ASOTIN COUNTY CONCEPTUAL RESTORATION PLAN:

TECHNICAL DOCUMENT & APPENDICES

Prepared for:

Asotin County Conservation District
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Asotin Working Group

This document was completed by the consulting team with significant input, guidance, and review by the Asotin Working Group. The Working Group included the following people and agencies:

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- Kris Fischer, Confederated Tribes of the Umatilla Indian Reservation
- Heidi McRoberts, Nez Perce Tribe
- Dave Karl, Washington Department of Fish and Wildlife
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- Tom Schirm, Washington Department of Fish and Wildlife
- John Foltz, Snake River Salmon Recovery Board
- Kay Caromile, Washington State Recreation and Conservation Office
- Andre L'Heureux, Bonneville Power Administration

KEY FINDINGS & RECOMMENDED RESTORATION STRATEGIES

Background

This report is part two of an assessment and planning process begun in 2016. The goal of the two reports was to determine the condition of streams, fish use, and factors limiting fish production (Part 1), and develop a framework for prioritizing restoration and develop a series of conceptual restoration project areas (Part 2). The assessment focused on determining the geomorphic reach types, their condition, and recovery potential. We also reviewed other factors to broaden the assessment, including riparian conditions, beaver dam capacity, fish barriers, upland conditions, and used models to estimate network scale fish capacity, stream temperature, and current and potential climate change hydrologic regimes. We concluded that sediment issues previously identified have mostly been addressed by improvements in upland practices, riparian function is improving due to fencing and planting projects, and water quality and quantity are in moderate to good condition in most reaches except the lower reaches where high temperatures and low flows can be common. The most significant issues remaining are low geomorphic diversity, reduced extent of riparian vegetation, disconnected floodplain (levees or rip rap) or lack of regular overbank flow (incision), invasive vegetation and/or upland encroachment, low flows (natural, but exacerbated by historic floods and development), and high stream temperatures (natural, but exacerbated by degraded riparian vegetation, historic floods, and development).

Restoration Strategies

We recommend the following restoration strategies to address limiting factors we identified in the assessment:

- Protect upper reaches and continue implementation of conservation and best management actions in the uplands to reduce sediment delivery to streams. Actions include direct seeding, enrolling land in the conservation reserve program, removing terraces that direct flows off fields, and construction of sediment ponds.
- Reconnect habitats by removing barriers to fish passage and remove or set back levees to reconnect floodplains, side-channels, or flood channels.
- Restore long-term processes such as riparian function, sediment routing, and nutrient cycling. Actions include removing levees and rip-rap to allow the river to access historic floodplain, and promoting overbank flow by making the channel more complex, and adding structural elements like rock and wood.
- Restore short-term processes by adding LWD to increase instream habitat complexity and promote overbank flow.
- Explore alternative restoration strategies and integrate planning and restoration across agencies to increase effectiveness and reduce restoration costs. Alternative strategies could include forest thinning combined with wood additions to nearby streams, grazing strategies to control weeds, reduce fire risk, and stimulate riparian growth, and relocation of beavers to increase floodplain connection and groundwater recharge.

Recommended Restoration Actions and Benefits

We suggest the following restoration actions to address limiting factors and expect the following benefits:

- Protect recovering processes
    - Isolated pockets of quality habitat and recovering processes should be connected to increase their potential benefit
    - Future LWD recruitment and LWD seed source
    - Flood hazard buffering for downstream reaches

- Reconnect - Levee setback/removal
  - Increase accessible floodplain/accommodation space to allow stream to build critical habitat features (side and flood channels, off-channel rearing areas, wetlands)
- Long-term processes – Riparian and Upland Management
  - Planting for future LWD seed source, chemical/sediment filter to mitigate sediment from adjacent agricultural and urban areas, shade to moderate stream temperatures
  - Planting should target newly connected flood channel or floodplains
  - Invasive vegetation control to improve survival of native plants (this is too extensive to map – generally, all PAs should have a weed control component),
  - Upland vegetation encroachment is likely pervasive and is an indicator of lowered water table when upland vegetation is encroaching into the floodplain. Reconnecting the floodplain could control, but may also require weed management
- Short-term processes – Add Structural Elements
  - Increase geomorphic/hydraulic diversity to improve rearing habitat through creation of high flow refuge, predator refuge, energy refuge, cover
  - Improve sediment sorting to trap pockets of fines, increase concealment opportunities for juveniles, increase spawning areas for adults, increase rearing areas for lamprey
  - Increase hyporheic exchange to help moderate stream temperatures
  - Increase floodplain roughness to encourage fine sediment deposition and create more planting opportunities, more potential for natural riparian recruitment, and prolonged water storage
  - Trap LWD transported during larger floods to reduce downstream flood hazard

Priority Project Areas

We identified 83 project areas in Asotin County that average approximately 2 miles long. The project areas were identified by overlaying the reach type, geomorphic function, and recovery potential of stream segments. We then developed a framework for prioritizing which project area should be considered a high priority for restoration. We used five components in our framework to rank each project area: geomorphic opportunity, fish capacity, resilience to climate change, cost of restoration actions, and fish distribution and use. We developed 10 different scenarios where the components were weighted differently to assess how different project areas were ranked. Through a series of workshops, the Technical Team selected a scenario where the geomorphic opportunity, fish capacity, and resilience to climate change were weighted more than restoration cost and fish distribution. We identified 24 Tier 1 (high priority for restoration) projects areas and developed conceptual restoration plans for each area. We also identified 26 Tier 2 (moderate priority), 21 Tier 3 (low priority), and 12 Tier 4 (conservation and enhancement reaches).

CONTENTS

LIST OF ABBREVIATIONS

ADA - Americans with Disabilities Act

ACCD - Asotin County Conservation District

AQEA - Anchor QEA

BDA - Beaver Dam Analog

BRAT - Beaver Restoration Assessment Tool

DEM - Digital elevation model

DoD - DEM of difference

DOE - Washington State Department of Ecology

ELR - Eco Logical Research Inc.

ELJ - Engineered log jam

ESA - Endangered Species Act

ESU - Evolutionary Significant Unit

FSA - Farm Services Agency

GCD - Geomorphic change detection

IMW - Intensively Monitored Watershed

LIDAR - Light detection and ranging

LWD - Large woody debris

NHD - National Hydrography Dataset

NREI - Net rate of energy intake

NOAA - National Oceanic and Atmospheric Administration

NRCS - USDA Natural Resources Conservation Service

PALS - Post-assisted log structure (i.e., the proposed LWD restoration method)

PCSRF - Pacific Coast Salmon Recovery Fund

PTAGIS - PIT Tag Information System

RCAT - Riparian Condition Assessment Tool

RM - River mile

RCO - Washington State Recreation and Conservation Office

RTT - Regional Technical Team

RVD - Riparian Vegetation Departure

RVCT - Riparian Vegetation Conversion Type

SRSRB - Snake River Salmon Recovery Board

USFS - United States Forest Service

USGS - United States Geological Survey

WDFW - Washington Department of Fish and Wildlife

KEY DEFINITIONS

Engineered structural elements: discrete objects in the valley bottom that are designed and built to remain static and intact following a predicted discharge (e.g., ELJs, levees, rip-rap, culverts).

Geomorphic unit: landforms with a distinct form to process association. Based on morphology, substrate, orientation, and forcing mechanism (building blocks of rivers).

Hydraulic units: spatially separated patches of homogenous substrate and surface hydraulics (synonymous with facies; building blocks of geomorphic units).

Incision or incised: a common symptom of many streams where by the bank height is greater than the average bankfull stage such that overbank flow is rare. Common causes of incision in Asotin County are a reduction of bed roughness and/or increased flow. Incision effectively disconnects the channel from the floodplain and degrades the channel by causing a straightening of the channel and decreased habitat complexity.

Non-engineered structural elements: discrete objects in the valley bottom with a typical design life of 5-10 years.

Structural elements: discrete objects in the valley bottom that directly influence hydraulics (e.g., LWD, bedrock, beaver dams).

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1 INTRODUCTION

The Asotin County Conservation District (ACCD) contracted with Eco Logical Research, Inc. (ELR) to conduct a geomorphic focused *Watershed Assessment* and develop a *Conceptual Restoration Plan* for Alpowa, Asotin, Couse, and Tenmile Creeks (hereafter referred to as the *study area*; Figure 1). We divided the Asotin Creek watershed into the Asotin Creek mainstem and George Creek for much of the assessment because George Creek makes up over 40% of the area of the Asotin Creek watershed, and the two creeks have distinct geomorphic characteristics. The watershed assessment and conceptual restoration plan are part of an overall effort within the Snake River Salmon Recovery Region to develop watershed-based strategic management plans that prioritize restoration projects that will most benefit the recovery of Endangered Species Act (ESA) listed salmon and steelhead and other species of management concern (e.g., AQEA 2011, GeoEngineers 2011). Eco Logical Research, Inc., in partnership with Anchor QEA (AQEA), used existing assessments as a template for conducting a geomorphic focused watershed assessment (hereafter "assessment") of the study area. We present the results of the assessment in a separate report (Bennett et al. 2018). We used the results from the assessment to develop a conceptual restoration plan that is presented in this report. The approach we used will provide continuity with regional goals and objectives for stream restoration and species recovery. The ultimate goal of the assessment and conceptual restoration plan is to promote implementation of restoration projects that will improve habitat for steelhead (*Oncorhynchus mykiss*), Chinook salmon (*O. tshawytscha*), bull trout (*Salvelinus confluentus*), Pacific Lamprey (*Entosphenus tridentatus*), and other fish species while maintaining viability of local communities and agricultural producers.

We present the conceptual restoration plan at two spatial scales based on the geomorphic assessment: reach and watershed scales. We present the reach scale conceptual restoration strategies using a modified perennial network developed for the geomorphic assessment. We divided the stream network into 83 project areas and then used results from the geomorphic assessment (geomorphic components) and management priorities based on local consultation with managers (management components) to rank reaches from low to high restoration priority. We worked with local managers and stakeholders to develop a series of restoration priority scenarios and select the most appropriate scenario. We then developed a set of conceptual project area restoration plans for the highest priority (Tier 1) reaches. We also present broad scale restoration strategies that can be applied to protect and enhance watershed scale processes.

2 GOALS & OBJECTIVES

Our overall goal was to work with local landowners, managers, and restoration practitioners to develop a conceptual restoration plan that has broad support, is founded in sound science, and that will provide specific direction for planning and implementing effective restoration actions for the next 5-10 years. We recognize there is a long history of public involvement in watershed restoration in the study area (e.g., ACCD 1995). The ACCD assisted in coordinating meetings, input, and review from both the public and Asotin Working Group to facilitate collaboration in the development of the assessment and conceptual restoration plan. The Working Group was made up of local and regional agencies representatives and members of the Snake River Salmon Recovery Board.

The goals of the Asotin County Conceptual Restoration Plan are to:

1. use the assessment results, meetings, and workshops with the public and the Working Group to develop a conceptual restoration plan, and

2. prioritize the locations for potential restoration projects that will lead to substantial improvement of instream habitat and riparian conditions for key life stages and a diversity of life history strategies of ESA listed steelhead, Chinook salmon, Bull trout, and Pacific lamprey.

The specific objectives of the Asotin County Conceptual Restoration Plan are to:

1. prioritize each reach for restoration based on benefits to target fish species, geomorphic condition, recovery potential (i.e., likelihood for success), economic, social, and management factors (cost, species distributions, potential increases in fish capacity, etc.), and
2. identify a series of priority restoration projects that have a high likelihood of meeting current funding criteria and species recovery objectives (e.g., SRSRB 2011).

