by May 3.

There will be a hearing before the Jefferson County Board of County Commissioners, who will be adopting the plan.

Appendix C.

Factsheets

This appendix includes the following factsheets:

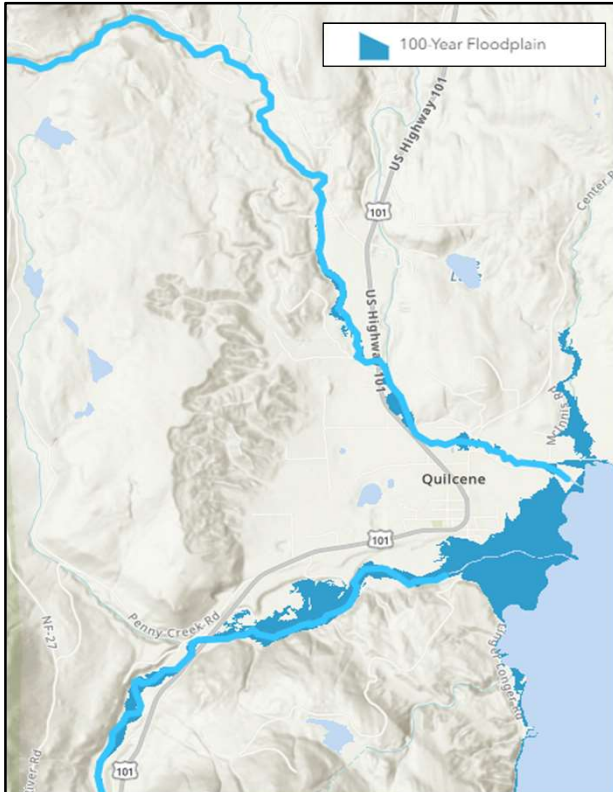
- The Big and Little Quilcene Comprehensive Flood Hazard Management Plan: Summary
- Flood Safety Guide: Know Your Flood Risk
- How Nature Reduces Flood Risk: Ecosystem Services in Resilient Watersheds
- Natural Systems in the Watershed
- Comprehensive Flood Hazard Management Plans



The Big and Little Quilcene Comprehensive Flood Hazard Management Plan: Summary

What is it?

Jefferson County staff and consultants from Environmental Science Associates developed this Flood Plan to identify flood risks and put forward flood risk reduction strategies for the lower Big and Little Quilcene River basins.



Goals of the Big and Little Quilcene Flood Plan

1. Implement projects that reduce the future risk of flood damages and hazards.
2. Reduce public expenditures to repair damaged areas.
3. Minimize, to the extent possible, the environmental impacts of flood hazard management.
4. Focus on non-structural alternatives and ecological restoration to address flood safety.

High Priority Recommended Actions

- Develop a community-based emergency flood response plan for the Hiddendale Drive community.
- Proactive landowner outreach and communication about flood risks and risk reduction strategies.
- Improve monitoring and documentation of flood events and impacts.
- Complete ecological restoration and flood risk reduction capital projects near on the lower Big Quilcene.
- Acquire properties and remove houses in the floodplain.

Learn more about the Flood Plan and future actions by contacting the Jefferson County Department of Community Development.

<https://www.co.jefferson.wa.us/260/Community-Development> | dcd@co.jefferson.wa.us



Flood Safety Guide

Know Your Flood Risk

From 2012 to 2022 there were six Presidentially-declared Disasters related to flooding in Jefferson County.

Do you live in a floodplain?

Search your address at www.msc.fema.gov to find out what flood zone you live in. You may also request flood map information from the Jefferson County Department of Community Development.



Get flood insurance

Any property insurance agent is qualified to sell flood insurance through the National Flood Insurance Program. You can also learn how to enroll in flood insurance at www.floodsmart.gov.

Watch for flood warnings

- Sign up for alerts at www.co.jefferson.wa.us/1066/Alerts-Warnings
- Find your local river gage and check for alerts at water.weather.gov/ahps/

Create a home flood plan

- Monitor how your property is affected during different river flows at your local gage, such as if access is blocked or the garage is flooded
- Choose response stages, such as flood extents for sheltering in-place, evacuating, or interim steps like moving vehicles to higher ground.
- Choose responsibilities and create checklists for each response stage
- If evacuating, secure valuables and shut off gas and electric utilities



How Nature Reduces Flood Risk

Ecosystem Services in Resilient Watersheds

Flooding is a natural process. Ecosystems have adapted to accommodate flooding long before human settlement.