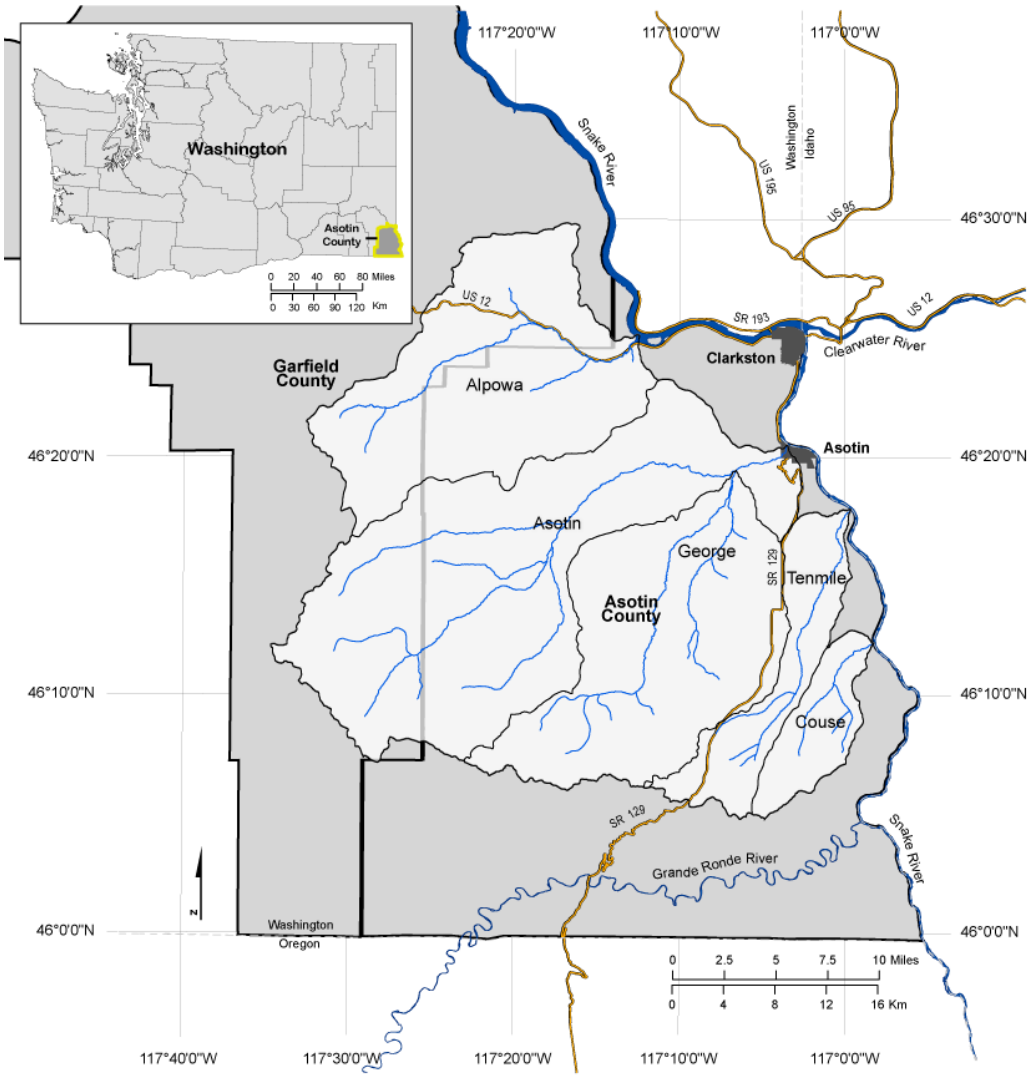


Figure 1. Asotin County and the watersheds included in the geomorphic and conceptual restoration planning process: Alpowa, Asotin, George, Tenmile, and Couse Creeks. Black lines are watershed boundaries, and the thick borders are the boundaries of Asotin and Garfield Counties. The stream layer is a modified perennial network based on the known distribution of steelhead and bull trout (Streamnet.org).

REPORT ORGANIZATION

The report is divided into ten sections. In Section 1, we describe the context of the report: Part 1 the Geomorphic Assessment (provided in a separate report; Bennett et al. 201) and Part 2 the Conceptual Restoration Design (this report). In Section 2, we describe the goals and objectives of the Geomorphic Assessment and the Conceptual Restoration Design. In Section 3, we describe the setting, background information, and provide a summary of the Geomorphic Assessment (Bennett et al. 2018). In Section 4, we outline the restoration framework and strategies we are recommending to address limiting factors. In Section 5, we describe the framework we used to prioritize project areas for restoration. In Section 6, we present the summary results of our prioritization framework where each project area is ranked based on a set of geomorphic and management components under different scenarios (i.e., weighting different components based on working group input). In Sections 7-10, we present ***conceptual restoration project area descriptions*** for all the project areas by restoration priority (Tier 1-4) and watershed. The project area descriptions identify restoration opportunities and strategies designed to address current limiting factors. Further details of the conceptual restoration plan methods, results of data analyses, and project area maps are provided in the following Appendices:

Appendix A: Key Geomorphic Assessment Maps

Appendix B: Location of Project Areas by Restoration Priority (Tier 1-4) and Watershed

Appendix C-F Tier 1-4 Project Area Conceptual Design Maps

Appendix G: Summary of data for Project Areas by Tier (1-4) and all Project Areas Combined

Appendix H: Potential Quantities of Physical and Habitat Attributes Changes Based on Conceptual Designs: Tier 2 and 3 Project Areas

3 SETTING AND BACKGROUND

STUDY AREA

The assessment covers most of Asotin County and includes Alpowa[1], Asotin, Tenmile, and Couse Creeks (Figure 1). The lower Grande Ronde River is within Asotin County but was not assessed for this project. All the creeks in the study area flow directly into the Snake River: Asotin, Couse, and Tenmile Creeks enter the Snake upstream of the town of Clarkston, Washington and the confluence of the Snake River and the Clearwater River. Alpowa enters the Snake River downstream of Clarkston (Figure 1). Alpowa Creek is 453 mi, Asotin 470 mi, Tenmile 475 mi, and Couse 482 mi from the ocean. There are eight mainstem dams downstream of the study area: four Snake River dams (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor), and four Columbia River dams (McNary, John Day, The Dalles, and Bonneville).

The study area is within the Columbia Plateau and Blue Mountains level III ecoregion (Omernik 1987, Clarke 1995, Omernik 1995). The area is dominated by deep narrow canyons cut into underlying basalt lithology and surrounded by semi-arid sagebrush steppe and grasslands at lower elevations and open conifer dominated forests at higher elevations. The area is semi-arid, receiving less than 12 in of precipitation at lower elevations. However, the headwaters of Asotin Creek drain from the Blue Mountains and can receive over 45 inches of precipitation. The area is prone to large floods associated with either highly localized, high intensity summer thunderstorms, or

[1] Note. Only the lower portion of Alpowa Creek is within Asotin County.

winter rain-on-snow or rain-on-frozen ground that causes rapid runoff. Temperatures vary greatly between seasons, with highs in the summer sometimes reaching > 100° F, and winter highs < 32 ° F. The wettest period is from March to June (3-4"/month) and the driest period is during the summer from July to September (1.5"/month).

All the watersheds in the study area are relatively short (~ < 25 miles long), moderate to high gradient along the mainstems (2-3%), with narrow valley bottoms, and surrounded by steep side hills. The main differences between the watersheds are maximum elevation, land ownership, land cover, land use, and their hydrologic regimes (Table 1, Appendix A. 1). Asotin Creek and parts of George Creek have a greater proportion of their watershed above 5,000 feet elevation (i.e., headwaters flow from the Blue Mountains), have more public land, and have hydrologic regimes dominated by snow-rain. Couse Creek, Tenmile, and Pintler Creek (a tributary to George Creek) do not exceed 5000 feet elevation, are almost entirely privately owned, the land use is predominately agriculture, and they all have hydrologic regimes dominated by groundwater. In all the watersheds, the proportion of perennial stream miles to intermittent and ephemeral stream miles is very low (~ 0.01%). These differences and the general dry-low flow environment of the area have a profound effect on the geomorphic condition and habitat available for fish. Large portions of Couse, Tenmile, Pintler, and the lower elevations of George Creek regularly have stream flows that go subsurface and these watersheds tend to be flashy (i.e., short-duration but intense runoff events).

Table 1. Watershed characteristics.

		Asotin Creek Tributaries						
Characteristic	**Asotin Creek**	**George Creek**	**Charley Creek**	**North Fork**	**South Fork**	**Alpowa Creek**	**Tenmile Creek**	**Couse Creek**
Drainage Area (acres)	208,312	82,520	14,419	40,749	25,658	83,770	26,935	15,321
Mean Elevation (feet)	3,350	3,150	3,990	4,280	4,050	2,539	2,910	2,910
Min Elevation (feet)	741	942	1710	1840	1850	741	758	784
Max Elevation (feet)	6,201	5,470	5,580	6,200	5,980	4,701	4,131	3,911
Max Relief (feet)	5,459	4,530	3,870	4,360	4,130	3,960	3,369	3,120
Mean Slope	24	15.4	33.5	39.6	28.7	23	17	24
% Area w/ Slope >30%	36	18.7	56.5	67.5	43.1	33	25	37
% North-Facing Slopes >30%	10	4.13	16.7	18.1	11.9	9	5	7
Percent Forested Area	21	13.7	38.9	43.9	29.8	2	7	4
Mean Annual Precipitation (inches)	22.8	20.7	26.5	29.9	27.5	18.9	18.1	16.9

**** Asotin Creek including George Creek***

The fish bearing extents of the streams are also influenced by the character of the watersheds. In Asotin Creek steelhead and bull trout distribution extend from the base elevation at the Snake River almost to the top of the watershed (Appendix A.2). In George Creek steelhead are found throughout much of the watershed but bull trout are likely restricted to the upper elevations (i.e., resident population). In Couse, Tenmile, and Pintler, the extent of steelhead is restricted to lower elevations because of the hydrologic regime and character of the watersheds. The streams in the study area are generally small to medium sized with most fish bearing reaches being stream order 2-4. The creeks in the study area range in size from 30-40 feet bankfull width and 1.0-1.5 % gradient (e.g., Asotin Creek, North Fork Asotin Creek) to 1-5 feet bankfull width and 5-10% gradient (e.g., upper Charley, upper George Creek, and Cougar Creek).

FISH PRESENCE, STATUS, AND DISTRIBUTION

The focus of the assessment and restoration plan is to improve conditions for ESA listed spring Chinook salmon, steelhead, bull trout, and Pacific lamprey. This summary was primarily derived from the Asotin Model Watershed (ACCD 1995), USFS stream surveys (USFS 2001, 2014a, b), baseline surveys from WDFW (Mendel et al. 2004, Mendel et al. 2008), Limiting Factors Analysis (Kuttel 2002), Subbasin Plan (ACCD 2004), Ecosystem Diagnosis and Treatment analysis (SRSRB 2011), Nez Perce Fisheries Management (NPT 2013), and the Asotin Creek Intensively Monitored Watershed (Bennett et al. 2015).

Three species currently listed as threatened under the Endangered Species Act (ESA) are present in the study area: bull trout, spring Chinook salmon, and summer steelhead (ACCD 1995, Mayer et al. 2008, Crawford et al. 2016). Spring Chinook salmon are listed as extirpated, though small numbers of adults spawn some years in Asotin Creek (Crawford et al. 2016). Lamprey are a species of concern in Washington and current efforts are underway to reintroduce them to Asotin Creek (Schlosser and Peery 2010).

The timing and distribution of some fish species has likely changed in the last 150 years (Figure 2 and 3). Lamprey and sucker distributions have been reduced due to historic dams, barriers, and irrigation diversions. McIntosh et al. (1989) summarized Bureau of Fisheries stream habitat surveys in Asotin Creek mainstem in March 1935 and June 1936 and documented three permanent and 11 temporary barriers (dams and irrigation diversions) and noted that the lower dam at ~RM 0.4 was built for the explicit purpose of stopping suckers from entering Asotin Creek. Headgate Dam at ~ RM 8.1 would divert all the water from Asotin Creek during times of low flow, causing the lower river to go dry. The irrigation diversions and permanent dams likely restricted Chinook salmon, bull trout, and lamprey from migrating upstream because they migrate during low flow periods (summer and fall). The distribution of steelhead was less influenced by fish passage barriers, as adult steelhead migrate during spring high flows when water demands are low, and they are able to ascend barriers that are otherwise impassable to other fish (e.g., lamprey, suckers, and whitefish).

3.1.1 Steelhead

Asotin Creek was designated by WDFW as a natural production steelhead reserve after the discontinuation of a hatchery stocking program in 1997 (ACCD 2004). An adult weir has been operated on the mainstem Asotin Creek since 2005 and all marked hatchery steelhead captured at the weir have been removed since 2008. The weir is typically operated on the Asotin Creek mainstem 3 miles upstream of the confluence with the Snake River and above the confluence of Asotin Creek and George Creek (Crawford and Herr 2017). Adult weirs are also operated by WDFW periodically on Alpowa, George, and Tenmile Creeks.

Steelhead are present in all of the target watersheds and use the watersheds during all life stages (Figure 3). Adults begin to enter the target watersheds in late fall to early December and peak spawning takes place in April and May (Figure 2). WDFW has conducted redd surveys throughout the target watersheds and has documented active spawning in mainstem Asotin, North Fork Asotin Creek, South Fork Asotin Creek, Charley Creek, George, Pintler, Couse, and Tenmile Creeks (WDFW unpublished data; Mendel et al. 2001, 2004, Mendel et al. 2008, Bennett et al. 2015, Crawford and Herr 2017). Juvenile rearing has also been documented and it is generally accepted that steelhead occupy the majority of accessible habitat in all streams with perennial flow. The distribution of steelhead, although extensive, is limited in several watersheds during the summer and early fall because of low flows or subsurface flows. In particular, lower sections of George, Pintler, Couse, and Tenmile Creeks can have very low flows during the summer and fall months (Kuttel 2002, ACCD 2004). Asotin Creek has the largest population of steelhead of the target watersheds and had an average of 595 (range 284-1411) adult steelhead estimated to return to spawn upstream of the WDFW adult weir trap on the mainstem of Asotin Creek between 2005-2016 (Crawford and Herr 2017). Adults generally spend 1-2 years in the ocean and juveniles rear for 1-4 years before

outmigrating. Resident "rainbow" trout (as determined by their small size < 300 mm) have been observed spawning in areas also used by steelhead, but it is unknown what proportion of the total population is made up of residents.

3.1.2 Chinook salmon

Spring/summer Chinook salmon were historically present and abundant in some of the target watersheds but it is believed that fall Chinook salmon did not use any of the streams because they tend to require larger streams for spawning (SRSRB 2011). The spring/summer Chinook salmon are part of the Snake River Chinook ESU and were listed in 1992 as threatened under the ESA. Spring/summer Chinook salmon are considered extirpated from the target watersheds. However, a small number of spring/summer and fall Chinook spawn in Asotin Creek and Alpowa some years (Bennett et al. 2015, Crawford and Herr 2017). An average of 17 adult Chinook have been captured at the WDFW adult weir from 2004-2016 (15% were hatchery origin; unpublished WDFW data). Adult Chinook enter the stream in mid-May through early July and spawn in August and September. Anecdotal data suggests that adults captured in Asotin Creek are seeking flow refugia when the Snake River flows are high, and several adults have been captured in other tributaries of the Snake River (e.g., Imnaha River; Personnel Communications, E. Crawford). Adults spend 4-5 years in the ocean and juveniles rear for a year or less in the larger tributaries. Juvenile Chinook salmon are often captured in Asotin Creek at the WDFW smolt trap and during Asotin IMW summer and fall surveys in Charley, and the South Fork and North Fork of Asotin Creek (Bennett et al. 2015). An average of 751 Chinook juveniles have been captured at the WDFW smolt trap each year between 2004-2016 (WDFW unpublished data). Juvenile Chinook have also been captured during electroshocking surveys in Alpowa and Couse Creeks (Mendel et al. 2008). Recent genetic analysis suggests that adult Chinook entering Asotin Creek are of Tucannon River origin (Blankenship and Mendel 2010).

3.1.3 Bull trout

Bull trout spawn in the fall and require cool water temperature and complex habitat and cover (Al-Chokhachy et al. 2010) . There are both resident and fluvial forms of bull trout in the Snake River region (Kuttel 2002, Al-Chokhachy and Budy 2008). Resident forms spend their entire life cycle in tributary streams, often at elevations at or above the extent of steelhead (Appendix A.2). Fluvial bull trout are generally larger (>12 inches) and spawn and rear in tributaries, but reside in larger rivers and the mainstem Snake River. Bull trout in the study area are considered part of the Columbia River Distinct Population Segment, Snake River Recovery Unit and were listed as threatened in 1998 by the USFWS (SRSRB 2011). Bull trout spawning and rearing is mostly limited to the upper watershed in George Creek and Asotin Creek and its tributaries (USFS 2001, Mendel et al. 2008, USFS 2014a, b). However, small numbers of adult bull trout use the lower reaches of Asotin Creek and its tributaries, and migrate between the Snake River and Asotin Creek.

3.1.4 Lamprey

Pacific lamprey are listed as a species of concern by the WDFW due to dramatically reduced adult returns (Schlosser and Peery 2010). Pacific lamprey have been affected by the same development activities as salmonids, but have received less conservation attention (Crandall and Wittenbach 2015). There are historical Nez Perce accounts of large numbers of lamprey returning to Asotin Creek (NPT 2013). The current status of reproducing lamprey is unknown. However, the Nez Perce are currently conducting a lamprey reintroduction program in Asotin Creek (Raymond Ellenwood, Nez Perce Tribe, Personnel communications). Adult lamprey are captured during their spawning migration up the Columbia and Snake River, held at the Nez Perce hatchery facility over winter, and released along the mainstem Asotin in the spring. Both Nez Perce and WDFW have documented juvenile lamprey in lower Asotin Creek which are presumed to be the off-spring of the reintroduced adults.

Pacific lamprey are anadromous and adults spend 1-3 years in the ocean. Lamprey migrate to tributary spawning areas in late spring and summer and may spend several months holding in streams before they spawn. Spawning usually occurs between February and July. Adult lamprey are attracted to spawning sites by pheromones produced by rearing juveniles and do not home to natal streams like salmon and steelhead (Crandall and Wittenbach 2015). Adult lamprey spawn in gravel and cobble dominated substrate in similar locations as steelhead. Juvenile lamprey rear in natal streams for up to seven years and require silt and sand substrates (Crandall and Wittenbach 2015). In gravel/cobble dominated streams like Asotin Creek, silt and sand deposits are usually found in off-channel habitat or in eddy pools behind structural elements like log jams.

A recent assessment of Asotin Creek was conducted to determine the habitat suitability of Asotin Creek for lamprey (Schlosser and Peery 2010). The suitability study suggested that George Creek and its tributaries were likely not suitable habitat for adults or juveniles because sections dewater, temperatures are high, and there is a lack of rearing and spawning habitat. Asotin Creek mainstem appears to have suitable habitat for adults as they use the same habitat as steelhead (clear, cool water, and gravel/cobble substrate).

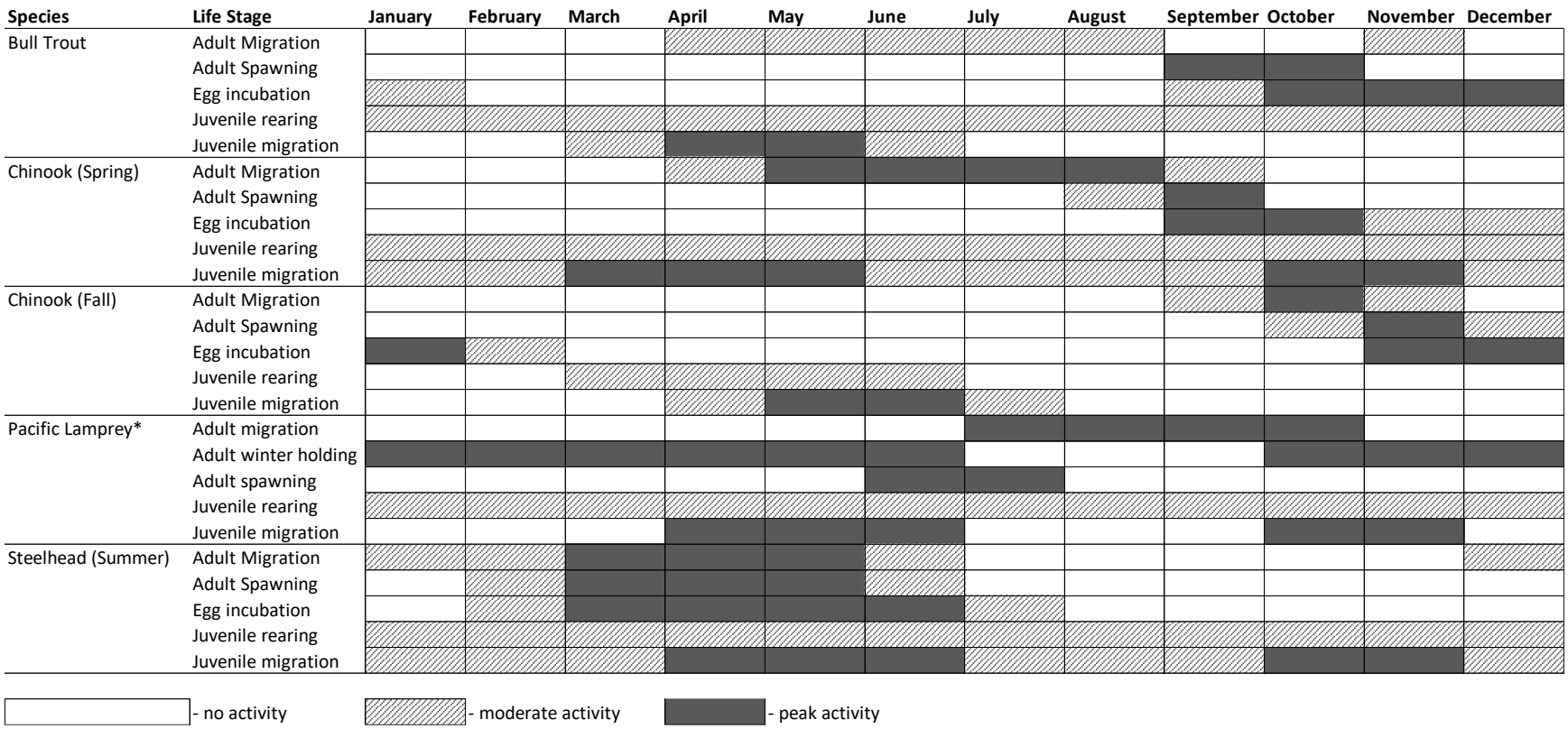


Figure 2. Timing of fish presence by life stage and month for key species in Asotin Creek. Data based on historic and ongoing WDFW surveys. Timing is expected to be similar for Alpowa, George, Couse, and Tenmile Creeks if the species is present (Figure 3).

Location					Chinook (spring)				Chinook (fall)				Steelhead				Bull trout			
Stream	Geographic Area	RM Start	RM End	Description of Geographic Area	Migration	Spawning	Juvenile Rearing	Adult holding	Migration	Spawning	Juvenile Rearing	Adult holding	Migration	Spawning	Juvenile Rearing	Adult holding	Migration	Spawning	Juvenile Rearing	Adult holding
Asotin	Lower	0.0	3.2	mouth to George Creek confluence	■				■	■	■	■	■	■	■	■	■			▨
	Mid	3.2	8.0	George Creek to Headgate	■	▨	■	▨	■	■	■	■	■	■	■	■	■			▨
	Upper	8.0	15.4	Headgate to Forks	■	■	■	■	▨	▨	▨	▨	■	■	■	■	■			▨
George	Lower	0.0	3.2	mouth of Pintler confluence									■	■	■	■				
	Mid	3.2	10.9	Pintler confluence to first river right tributary with steelhead present (just below USFS boundary)									■	■	■	■				
	Upper	10.9	~25	tributary junction to headwaters (includes tribuatries on USFS property)									▨	▨	▨	▨				
Charley	Lower	0.0	0.4	mouth to end of private property (Koch)			▨						■	■	■	■				
	Mid	0.4	7.1	Koch property to end of WDFW property									■	■	■	■				
	Upper	7.1	13.0	End of WDFW property (beginning of USFS) to headwaters									▨	▨	▨	▨				
North Fork	Lower	0.0	1.0	mouth to Lick Creek	■	■	■	■					■	■	■	■	■		▨	▨
	Mid	1.0	4.9	Lick Creek to USFS boundary	■	■	■	■					■	■	■	■	■		▨	▨
	Upper	4.9	~20	UsFS Boundary to Headwaters (Including forks of NF and Cougar)	▨	▨	▨	▨					■	■	■	■	■	■	■	■
South Fork	Lower	0	3.6	mouth to Warner Gulch			▨						■	■	■	■				
	Mid	3.6	8.3	Warner Gulch to USFS Boudary									■	■	■	■				
	Upper	8.3	10	USFS Boundary to Headwaters									▨	▨	▨	▨				
Alpowa	Lower	0	3	mouth to confluence with Pow Wah Kee					■	■	■	■	■	■	■	■				
	Mid	3	6.7	Pow Wah Kee to confluence with Stember									■	■	■	■				
	Upper	6.7	20	Stember to Headwaters									▨	▨	▨	▨				
Couse	Lower	0	3.2	mouth to first bridge crossing									■	■	■	■				
	Mid	3.2	5.2	bridge to end of fish distribution									▨	▨	▨	▨				
	Upper	NA	NA	no fish																
Tenmile	Lower	0	1.1	mouth to first bridge crossing									■	▨	■	■				
	Mid	1.1	10.7	first bridge to Mill Creek									■	■	■	■				
	Upper	10.7	15	Mill Creek to headwaters									▨	▨	▨	▨				

□ - no activity ▨ - moderate activity ■ - peak activity

Figure 3. Presence and approximate distribution of Chinook, steelhead, and bull trout starting at the mouth of the target watersheds.

GEOMORPHIC ASSESSMENT SUMMARY

3.1.5 Valley Confinement, Reach Types, and Geomorphic Units

The study area is dominated by reach types that are naturally confined or partly confined by the valley walls, and streams often run along steep bedrock cliffs. Valley widths rarely exceed 300' for large streams and 100' on small to medium sized streams. The most common reach types in these valley settings are characterized by a single channel, low sinuosity, moderate to high gradient, and long planar features (e.g., runs and rapids). Floodplains are patchy or discontinuous and pools are often forced by bars or large woody debris (LWD). Multiple channels can exist but they are usually forced by wood. Wandering gravel bed reaches that commonly have multiple channels and wider floodplains make up only 12% (22 miles) of the study area.