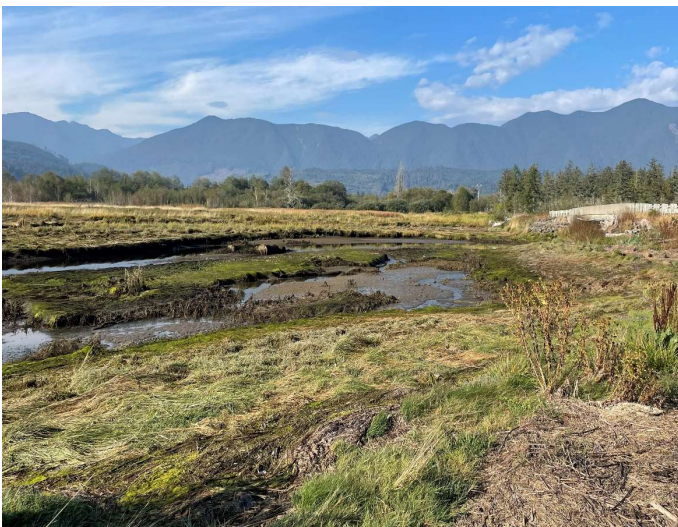
How do floodplains work?

Floodplains are flat areas along water bodies. Floodplains provide additional storage for water and recharge groundwater, while reducing the velocity of water when rivers overtop their banks. This helps to lessen impacts to downstream areas.



Impacts of altering floodplains

Altering floodplains can reduce their ability to mitigate the impacts of flooding. Development in the floodplain, such as homes or other structures, reduces the area where floodwater can be stored, resulting in higher flood flow rates and volumes. Armored shorelines, such as levees, also produce faster flows, reduce floodwater storage, and limit healthy, vegetated areas that are resilient against erosion.



Naturally resilient watersheds

- Coastal wetlands mitigate wave impacts and store floodwater
- Forests slow runoff, reduce erosion, and aid groundwater infiltration
- Sediment movement through rivers creates winding channels that slow flows and create side channels with floodwater storage



Natural Systems in the Watershed

The many sensitive natural areas near our streams and rivers benefit the public and sustain healthy habitats.

Floodplains

Floodplains are flat areas along water bodies. Floodplains provide additional storage for water and recharge groundwater, while reducing the speed of river flows. This can reduce impacts to downstream areas from heavy rain, snowmelt, or other flood causes. Protecting floodplains from development helps to ensure that these natural systems work properly, while keeping people out of harm's way.



River floodplain in mountain valley
Photo credit: National Parks Service



Forested riparian areas
Photo credit: National Parks Service

Riparian areas

Riparian areas occur along the shores of water bodies, which have wet soils and vegetation, including aquatic plants, trees, or grasses. These environments provide important habitat, filter pollutants from water, and protect against erosion from fast or high river flows. Natural riparian areas may have logs and sand bars that slow the flow of water and provide fish habitat. Riparian vegetation also provides shade that keeps the water cool, which supports healthy aquatic life.

Wetlands

Wetlands refer to a wide range of environments that have surface water or wet soils seasonally or permanently. Wetlands include salt marshes, vernal pools, bogs, and swamps, among other types. Like other critical watershed environments, wetlands can store excess water from floods and slow flows. Coastal wetlands also absorb wave impacts, which reduce coastal flooding and damage.



Swamp in mountain foothills
Photo credit: Bureau of Land Management

Forests – From trees to debris

Forests support healthy water bodies throughout the life cycle of trees. The strong roots of trees hold soil together, preventing erosion and helping to recharge groundwater. This reduces the impact of flooding by slowing water that is flowing to streams and rivers. Fallen trees are called "large woody debris," which can block water and create winding river movements around the debris. This slows the flow of rivers and can create pools and side channels that provide habitat and more storage space for water.



Large woody debris on a stream
Photo credit: US Fish and Wildlife Service



COMPREHENSIVE FLOOD HAZARD MANAGEMENT PLANS

Jefferson County applied for and was awarded a grant from the Washington State Department of Ecology to fund the development of a Comprehensive Flood Hazard Management Plan (CFHMP) for the Big Quilcene and Little Quilcene Rivers. Jefferson County worked with stakeholders, including government agencies, tribal representatives, nonprofit organizations, and residents to guide the CFHMP.

While Jefferson County maintains flood development regulations to protect people, property, and infrastructure, the CFHMP expands upon existing efforts to guide land use planning, environmental health, emergency management, and conservation.



Flooding near Big Quilcene River
Photo credit: Pat McCullough

Why prepare a CFHMP?

1. The Little Quilcene River has never had a CFHMP prepared, and the Big Quilcene River CFHMP has not been updated since 1998.
2. To incorporate nature-based solutions and the best available science into County flood planning efforts
3. To address the needs of vulnerable communities
4. To raise awareness of flood hazards
5. To identify flood risk reduction actions and funding mechanisms

What work went into the CFHMP?

- Identifying goals and objectives for the plan;
- Assessing existing conditions in both watersheds;
- Presenting historic flooding and need for the CFHMP;
- Identifying management strategies and actions; and
- Collecting input from stakeholders on risks, needs, and actions throughout the process.



Flooding at Penny Creek near Quilcene National Fish Hatchery above Big Quilcene River (2009)
Photo credit: Ron Wong, USFWS