3.1.6 Geomorphic, Riparian, and Floodplain Functions

There are 182 miles of perennial stream in the study area and we found that 76% of the length had moderate to high geomorphic function (i.e., the expected frequency and type of geomorphic units in a reach type were often observed). Past conservation actions appear to have stabilized many limiting factors and in general, geomorphic conditions are stable or improving in most reaches. Limited geomorphic function was often due to low habitat diversity, lack of LWD, simplified channel planforms, and infrequent overbank flows. Riparian functions have recovered well from historic disturbances and we found that along the mainstems of the study streams 44.5% of the riparian areas had moderate function and 43.5% had high to near full function. Riparian areas with limited function were often due to reduced extent of riparian habitat, young riparian canopy, monoculture of species, invasive species, upland encroachment, and conversion to agriculture or development. We identified 498 acres (22%) of disconnected floodplain out of 2,237 acres of potential floodplain we assessed. Disconnected habitat was mainly caused by levees and rip-rap in the lower sections of streams that were installed for protection of infrastructure (i.e., houses and roads).

3.1.7 Other Assessments

Temperature assessments suggests that during cool years (i.e., high flow and/or low air temperature) streams rarely exceed mean maximum weekly temperatures of 64.4°F, but during warm years (low flow and/or high average air temperatures), the lower reaches of streams can exceed 64°F for almost 50% of the summer weeks (June to September). However, streams rarely exceed 72°F even during warm years. Results from the beaver restoration assessment tool suggest there is a high capacity to support beaver dams in most of the mid to upper reaches and the potential for conflict is generally low in these areas. Two partial barriers were identified at the mouth of Tenmile and Couse Creeks. These potential barriers appear to be caused by the operation of dams along the Snake River and Columbia River. Adult and juvenile can be unable to enter or leave Couse and Tenmile Creeks if the elevation of the Snake River is too low and/or the flows from these creeks goes subsurface before entering the Snake River.

CURRENT LIMITING FACTORS

Based on the results of the assessment, channel stability (defined as the channel being too unstable) is not an issue in most areas. The flooding, loss of LWD, straightening of many channels, and re-establishment of dense riparian areas dominated by alder has had the opposite effect – channels are "locked" in place and are very efficient at transporting sediment and wood. This situation leads to low habitat diversity and a lack of sorting of all substrate sizes (i.e., silt, sand, gravel, and cobbles). This means a lack of well sorted gravel bars for lamprey and steelhead spawning, cobble bars for winter juvenile steelhead concealment, and silt and sand bars and backwaters for juvenile lamprey rearing. We found no evidence of an over-supply of fine sediment, which is likely due to the

extensive investment in erosion control measures on the loess uplands in the past 20 years. Low flows continue to be observed especially in Couse, Tenmile, and George Creeks and their tributaries. However, these watersheds have groundwater dominated hydrologic regimes and are naturally prone to low flows. We suspect that past disturbances have exacerbated the flow conditions, but it is unknown by how much. High stream temperatures also continue to be observed in the groundwater dominated streams but, like flow, it is likely that these streams frequently had high stream temperatures due to low flow, high air temperatures, and low precipitation. We found that a lack of habitat diversity and key habitats (i.e., LWD and pool frequency, cover, gravel bars, undercut banks, off-channel habitat) continue to be a significant limiting factor. There are two general situations where this occurs: 1) areas where floodplain has been physically disconnected by way of levees or rip-rap, and 2) areas where there are no levees or rip-rap, but the stream is incised and rarely has overbank flows. There are infrequent overbank flows in these situations because of a lack of structural elements in the channel and because the surrounding riparian habitat is not contributing LWD. We characterize this state as a "legacy" effect of past disturbances. The major stressors have been removed (e.g., sediment supply, removal of LWD and loss of riparian areas, water withdrawals), and the stream is recovering, but it may take several more decades to see improvements without active restoration.

4 RESTORATION FRAMEWORK & STRATEGIES

RESTORATION FRAMEWORK

Acknowledgement of the importance of landscape level processes in creating and sustaining fish habitat has led to a change in how stream restoration is planned and implemented. Actions that are more process-based are now commonly used in stream restoration. The goals of process-based restoration are to: (1) address the root causes of degradation, (2) be consistent with the physical and biological potential of the site, (3) be at a scale commensurate with environmental problems, and (4) clearly articulate expected outcomes for ecosystem dynamics (Beechie et al. 2010). We used a similar prioritization and restoration framework as described by Roni et al. (2002) and used in the Tucannon River Geomorphic Assessment (AQEA 2011) to develop this conceptual restoration plan and identify high priority project areas. In general, protection of high quality habitats and maintenance of natural processes should be the first restoration priority (Figure 4). The second restoration priority is the removal of barriers and reconnection of disconnected habitats because these actions can often provide large benefits by opening access to miles of previously inaccessible habitat (Roni et al. 2008). Restoration of long-term processes is fundamental to achieving lasting and sustainable restoration of stream habitat (Spence et al. 1996). A common example of restoring long-term processes is the removal or realignment of confining features (e.g., roads and levees) to allow the stream access to disconnected floodplain. Removing confining features leads to more interaction between the floodplain and the stream channel which can promote sediment sorting, recharging of the water table, improved riparian conditions, and greater recruitment of nutrients and LWD (Beechie et al. 2008, Bellmore et al. 2013). Restoration of short-term processes are typically the lowest priority in the restoration framework. However, because of the time required to restore long-term processes (e.g., recovery of riparian function can take decades), short-term restoration actions like adding LWD to the stream can provide an immediate benefit and promote recovery of long-term processes. Addition of wood into the active channel can also enhance floodplain connectivity by promoting channel avulsions, slowing velocities and activating side-channels, and trapping sediment which raises the channel elevation (Wohl 2013, Roni et al. 2015).

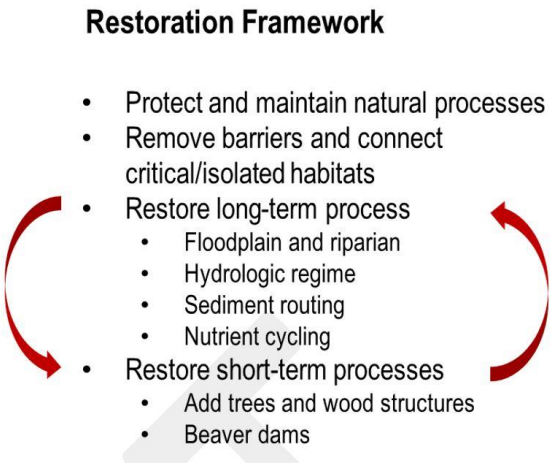


Figure 4. Restoration framework used in the Asotin Watershed Assessment. Adapted from Roni et al. (2002). Red arrows indicate that sometimes short-term processes need to be implemented in order to promote recovery of long-term processes (e.g., adding LWD debris to promote over-bank flow and channel avulsions, which can increase floodplain connection and promote riparian recovery).

REACH SCALE RESTORATION STRATEGIES

The restoration framework (Figure 4) provides the conceptual outline of priorities for watershed restoration. Within the context of the framework, we identified six general strategies to target the root causes of degradation in the study area. Specific project actions identified in the restoration plan fit within the general strategies defined below.

4.1.1 Protect and maintain natural processes

a) ***Protect fragile soils, maintain soil conservation practices, and protect and enhance riparian areas*** - Our assessment suggests that measures to minimize erosion in loess dominated watersheds and improve water quality (e.g., reduce fecal coliform levels in lower Asotin Creek) should continue to be a top priority. Numerous conservation programs are promoted by ACCD and NRCS in the county, and landowners have adopted many best management practices to reduce erosion. These efforts should be continued and enhanced where erosion concerns still exist. Riparian protection should also be a priority throughout the study area. Riparian habitat has shown great recovery in many areas, but these habitats can be easily damaged, and many riparian areas have been reduced in size which also makes them vulnerable to disturbance. Increasing the width of riparian areas where possible could help to reduce contaminant levels by buffering the stream.

4.1.2 Remove barriers and reconnect disconnected habitats

a) ***Barrier removal*** – We define barriers as single locations along a stream network that impede fish movement (upstream or downstream) such as perched culverts or dams. Removal of barriers is paramount to recovering fish populations and should be a top priority for active restoration actions as it can be cost effective and provide access to miles of habitat. However, in Asotin County it appears most of the fish barriers have been removed (e.g., Headgate Dam was removed completely in 2016). There are potential barriers caused by low or subsurface flows across the alluvial fan at the mouth of Tenmile and Couse Creeks that can restrict upstream and downstream movement of both adults and juvenile fish during some years. Addressing these barriers will involve a multi-stakeholder and agency participation as the cause of the barriers is varying levels of the Snake River due to dam operations throughout the Columbia and Snake hydro systems. Only one other barrier has been documented in the study area and that is a culvert barrier in a non-fish bearing reach of Lick Creek (WWCC 2008).

b) ***Reconnect habitats*** – We define disconnected habitats as floodplain areas (including side-channels and off-channel habitat) that would have been accessed by regular high flows (e.g., ever 2-5 years) but are currently inaccessible due to physical features (levees, rip-rap, etc.). Disconnected habitats are generally restricted to the lower mainstem reaches where infrastructure density is highest. The disconnection of floodplain reduces the extent of riparian vegetation that can lead to increased water temperatures and reduced input of wood to streams. Confining features such as rip-rap, levees, and dikes increase the velocity of high flows because the water is contained within the channel. This also leads to a coarsening of the sediment in the reach, reduces the number of pools, and reduces the quality and abundance of edge habitat. These confined channels transport wood more effectively which reduces cover for adult and juvenile fish. Fish are especially susceptible when the flows are high because there is limited velocity refugia in these sections. Survival of adult and juvenile fish could be increased if they could access off-channel habitats during high flows.

c) ***Promote overbank flow*** – We present this restoration strategy to contrast it with ***reconnect habitats*** above because there are many cases where the floodplain is functionally disconnected from the channel but there are no obvious features (e.g., levees) but rather it is degraded channel conditions that are preventing overbank flow. The low frequency and duration of overbank flows is a major contributing factor to simplified geomorphic conditions and limited fish habitat in the study area. Actions that promote overbank flow during regular flood events (e.g., 2-year recurrence interval) should be a priority in most reaches. This is a similar strategy to "reconnecting habitats" but has some important differences. Unlike reconnecting habitats, promoting overbank flow is appropriate where there are no artificial confining features. Successive floods over the last 200 years, removal of riparian areas, straightening of the channel, and removal of LWD have created very efficient "bowling alleys" out of many of the streams. In order to "reconnect" these streams to their floodplains, restoration strategies are needed that promote overbank flow (i.e., stage height of the stream exceeds the bank height and water flows out onto the floodplain). Strategies that either cause avulsions (i.e., rapid abandonment of the current channel and the formation of a new channel), deposition, or the slowing of flows would all help to achieve greater overbank flow. The IMW has recently installed almost 700 wood structures in Charley, North Fork, and South Fork Asotin Creeks and demonstrated that overbank flow can be achieved in these systems (Bennett et al. 2017). Once overbank flow is more common (i.e., every 1.5-2 years on average), riparian areas will have the ability to expand (i.e., increased height and extent of the water table), more refuge habitat will be available for fish during high flows, wood recruitment will increase, and groundwater recharge will increase. These responses can lead to improved riparian function, less solar input to streams (less heating), better sediment sorting and storing (i.e., more gravel bars created for spawning, more sediment trapped on floodplain), and reduced peak flows.

4.1.3 Long-term processes

a) *Riparian enhancement and management* - Many of the mainstems of the study creeks have some form of riparian protection and as a result, riparian function is moderate to good in the majority of the study area. However, significant areas are still in need of riparian management. A variety of riparian management strategies will be required depending on the specific conditions and needs of landowners. In many areas, invasive weeds and/or upland encroachment are impairing the function of riparian areas. Active weed management and planting may be required in these areas. In other areas, grazing pressure is damaging riparian plants or preventing recruitment. Fencing and off-site water developments have been proven to help manage grazing pressure in these situations and have been successfully implemented by ACCD and their partners in the study area.

4.1.4 Short-term processes

a) *Improve Instream Habitat* - A common impairment of fish habitat in Asotin County is low habitat diversity. Legacy riparian disturbance, limited floodplain connection, and past floods have all led to low volumes of LWD in

the streams. LWD is a main driver of habitat complexity and its importance in stream processes is no longer in dispute (Roni et al. 2015). There are several alternatives to adding LWD to create habitat complexity. In areas of confinement and high densities of infrastructure (i.e., near towns and bridges), restoration strategies will require engineered approaches to reduce the potential that structures will fail or cause unintended consequences. However, in large portions of the study area where infrastructure is minimal, it may be appropriate to use non-engineered LWD restoration approaches such as post-assisted log structures or whole trees (Wheaton et al. 2012, Carah et al. 2014). In naturally confined reach types (e.g., bedrock canyons), boulders and colluvium from adjacent hillslopes may replace LWD's role as the primary structural element because they can withstand higher stream power.

WATERSHED SCALE (UPLAND) RESTORATION STRATEGIES

There are a variety of other management strategies that could be beneficial to overall restoration objectives but require implementation in upland areas and/or at the watershed scale. Many of these strategies will require coordination with land management agencies (e.g., WDFW, USFS) and/or private landowners. It is beyond the scope of this conceptual restoration plan to develop detailed restoration strategies and plans for watershed scale processes. Also, watershed level planning will require coordination between multiple land management agencies, local and state governments, and private landowners. However, we have provided a set of strategies for promoting and maintaining watershed level conservation, restoration, and maintenance habitats and processes that will also benefit instream and riparian conditions

4.1.5 Fuel reduction

Fuel reduction is a necessity across the west. Using a coordinated thinning program could be very effective at meeting fuel reduction, wildlife management, and stream restoration objectives. Snags, Legacy Trees, Openings, Patches, Piles, Shrubs, and Logs (SLLOPPS) is a forest fuels reduction approach that can be used to provide LWD small woody debris material for the benefit of forest wildlife and creating fish habitat (Strong et al. 2016).

4.1.6 Alternative riparian management

Traditional riparian management actions (i.e., fencing/exclusion) could be substituted in selected areas with controlled grazing that focuses on managing the timing, duration, frequency, and intensity of the grazing. Managed grazing in riparian areas can increase vigor and function and provide landowners with increased cattle production and alternative grazing areas (Swanson et al. 2015, Kozlowski et al. 2016). Implementation of this strategy should be accompanied by an active grazing management plan and monitored to avoid negative impacts to riparian and floodplain areas. Additionally, riparian buffers surrounding upland swales and sediment basins among agricultural lands in the dissected loess uplands should be considered. Perennial and woody vegetation adjacent to sensitive headwater channels can filter fine sediment and nutrient runoff from agricultural and range lands, provide wildlife and migratory bird habitat, and provide a native seed source for downstream reaches.

4.1.7 Beaver management

Recognition and use of beavers as nature's engineers is not new, but the increase in beaver management as a part of stream restoration has become very popular in recent years (Pollock et al. 2015, Bouwes et al. 2016). There is an enormous potential in the study area to achieve multiple objectives at low cost by having beavers do the work. We suspect that many of the perennial streams were home to beaver populations prior to Euro-American settlement. Evidence of beaver activity is still common and dams have been documented on the mainstem of Charley, North Fork, and South Fork Asotin Creeks. It is speculated that high densities of cougars and poor habitat conditions (long stretches of shallow habitat) are preventing beaver from recolonizing the study area. We propose developing a beaver management plan in conjunction with WDFW and local landowners prior to attempting a reintroduction.

4.1.8 Nutrient enhancement

Nutrient enhancement (e.g., adding fish carcasses or analogs) has the potential to increase the effectiveness of stream restoration actions and this strategy could be implemented as a trial in the study area. There was a much more diverse fish assemblage in the study area historically and much higher densities of returning adults which would have provided substantial marine derived nutrients to the system. The reduced diversity and abundance of anadromous fish could be limiting the current carrying capacity by reducing primary productivity and this could be tested with a trial. Nutrient enhancement has been moderately successful in some areas, but it is not widely used, and it is not clear how effective it is (Harvey and Wilzbach 2010, Childress et al. 2014, Bellmore et al. 2017)

RESTORATION GOALS

The recovery goals of the Snake River Salmon Recovery Board are "… to have all extant populations [of salmon, steelhead, and bull trout] at either viable (low risk) or highly viable status, with representation of all the major life history strategies present historically, and with the abundance, productivity, spatial structure and diversity attributes required for long-term persistence" (SRSRB 2011). The restoration strategies we are proposing to meet these goals are consistent with the strategic guidelines for restoration adopted by SRSRB (2011) and include actions that have a long "life span", distribute benefits across a range of environments, and blend immediate actions (not necessarily process-based) with long-term actions that deal with root causes of habitat impairment. The Snake River Salmon Recovery Board developed a set of general restoration objectives for the major spawning areas (MaSA) in the Asotin Creek study area (Table 2). Couse and Tenmile Creek are considered minor spawning areas and were not assigned have specific restoration goals in the recovery plan. We suggest the restoration goals for George Creek be applied to Couse and Tenmile Creeks as they have similar characteristics.

Table 2. Summary of habitat factors and associated objectives for Asotin Assessment Study Area Major Spawning Areas (MaSA). Reproduced from SRSRB (2011).

MaSA	Priority	Habitat Factor and Objective
Alpowa Creek	I.	Riparian > 80% of maximum
	II.	Embeddedness < 10%
	III.	Temperature ≤ 4 days > 72 °F
	IV.	Large Woody Debris > 1 piece per channel width
Asotin Creek	I.	Large Woody Debris > 1 piece per channel width
	II.	Embeddedness < 10%
	III.	Bed scour reduce to < 10 cm
	IV.	Riparian > 75-90% of maximum
George Creek	I.	Embeddedness < 10%
	II.	Large Woody Debris > 1 piece per channel width
	III.	Riparian > 75% of maximum
	IV.	Temperature ≤ 4 days > 72 °F

5 PRIORITIZATION FRAMEWORK METHODS

LINK TO GEOMORPHIC ASSESSMENT

We used the geomorphic assessment results as the foundation for prioritizing reaches for restoration. We based the geomorphic assessment on the River Styles Framework developed by Brierley and Fryirs (2005) which distills an assessment into understanding "… why rivers are the way they are, how they have changed, and how they are likely to look and behave in the future." The assessment consisted of three stages. In Stage 1 we described the landscape setting and each unique reach type within the study area. The landscape setting (i.e., geology, climate, topography, vegetation) controls the range of reach and habitat types available to fish and the productive potential of a watershed. We identified four landscape units and nine reach types in the study area (Appendix A.3&4). Two reach types were non-fish bearing, and four types contained the majority of fish bearing reaches. See Bennett et al. (2018) for detailed descriptions of each reach type.

In Stage 2, we determined the condition of each reach type using field visits and GIS data. We compared current reach conditions to expected reach conditions based on an understanding of geomorphic unit assemblages, instream structure and diversity, and floodplain and valley conditions. We characterized the geomorphic condition of a reach as having limited, moderate, high, or full form and function. We also assessed other key factors that influence fish habitat such as stream temperature, fish barriers, hydrologic regime, riparian condition, and valley fragmentation (i.e., amount of anthropogenic confinement). In Stage 3, we determined the recovery potential of each reach. We define the geomorphic recovery potential as the capacity for natural improvement of the geomorphic condition in the foreseeable future (e.g., 5-25 years).

We overlaid GIS layers that contained the results from our geomorphic assessment reach typing, geomorphic condition assessment, and recovery potential, and created a single layer that identified 83 reaches with a unique combination of reach type, geomorphic condition, and recovery potential. We refer to these reaches for the remainder of this report as ***project areas***.

REACH SCALE RESTORATION PRIORITIZATION

We used the geomorphic assessment results (Bennett et al. 2018) and a series of workshops and tele-conferences to determine the components we would review and/or include in a framework used to prioritize restoration. We selected five components to include in the framework:

- Geomorphic Opportunity
- Potential Fish Capacity Increase
- Water Quantity and Temperature
- Cost of Restoration
- Fish Distribution and Use

Project areas were evaluated based on the components of the framework and categorized into four implementation tiers. Tier 1 projects are considered the highest priority for implementing restoration because the benefits to habitat conditions and fish populations are expected to be more likely in the short-term (5-10 years). Tier 2 project areas are a moderate priority to implement restoration and may have similar benefits to habitat and fish populations but may take longer or require more restoration actions than Tier 1 project areas. Tier 3 project areas have the lowest priority for restoration actions because they are in the most degraded condition, have lower

recovery potential, and/or may have multiple factors that are causing degradation that will take considerable effort, cost, and time to improve. Tier 4 project areas are classified as conservation and enhancement areas. Tier 4 areas are typically in good geomorphic condition and are recovering naturally or from past restoration actions, towards more full geomorphic function. The conservation reaches typically are located in the upper reaches of the study area.

Below we describe the components we used for ranking project areas. Each component may include multiple factors that were given scores based on the results of specific analyses conducted in the geomorphic assessment or from input from the Working Group. We assigned scores to factors such that high values represent conditions that would be more optimal for restoration (i.e., physical and biological responses would be larger and/or more rapid). Factor scores were combined into a composite score and normalized to a value between 0 and 1 for each component. The scores for each component were then combined for a total score for each project area. Finally, the Working Group developed scenarios where different weights (i.e., scalars) were used to emphasize the importance of different sets of components. A single scenario was chosen by the Working Group after review of 10 different options.

5.1.1 Geomorphic Opportunity

We used the key outputs from the geomorphic assessment to assess the geomorphic opportunity (i.e., likelihood to restore geomorphic processes and key habitats). We used three factors to generate a score for the geomorphic opportunity component: reach type, geomorphic function, and recovery potential (Table 3 and 4). This approach gave project areas dominated by wandering gravel bed reach types (with the most extensive floodplain of all the reach types), high geomorphic function, and with a high recovery potential the highest scores. Wandering gravel bed reach types with high geomorphic function are found primarily along portions of the mainstem Asotin Creek and North Fork Asotin Creek. Project areas that also received high scores for geomorphic opportunity were planform controlled and fan controlled reach types, with moderate or high geomorphic function, and high recovery potential. These project areas were common in portions of Charley Creek and Tenmile Creek. Reaches that had low recovery potential could still be ranked as high priority reaches if the potential biological or water quality benefits were high and cost of the restoration was not considered a significant factor.

Table 3. Valley setting and reach types of project areas within the study area. See Appendix A.4 a map of reach types and see Bennett et al. (2018) for detailed description of the reach types.

Valley Setting	Reach type	Score
Partly Confined	Wandering Gravel Bed	5
Partly Confined	Planform Controlled Discontinuous Floodplain	3
Partly Confined	Fan Controlled Discontinuous Floodplain	3
Unconfined	Alluvial Fan Dissection	1
Confined	Occasional Floodplain Pockets	1
Confined	Steep Headwater	1
Confined	Bedrock Canyon	1

Table 4. Scores given to project areas with specific geomorphic conditions and recovery potentials.

Geomorphic Function	Recovery Potential	Score
High	High	5
Moderate	Moderate	3
Limited	Low	1

* Note – there were no reaches in the study area that were considered to have full geomorphic function.

5.1.2 Potential Fish Capacity Increase

We determined the potential fish capacity using models that relate reach type, geomorphic function, and the results from the net rate of energy model (Wall et al. 2015 and 2016) that estimate fish carrying capacity of a reach. We identified individual geomorphic units derived from 112 high resolution topographic surveys available from the Columbia Habitat Monitoring Protocol (CHaMP; champmonitoring.org) that represent the reach types common in the study area. We identified geomorphic units using the Geomorphic Unit Delineation Tool (GUT) developed by the Ecogeomorphology and Topographic Analysis Lab at Utah State University (https://github.com/Riverscapes/pyGUT; Wheaton et al. 2016). GUT produces a map of topographic forms (Tier 2) and a map of geomorphic units (Tier 3). The Tier 2 units identify the shape of the topography as bowls, mounds, troughs, planes, walls, bowl transitions and trough transitions. The Tier 3 output maps geomorphic units as margin attached bars, mid-channel bars, run-glides, banks, riffles, pools, pocket pools, ponds, chutes, cascades, transitions, and rapids based on a combination of shape of the topography and position within the channel. The geomorphic unit maps of the 112 sites provided a database of the percentage of different geomorphic units across different reach types and geomorphic conditions.

Second, we used CHaMP topographic surveys, along with a 2D hydraulic model to model fish locations, capacity of the survey reach, and each geomorphic unit using the net rate of energy intake (NREI) approach (Wall et al. 2015 and 2016). The NREI model predicts the most energetically suitable location for a ***juvenile steelhead*** based on the topography, hydraulic model, stream temperature, food, and territorial rules of salmonids. The model produces a grid of NREI values in the reach and selects the highest NREI value in the reach (i.e., where fish growth will be maximized) to locate a fish. The model continues to locate fish in the reach until no more fish can be added without violating territory rules. Food and temperature inputs were held constant to produce estimates consistent with variations in geomorphic and hydraulic habitat features. By overlaying the NREI results on the GUT output, we were able to get estimates of the proportion of each geomorphic unit that is used by fish (fish/ft^2). In general, fish densities were more variable between geomorphic unit types than between the same geomorphic unit mapped in different reach types. For example, juvenile densities in pools varied from 2.7-8.1 fish/ft^2 across all reach types, whereas juvenile densities for most other units were < 2.7 fish/ft^2.

Third, we mapped the reach type and geomorphic condition for the entire perennial stream network (these were available from the geomorphic assessment). We then used the current geomorphic unit assemblages from the GUT output and the carrying capacity estimates from NREI to determine the current fish capacity for each 1640 ft (500 m) segment of the perennial stream network using the formula:

Bankfull Width (ft) * Segment Length (ft) * %Area Unit in BF * Density of fish (#/ft^2) = # fish in Unit

Where Bankfull width was measured in the field or estimated from GIS, segment length = 1640 ft, %Area Unit in Bankfull = total area of a geomorphic unit type/total area of topographic survey area, Density of fish = number of fish/area of geomorphic unit based on NREI placement of fish and area of each geomorphic unit. We determined the total fish capacity for a project area by summing up all fish capacity estimates for each segment within the project area. We then estimated the carrying capacity of a restored project area the same way by assuming the geomorphic condition improved one category level (e.g., limited to moderate, or moderate to high function). We

did not estimate changes in fish capacity for reaches already with high function that could move to full function. In general, when the geomorphic function increased the capacity for juvenile fish increased. We calculated the potential increase in fish capacity per mile by:

(Restored fish capacity – current fish capacity) / length of project area = Δ fish capacity/mile

Project areas that already had good geomorphic function were excluded from this analysis and assigned as "conservation and enhancement" areas unless they were isolated (i.e., limited or moderate function reaches upstream and downstream). See section 10 for more detail on conservation areas. We used juvenile steelhead capacity for ranking purposes because they are the dominant salmonid species in the study area and the focus of the assessment. Ranking of reaches based on fish capacity would likely change if we used other salmonid species (e.g., chinook or bull trout) or other species of fish (e.g., lamprey).

5.1.3 Water Quantity and Temperature

The geomorphic assessment confirmed previous studies that several of the streams in the study area are prone to exceeding state stream temperature standards and that sections of some streams can run dry during years of low precipitation. The characteristics of the study area that contribute to these conditions are low elevations with minimal snow pack and a climate that is hot and dry for much of the year (e.g., precipitation is < 20" across much of the watersheds). The following describes how we used data gathered during the geomorphic assessment to identify and prioritize project areas that have more consistent flow and lower temperatures.

Hydrologic regime

Liermann et al. (2012) classified Washington state rivers by hydrologic regime and then used climate change scenarios to determine how hydrologic regimes may change across the state. We used this data set to classify project areas based on their potential to change from one hydrologic regime to another because of climate change. The study area currently has five hydrologic regimes: snowmelt, snow-rain, rain, and groundwater dominated flows. We determined the hydrologic regimes for the current and two predicted climate change scenarios for each project area based on Liermann et al. (2012). We then assigned scores to each project area based on the current hydrologic regime giving snowmelt the highest and groundwater the lowest rank (Table 5). We summed the difference between the score for the current hydrologic regime and the scores of the hydrologic regime under each climate scenario: *(current – A1B) + (current – B1)*. If there was no change in the hydrologic regime under either climate scenario the project area got the highest score (5) for "climate change resilience."

Table 5. Scores assigned to hydrologic regimes.

Regime	Score
Snowmelt	5
Snow-Rain	4
Rain	2
Groundwater	1

Stream Temperature

We used the stream temperature model results from the geomorphic assessment to classify portions of the study area into temperature regimes. There was a strong correlation between the temperature model results and river mile, with lower elevation river miles (i.e., lower elevation reaches closer to the mouth) being warmer than higher elevation river miles. We assigned stream segments a value between 1 and 4 with lower numbers being warmer and therefore a lower priority for restoration assuming it will be difficult to change the temperature regime (Table

6). We classified stream segments based on the temperature model results to estimate the "temperature" regime of broad areas (0-5, 5-10, 10-15, > 15 river miles from mouth); cooler reaches are given higher priority.

Table 6. Temperature regime scoring

River Mile	Temperature	Score	Description
>15	Cool	4	does not exceed 64.4°F during summer
10-15	Optimum	3	exceeds 64.4°F < 25% of summer weeks
5-10	Warm	2	exceeds 64.4°F > 25-50% of summer weeks
0-5	Hot	1	exceeds 64.4°F > 50% of summer weeks

Low Flow

We mapped the approximate areas of each stream where the flow goes subsurface each year (always), occasionally (i.e., during very dry year) or puddled most years, and those that never go subsurface and assigned them values with high values representing stream segments that do not go dry (Table 7). Finally, we combined the scores for hydrologic regime, stream temperature, and propensity to go subsurface into one score representing a composite water quantity and temperature for each project area.

Table 7. Susceptibility to limited or loss of surface flow.

Goes Subsurface	Score	Description
Always	1	goes subsurface every year
Sometimes	3	goes subsurface or puddled occasionally (i.e., very dry years)
Never	5	never goes subsurface

5.1.4 Potential Restoration Cost

We estimated the potential cost of each restoration action using published stream restoration costs, actual cost of restoration projects within the Snake River Salmon Recovery Region, and our experience. A separate cost per mile was estimated for each restoration action type and then a simple scalar was applied based on the size of the stream. We used bankfull width as our measure of stream size and doubled the cost of a restoration action each time the bankfull width category increased (Table 8). The higher the total cost/mile the lower a project area was scored.

Table 8. Cost estimates for restoration based on restoration action and bankfull width.

	Bankfull Width Category (m)		
Restoration Action	**<5**	**<10**	**>10**
Barrier Removal*		to be determined	
Levee	50,000	100,000	200,000
Reconnect Habitats	50,000	100,000	200,000
Promote Overbank Flow	20,000	40,000	80,000
Riparian Enhancement	5,000	10,000	20,000
Instream Habitat	20,000	40,000	60,000

* Due to the wide differences in the complexity and types of potential barrier removals these costs were not estimated. There were also no barriers that were identified as a priority for restoration.

5.1.5 Fish Distribution

We worked with local WDFW staff to document the fish distribution and use of the perennial network to use as a potential factor in prioritization. Fish species presence and use (migration, juvenile rearing, adult spawning, and adult holding) was estimated based local experience and numerous historic and current fish surveys (CITATIONS). Fish distribution and use was estimated across broad scale areas (lower, mid, and upper watersheds) and then these broad areas were scored based on the number of species that used the areas and the types of use (Table 9). Steelhead were given higher scores than other species because they are the dominant species in the watershed and have the broadest distribution.

Table 9. Fish distribution and use scores.

Species	Low/Moderate Use	Peak Use
Steelhead	3	5
Chinook	1	3
Bull trout	1	3

* no use = 0

Potential adult and juvenile fish barriers were identified at the mouth of Couse and Tenmile Creek due to changes in the elevation of the Snake River upstream of Lower Granite dam. The Working Group decided to exclude these from the Conceptual Plan. We also excluded one culvert barrier identified on Lick Creek was also excluded from the Conceptual Plan because it was outside the known fish distribution. No other barriers were identified in the assessment area (see the Geomorphic Assessment report for more details).

6 PRIORITIZATION FRAMEWORK SUMMARY RESULTS

In the Geomorphic Assessment report, we summarized the current geomorphic and riparian function of the target watersheds and presented restoration strategies to improve degraded functions (Bennett et al. 2018). In this this Section, we present a summary of the 1) expected benefits of restoration actions in general and for specific areas in within the target watersheds, and 2) results of conceptual restoration designs for specific Project Areas and rank Project Areas based on a systematic prioritization framework.

GENERAL EXPECTATIONS AND PRIMARY BENEFITS OF RESTORATION ACTIONS

The list below represents the default expectations/benefits of the primary restoration actions. The following lists by watershed/area highlight deviations from the general expectations specific to that watershed/area.

6.1.1 Primary Issues

- Low geomorphic diversity
- Reduced extent of riparian vegetation
- Disconnected floodplain (levees or rip rap) or lack of regular overbank flow (incision)
- Invasive vegetation and/or upland encroachment
- Low flows (natural, but exacerbated by historic floods and development)
- High stream temperatures (natural, but exacerbated by degraded riparian vegetation, historic floods, and development)

6.1.2 Recommended Actions/Benefits

- Protect recovering processes
  - Isolated pockets of quality habitat and recovering processes should be connected to increase their potential benefit
  - Future LWD recruitment and LWD seed source
  - Flood hazard buffering for downstream reaches
- Reconnect - Levee setback/removal
  - Increase accessible floodplain/accommodation space to allow stream to build critical habitat features (side and flood channels, off-channel rearing areas, wetlands)
- Long-term processes – Riparian and Upland Management
  - Planting for future LWD seed source, chemical/sediment filter to mitigate sediment from adjacent agricultural and urban areas, shade to moderate stream temperatures
  - Planting should target newly connected flood channel or floodplains
  - Invasive vegetation control to improve survival of native plants (this is too extensive to map – generally, all PAs should have a weed control component),
  - Upland vegetation encroachment is likely pervasive and is an indicator of lowered water table when upland vegetation is encroaching into the floodplain. Reconnecting the floodplain could control, but may also require weed management
- Short-term processes – Add Structural Elements
  - Increase geomorphic/hydraulic diversity to improve rearing habitat through creation of high flow refuge, predator refuge, energy refuge, cover
  - Improve sediment sorting to trap pockets of fines, increase concealment opportunities for juveniles, increase spawning areas for adults, increase rearing areas for lamprey
  - Increase hyporheic exchange to help moderate stream temperatures
  - Increase floodplain roughness to encourage fine sediment deposition and create more planting opportunities, more potential for natural riparian recruitment, and prolonged water storage
  - Trap LWD transported during larger floods to reduce downstream flood hazard

LOWER ASOTIN – DS OF GEORGE CREEK (WANDERING GRAVEL BED)

6.1.3 Primary issues

- Functioning as a transport zone; evidence suggests historic deposition/accumulation zone
- Disconnected floodplain due to levees, agricultural/residential infrastructure
- Low geomorphic/hydraulic diversity
- Limited fish rearing habitat
- High stream temperatures

6.1.4 Recommended Actions

- Reconnect - Levee setback/removal
  - Promote development of multiple channels, increased deposition, and open up flood channel habitat to provide high flow refuge for juveniles
- Long-term processes – Riparian and Upland Management
  - Limited benefit to stream temperature from planting due to existing vegetation; greater benefit may be from reconnecting floodplain in upstream PAs
- Short-term processes – Add Structural Elements
  - Likely require engineered/stable structures due to proximity to infrastructure
  - Boulders would be suitable alternative to LWD or combined with LWD

- Floodplain access may be limited due to development, which makes structural elements more important to add

MID ASOTIN – US OF GEORGE, DS OF RM 12.6 (PLANFORM CONTROLLED, CONFINED WITH OCCASIONAL FLOODPLAIN POCKETS, BEDROCK CANYON)

6.1.5 Primary Issues

- Currently functioning as transport zone; planform Controlled sections should be transitional (moderate mix of erosion and deposition in equilibrium)
- Disconnected floodplain due to levees, agricultural/residential infrastructure
- Isolated pockets of high quality habitats are disconnected from each other
- Low frequency of overbank flow, geomorphic/hydraulic diversity, fish rearing habitat, and high stream temperatures

6.1.6 Recommended Actions

- Reconnect - Levee setback/removal
  - Opportunities for levee setback/removal are greatest in Partly Confined Planform Controlled reaches and can provide high flow refuge for juveniles, reduce stream power to encourage deposition, and increase accommodation space for stream to develop occasional side and flood channels
- Short-term processes – Add Structural Elements
  - Improve edge habitat in Bedrock Canyon reaches by adding LWD on outside meanders. Boulders are a suitable alternative to LWD and could be placed sporadically to improve rearing habitat and provide flow refuge for juveniles and adults
  - Confined with occasional floodplain pocket reaches are similar to Bedrock Canyon reaches, but have more energy relief because of the floodplain pockets. LWD could be added but should be designed to be stable. Use structural elements to direct flow at the floodplain pockets to increase inundation frequency

UPPER ASOTIN – US OF RM 12.7 TO CONFLUENCE OF NORTH FORK AND SOUTH FORK ASOTIN CREEK (WANDERING GRAVEL BED)

6.1.7 Primary Issues

- Disconnected floodplain due to levees, agricultural/residential infrastructure
- Low geomorphic/hydraulic diversity
- Isolated pockets of high quality habitats are disconnected from each other.; some pockets are functioning very well
- Low frequency of floodplain inundation in some areas – if not restricted by levees, channel is often incised

6.1.8 Recommended Actions

- Short-term processes – Add Structural Elements
  - Promote overbank flow, specifically by directing flows into contemporary and relic secondary channels to increase the frequency of overbank flows to every 2 years on average
  - Spawning habitat is likely not limited, but this area is a priority spawning area, so any improvements to sediment storage and sorting, pools, and cover will benefit spawning opportunities/success
  - Flow benefits should be a focus in this section because of the potential to improve flow conditions downstream by slowing runoff and increasing sediment retention. Improving access to the floodplain and increased flood frequency should be a primary goal of projects. Increased hyporheic exchange,

overbank flows, and diverse hydraulics should benefit downstream reaches by moderating stream temperatures and extending the receding limb of the hydrograph
- Sediment accumulation could be rapid in this section with an increase in structural elements due to the high bed load that is transported through this section. Aggrading the bed will further promote overbank flows and improve floodplain function

ALPOWA AND CHARLEY CREEKS

6.1.9 Primary Issues

- Low geomorphic and hydraulic diversity
- Sediment is poorly sorted, often uniformly distributed
- High proportion of fine sediment, which is exacerbated by poor sediment sorting
- Channel is often incised (Charley Creek) or includes levees/rip rap (Alpowa), limiting frequency of floodplain inundation
- Upland and invasive vegetation encroachment (especially Charley Creek)

6.1.10 Recommended Actions

- Short-term processes – Add Structural Elements
  - Aggrade the bed to promote overbank flow; due to low stream competence this goal could take several years of aggradation (especially in Alpowa Creek), but should be a primary goal.
  - Raise the water table to improve riparian growth/establishment
  - LWD would increase hydraulic diversity and improve sediment sorting. Rather than uniform distribution of fines across the bed, they would accumulate in pockets near structures

SOUTH FORK ASOTIN

6.1.11 Primary Issues

- Armored, planar bed – highly simplified morphology and hydraulics
- Very infrequent floodplain inundation
- Incised channel

6.1.12 Recommended Actions

- Short-term processes – Adding Structural Elements
  - Slowing water and sediment transport should be primary goal of projects
  - There is large bed load movement to raise the bed if LWD additions are in high enough density
  - Promote overbank flows and reconnection of relic side channels by LWD placement; could speed up reconnection by breaching bank on upstream end of side channel

GEORGE, PINTLER, TENMILE, COUSE, PAGE, POW WAH KEE, KELLY, PAGE, AND SMALL TRIBUTARIES

6.1.13 Primary Issue

- Excessive sediment (very active sediment deposition); natural, but likely exacerbated by anthropogenic impacts
- Low floodplain roughness and little to no riparian vegetation
- Often poorly sorted sediment
- Low summer base flows (or completely subsurface)
- Low geomorphic and hydraulic diversity

6.1.14 Recommended Actions

- Long-term processes – Riparian and Upland Management
    - Planting in portions of George, Pintler, Couse, Tenmile, and tributaries that do not have perennial flow is very challenging. Future planting efforts should follow efforts to mitigate flow and sediment issues.
    - Short-term processes – Adding Structural Elements
        - Flow improvements should be the primary goal throughout, especially in upper reaches and upstream Project Areas. Slow the spring runoff and recharge the groundwater to increase summer base flows downstream
        - Addressing excessive sediment is likely impractical; however, the lack of structural elements leaves these reaches in a static state where high flow events are not effective at altering the channel in a way that produces quality salmon habitat. These reaches are highly dynamic and transport a lot of sediment, so there would likely be a quick geomorphic response to LWD additions

Floodplain often lacks the structure to facilitate the creation of beneficial floodplain features. These reaches often have the flows to access the floodplain every 1-5 years, but water and sediment is not being stored, leaving an unsorted, poorly defined channel dominated by cobble and boulders. Structural elements on the floodplain would encourage fine sediment deposition, increase water storage, and promote riparian health.

SELECTION OF PRIORTIZATION SCENARIO

We developed 10 different scenarios to prioritize reaches in the study area and discussed the scenarios with the working group at two workshops and a tele-conference. The scenarios weighted each of the five restoration framework components differently to assess how it affected the priority of a reach. We used scalars to weight each component of the framework (geomorphic, potential fish capacity increase, water quantity and temperature, cost of restoration, and fish distribution and use). Five scenarios used a scalar of 1 for one component while setting the other components to 0. The other five scenarios used scalars of ~ 0.5 for one component while setting other components to 0.25 and/or 0.05-0.1. After reviewing and debating the pros and cons of the 10 scenarios, the working group chose a scenario that weighted geomorphic opportunity 0.45, potential fish increase 0.25, water quantity and temperature 0.25, potential restoration costs 0.0, and fish distribution and use 0.05. This scenario was chosen because it weighs the geomorphic assessment results higher and the working group felt that the geomorphic assessment results were the most consistent and reliable.

PRIORITIZATION OF PROJECT AREAS

The prioritization framework and scenario we used to weight the different components resulted in 24 Tier 1, 23 Tier 2, 24 Tier 3, and 12 Tier 4 Project Areas (Table 10, Appendix B. 1-5, Appendix C. 1, Appendix D).

6.1.15 Tier 1 Project Area Summary

Tier 1 projects are those projects that should be considered for early implementation within Asotin County. In general, the actions recommended for these projects are expected to provide an immediate physical and biological response by addressing the limiting factors identified in the project area. The Tier 1 projects are distributed mostly in Asotin Creek and its tributaries (24), Tenmile (3), and Couse (1). See Section 6 for Tier 1 Project Descriptions and Appendix D for Tier 1 Conceptual Design maps.

6.1.16 Tier 2-3 Project Area Summary

We identified 23 Tier 2 and 24 Tier 3 projects areas (Appendix B. 1-5, Appendix C. 2-3). Tier 2 and 3 project areas are in lower priority reaches because the responses are expected to take longer or the biological and physical

responses are expected to be less than Tier 1 projects. However, these projects are still worth pursuing, especially if landowners are willing to support such projects. See Section 6 for Tier 1 Project Descriptions and Appendix D for Tier 1 Conceptual Design maps.

6.1.17 Tier 4 Project Area Summary

We identified and 12 Tier 4 project areas (Appendix B.1-5, Appendix C. 4). Tier 4 project areas typically have moderate to near full geomorphic function and are recovering due to past conservation actions and best management practices. However, there areas are still not fully recovered and could be targeted for restoration actions, especially those that have propagated downstream effects such as LWD or beaver management actions that could result in connecting floodplain habitat, improving riparian function, increasing water quality, promoting overbank flow, recharging groundwater, and slowing runoff (See Section 3.3). These Tier 4 reaches could also be an integral part of climate change mitigation strategies because of their potential to store water, slow runoff, and recharge groundwater which could buffer changes in precipitation, snowpack depth, and degrading of hydrologic regimes.

Table 10. Tier 1 Project Areas and summary of location, geomorphic function, limiting factors, and fish distribution and use. See Appendix B for Project Area locations and Appendix C for Conceptual Design maps. Reach types: AF = alluvial fan, FC = fan controlled, PFC = planform controlled, WGB = wandering gravel bed. Restoration Strategies: INS = instream complexity, OVB = Promote Over-bank Flow, REC = Reconnect Isolated or Disconnected Habitats, and RIP = Riparian Management.

Location							Project Area Info				Limiting Factors							Spring Chinook				Fall Chinook				Steelhead				Bull Trout				
Project Area	Restoration Reach	RM Start	RM End	Length (mi)	Stream	Landownership	Reach Type	Geomorphic Function	Recovery Potential	Restoraiton Strategies	Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Restoration Priority
02	AC_02	0.4	3.2	2.8	Asotin	Private	WGB_DF	Limited	Low	REC, RIP, INS			X		X	X																		1
06	AC_02	7.0	7.4	0.4	Asotin	Private	PC_DF	Moderate	Moderate	OVB, INS			X	X	X	X																		1
09	AC_04	9.9	12.6	2.7	Asotin	Private	PC_DF	Moderate	Moderate	REC, OVB, INS			X			X																		1
10	AC_04	12.6	13.0	0.4	Asotin	State/Private	WGB_DF	High	High	OVB, INS						X																		1
11	AC_04	13.0	15.7	2.7	Asotin	State/Private	WGB_DF	Moderate	High	REC, OVB, INS			X			X																		1
12	CC_01	0.0	0.6	0.6	Charley	Private	AF	Moderate	High	REC, OVB, RIP, INS			X			X																		1
14	CC_01	1.9	2.4	0.5	Charley	State	PC_DF	Moderate	High	OVB, RIP, INS			X			X																		1
15	CC_02	2.4	3.1	0.7	Charley	State	FC_DF	Moderate	High	OVB, RIP, INS			X			X																		1
16	CC_02	3.1	5.5	2.4	Charley	State	FC_DF	Limited	High	OVB, RIP, INS	X		X			X																		1
17	CC_02	5.5	7.7	2.2	Charley	State	FC_DF	Moderate	High	OVB, RIP, INS			X			X																		1
18	CC_02	7.7	8.4	0.7	Charley	State/Federal	PC_DF	Moderate	High	OVB, RIP, INS			X			X																		1
19	NF_01	0.0	0.9	0.9	North Fork	State	WGB_DF	Moderate	High	OVB, INS			X			X																		1
20	NF_02	0.9	3.3	2.4	North Fork	State	WGB_DF	Moderate	High	OVB, INS			X			X																		1
21	NF_02	3.3	4.7	1.4	North Fork	State	WGB_DF	High	High	OVB, INS						X																		1
22	NF_02	4.7	5.8	1.1	North Fork	State/Federal	WGB_DF	Moderate	High	OVB, INS			X			X																		1
28	SF_01	0.0	3.9	3.9	South Fork	State	PC_DF	Moderate	High	OVB, INS			X		X	X																		1
29	SF_01	3.9	4.3	0.4	South Fork	State	FC_DF	Moderate	High	OVB, INS			X		X	X																		1
31	SF_01	4.9	9.2	4.3	South Fork	State/Federal	PC_DF	Moderate	High	OVB, INS			X			X																		1
36	GC_01	6.0	9.7	3.7	George	State/Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																		1
37	GC_02	9.7	10.9	1.2	George	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																		1
68	TM_01	3.1	4.8	1.7	Tenmile	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X	X	X	X																		1
69	TM_02	4.8	7.6	2.8	Tenmile	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																		1
71	TM_02	10.3	11.4	1.1	Tenmile	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																		1
78	CO_01	0.1	1.4	1.3	Couse	Private	FC_DF	Moderate	Moderate	REC, OVB, RIP, INS		X	X	X	X	X																		1

QUANTIFYING THE POTENTIAL PHYSICAL AND HABITAT CHANGES BASED ON CONCEPTUAL DESIGNS

We calculated preliminary quantities of key physical and habitat attributes in each Tier 1 project area that are expected to be improved based on the conceptual plan. We calculated the length of stream of potential restoration actions of LWD addition (length of project area), levee removals/setbacks, relic dam removal (Charley Creek only), flood channels, side channels, and roads that could be decommissioned. We then calculated the area of improved floodplain function and riparian enhancement that could be achieved from the addition of instream structural elements and removal of confining features. We define each one of these benefits in Table 11.

The average length of Tier 1 project areas is 1.8 miles and the total length of Tier 1 project areas is 42.3 miles. LWD addition is recommended for all Tier 1 project areas and averages 9,504 feet of treatment length per project area (Table 12). There are over a mile of levees that were identified that, if set back or removed, could open up almost 200 acres of floodplain habitat. Specific targets for all Tier 1 project areas will be developed in more detailed project area plans (i.e., full design) once willing landowners and the ACCD begin to develop site level objectives. We provide quantities of key physical and habitat attributes for all Tier 2 and 3 Project Areas in Appendix H. Quantities of key physical and habitat attributes for Tier 4 were not estimated because no specific restoration actions were identified (i.e., only suggested possible management strategies).

Table 11. Definitions of potential physical and habitat actions and how the approximate quantity of benefits/restoration extent were calculated for each Conceptual Restoration Plan by Project Area.

Action	Definition of Potential Actions	Calculation
LWD Addition	Length (feet) of stream that could have large woody debris added to based on the length of the project area	Length of the Project Area
Levee Removal/ Setback	Length of levee (feet) removal or setback levee to address anthropogenic confinement	Length of levee identified using LIDAR and aerial imagery
Dam Removal	Length of dam (feet) removal from old earthen dams (specific to Charley Creek)	Length of levee identified using LIDAR and aerial imagery
Flood Channel Connection	Length of flood channels activated during high flow events due to restoration actions (regular inundation approximately every 1-2 years; do not maintain perennial flow)	Length of flood channels identified using LIDAR and aerial imagery
Side Channel Connection	Length of side channels activated or created through restoration actions (maintain perennial flow)	Length of side-channels identified using LIDAR and aerial imagery
Road Decommission	Length of road (feet) to decommission and promote improved sediment transport from hillslope to channel (specific to Charley Creek)	Length of road identified using LIDAR and aerial imagery
Floodplain Reconnection	Area (acres) of historic floodplain that could be reconnected	Area of floodplain identified using LIDAR and aerial imagery
Riparian Enhancement	Area of riparian plantings and invasive/upland vegetation encroachment control (often in conjunction with improved floodplain access)	Area of riparian habitat identified using LIDAR and aerial imagery
Protection Area	Location of recovering riparian and fluvial processes to conserve or enhance for benefits upstream/downstream	Identification of approximate location by downstream and upstream river mile

Table 12. Summary of the potential quantity of physical and habitat attributes expected from restoration actions in Tier 1 Project Area (See Table 11 for definitions and methods for calculating quantities).

						Project Actions (feet)								
						Instream Complexity	Reconnect Habitats		Promote Overbank Flow		Roads	Potential Areas Affected		Conserve/ Enhance
Stream	Restoration Reach	Project Area	RM Start	RM End	Length	LWD Addition	Levee Removal or Setback	Dam Removal	Flood Channel Connection	Side Channel Connection	Decommision	Floodplain (acres)	Riparian Enhancement (acres)	Protection Area (river mile)
Asotin	AC_02	2	0.4	3.2	2.8	14,784	5,131			4,503		26	5	2.1-2.9
Asotin	AC_02	6	7	7.4	0.4	2,112				1,805			3	
Asotin	AC_04	9	9.9	12.6	2.7	14,256	303		2,317	5,262		22	11	
Asotin	AC_04	10	12.6	13	0.4	2,112				3,046				12.6-13.0
Asotin	AC_04	11	13	15.7	2.7	14,256	418		2,245	11,207		32	31	13.0-13.3
Charley	CC_01	12	0	0.6	0.6	3,168						5	5	
Charley	CC_01	14	1.9	2.4	0.5	2,640						1	2	
Charley	CC_02	15	2.4	3.1	0.7	3,696			514			1	1	
Charley	CC_02	16	3.1	5.5	2.4	12,672		186	1,999			3	14	
Charley	CC_02	17	5.5	7.7	2.2	11,616		161			9,934	1		
Charley	CC_02	18	7.7	8.4	0.7	8,448								
North Fork	NF_01	19	0	0.9	0.9	4,752			1,737	1,594		13	13	
North Fork	NF_02	20	0.9	3.3	2.4	12,672			910	4,506		10	5	
North Fork	NF_02	21	3.3	4.7	1.4	7,392				3,558		7		
North Fork	NF_02	22	4.7	5.8	1.1	5,808			3,502	3,205		11		
South Fork	SF_01	28	0	3.9	3.9	20,592			2,820	1,349		10	2	
South Fork	SF_01	29	3.9	4.3	0.4	2,112	241					1	1	
South Fork	SF_01	31	4.9	9.2	4.3	22,704			2,106	3,444		4		
George	GC_01	36	6	9.7	3.7	19,536			6,746	3,592		17	41	
George	GC_02	37	9.7	10.9	1.2	6,336			3,308			4	8	
Tenmile	TM_01	68	3.1	4.8	1.7	8,976			6,273	694		11	10	3.2-3.3 and 3.5-3.75
Tenmile	TM_02	69	4.8	7.6	2.8	14,784			5,639			11	24	5.8-6.1 and 6.3-6.8
Tenmile	TM_02	71	10.3	11.4	1.1	5,808			3,583			5	6	
Couse	CO_01	78	0.1	1.4	1.3	6,864			2,853			4	2	
			Average		**1.8**	**9,504**	**1,523**	**174**	**3,103**	**3,674**	**9,934**	**9**	**10**	

7 TIER 1 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

ASOTIN CREEK TIER 1 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

7.1.1 Asotin Creek Mainstem - Project Area 02 (River Mile 0.4 to 3.2)

7.1.1.1 Site Description

Project Area **02 (PA-02)** is located between the upstream end of Asotin City Park and the George Creek confluence at RM 3.2. The PA begins in a residential area and passes through working ranches in the widest parts of the valley. The channel crosses the valley bottom occasionally but is often confined against the valley wall or Asotin Creek road. The channel has been straightened and confined by rip rap and levees in many areas to protect infrastructure and agricultural lands from high flow events. This has resulted in the channel being incised with low complexity and disconnected from the floodplain. The channel and floodplain are more diverse between RM 2.1 and 2.8.

Basic descriptors of Project Area 02.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.4	3.2	2.8	Wandering Gravel Bed with Discontinuous Floodplain	Limited function	Private

Primary limiting factors in Project Area 02.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X		X	X	

Fish species presence and use by life history stage in Project Area 02.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 02.

Restoration Strategy	Recommended Restoration Actions

Protect and Maintain Natural Processes	Protect mostly full functioning riparian vegetation, particularly between RM 2.1 and 2.8.
Remove Barriers and Reconnect Disconnected Habitats	Remove or set back levees to increase lateral accommodation space for natural development of complex geomorphic units and increase floodplain connectivity. Reconnect relic side channels at RM 1.1, and between RM 1.9 and 2.7.
Long-term Processes	Invasive vegetation control throughout.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Active grazing management in riparian areas to target invasive vegetation (e.g., Himalayan blackberry).

7.1.1.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-02 is limited, largely due to anthropogenic confinement restricting access to the floodplain, and a lack of structural elements. The channel has been reduced to single thread and straightened in most of the PA. Geomorphic and hydraulic diversity is low and there are very few structural elements aside from occasional LWD and a few boulder structures. Aside from the mouth of Asotin Creek, PA-02 includes the widest valley bottom and historic floodplain among the target watersheds. However, the channel has been effectively cut off from the floodplain for most of the PA. There are a few opportunities to increase floodplain connection which would improve geomorphic function.

The extent of riparian vegetation in this reach is variable, ranging from 36-100% cover, and mostly high function. There are some examples in the PA where the riparian function is near full (e.g., RM 1.8 – 2.7). However, there are several long sections where riparian vegetation is limited to a thin extent along the channel margin. Alder and cottonwood are the dominant canopy species in PA-02 and likely provide adequate shade to the stream channel.

7.1.1.3 Recommended Restoration Actions

Recommendations for PA-02 include setting back levees between RM 1.3 and 3.1, protecting and enhancing riparian areas, particularly between RM 2.1 and 2.8, and increasing structural elements throughout the project area.

7.1.1.4 Geomorphic Implications

Levee setbacks will increase lateral accommodation space for the channel to naturally develop complex geomorphic units such as secondary channels and mid-channel bars. Setting back some of the identified levees would also improve floodplain connection and potentially reduce flood hazards downstream. Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

7.1.1.5 Biological Benefits

Widening the channel through levee setbacks would improve riparian function and the development of critical habitat features for ESA-listed fish species such as complex pools and spawning areas. Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat.

7.1.1.6 Potential Challenges

The proposed actions would require landowner permission. There are many individual landowners in PA-02, so achieving continuity between project actions may be difficult. Levee setbacks that have the highest potential benefit are typically on working agricultural lands. Some relic side channels are currently disconnected and may need to be partially excavated to gain access during regular high flow events. Because of the proximity to infrastructure, structural elements may need to be secured to increase longevity and reduce potential negative impacts to landowners.

7.1.2 Asotin Creek Mainstem - Project Area 06 (River Mile 7.0 to 7.4)

7.1.2.1 Site Description

Project Area **06 (PA-06)** begins at RM 7.0 of the mainstem of Asotin Creek and ends at a bedrock canyon reach near RM 7.4. Heightened stream power in the upstream adjacent bedrock canyon reach delivers substantial amounts of sediment to PA-06. The stream channel is incised but some flood channels are accessible during large flood events when sediment is distributed in low-lying areas in the valley bottom. During smaller floods, the flood channels are not accessible, and due to incision, this PA inappropriately operates as a sediment transfer zone.

Basic descriptors of Project Area 06.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
7.0	7.4	0.4	Planform Controlled with Discontinuous Floodplain	Moderate function	Private

Primary limiting factors in Project Area 06.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X	X	X	X	

Fish species presence and use by life history stage in Project Area 06.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding
■		■		■	■	■	■	■	■	■	■	■			■

□ - no activity ▒ - low to moderate activity ■ - peak activity

Restoration recommendations for Project Area 06.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Natural processes are impaired or disconnected throughout this PA.

Remove Barriers and Reconnect Disconnected Habitats	Improve access to flood channels on river left during regular flood events and promote overbank flow.
Long-term Processes	Control invasive vegetation and plant native riparian species in conjunction with improved floodplain access.
Short-term Processes	Add LWD throughout channel to increase complexity. Add LWD to floodplain to increase roughness.
Alternative Strategies	Active grazing management may be useful in controlling invasive vegetation.

7.1.2.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-06 is moderate, primarily due to low hydraulic and geomorphic complexity, irregular floodplain access, and limited LWD. The stream channel is incised, making the reach act more like a sediment transport zone rather than a sediment sink in most years. The floodplain has several flood channels which have been modified for land use. Sediment in the floodplain is dominated by alluvial deposits of cobble from floods; fine sediment is limited on the floodplain in some areas, likely due to a lack of roughness.

Riparian function near the channel is high and dominated by young white alder. Open spaces in the riparian zone are a result of cobble sheet deposits during past large floods. These open areas are slowly recovering, but invasive vegetation and a lack of fine sediment may be delaying recovery.

7.1.2.3 Recommended Restoration Actions

Recommendations for PA-06 include adding LWD throughout the channel and floodplain, improving access to flood channels and floodplain, riparian plantings in open spaces, and controlling invasive vegetation.

7.1.2.4 Geomorphic Implications

Adding LWD to the channel will increase hydraulic and geomorphic complexity. High density LWD has the potential to increase sediment retention, thereby aggrading the channel to improve access to the floodplain. Structures may also directly target flow to access points to flood channels during regular flow events. Adding LWD to the floodplain and flood channels to increase roughness would promote fine sediment retention and aid riparian recovery.

7.1.2.5 Biological Benefits

Adding LWD to the channel would improve habitat quality for all ESA-listed species present in the reach. LWD interacts with stream flows to provide refuge and feeding lanes for juvenile salmonids. Increased sediment retention and improved sediment sorting will increase suitable spawning areas. Promoting overbank flow and increasing access to flood channels will help expedite riparian recovery by increasing fine sediment deposition on the floodplain.

7.1.2.6 Potential Challenges

The Recommended Restoration Actions will require landowner permission. Limiting damage to the recovering riparian zone should be a priority. There is a high potential for increased sediment delivery to this project area from the upstream bedrock canyon reach which could impact any work completed here.

7.1.3 Asotin Creek Mainstem - Project Area 09 (River Mile 9.9 to 12.6)

7.1.3.1 Site Description

Project Area **09 (PA-09)** is located on the mainstem of Asotin Creek between RM 9.9 and 12.6. The channel is moderately sinuous, but there are several long straight stretches where the channel is incised and unable to regularly access the floodplain despite a relatively wide valley bottom. The stream flows through a working ranch, and Asotin Creek Road follows the entire length on river left. Fans from adjacent steep ephemeral hillslopes impose higher confinement in short sections.

Basic descriptors of Project Area 09.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
9.9	12.6	2.7	Planform Controlled with Discontinuous Floodplain	Moderate function	Private

Primary limiting factors in Project Area 09.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 09.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 09.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Fluvial processes are impaired or disconnected in many sections of this PA. The riparian area is young but healthy, and should be protected throughout.
Remove Barriers and Reconnect Disconnected Habitats	Improve access to numerous flood channels and relic side channels throughout and promote overbank flow. Remove or set back levee near RM 10.7.
Long-term Processes	Control invasive vegetation in open spaces. Selective riparian plantings in open spaces to connect to healthy riparian.
Short-term Processes	Add LWD in channel, side channels, and flood channels throughout.

Alternative Strategies	NA

7.1.3.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-09 is moderate primarily due to low instream geomorphic and hydraulic diversity and irregular floodplain connection. LWD is limited and typically occurs as large jams, creating pockets of high complexity and quality fish habitat. LWD jams are also associated with improved floodplain and flood channel access.

Riparian function in PA-09 is high and is dominated by young white alder. Invasive vegetation is not prominent, but is encroaching into open spaces in the valley bottom, particularly near incoming fans and livestock feed lots.

7.1.3.3 Recommended Restoration Actions

Recommendations for PA-09 include adding LWD to the channel, improve access to numerous flood channels and relic side channels, address the levee on river left near RM 10.7, controlling invasive vegetation, and riparian plantings.

7.1.3.4 Geomorphic Implications

Adding LWD to the channel will improve hydraulic and geomorphic complexity, encourage channel aggradation, and promote overbank flow. LWD may also directly target access points to flood channels, so they are inundated during regular flood events. Removing the levee near RM 10.7 will improve access to the floodplain and increase lateral accommodation space on river right.

7.1.3.5 Biological Benefits

Adding LWD to the channel would improve habitat quality for all ESA-listed species present in the reach. LWD interacts with stream flows to provide refuge and feeding lanes for juvenile salmonids. Increased sediment retention and improved sediment sorting will increase suitable spawning areas. Promoting overbank flow and increasing access to flood channels increases refuge opportunities for salmonids during large floods. Controlling invasive vegetation encroachment will help protect the relatively healthy riparian zone.

7.1.3.6 Potential Challenges

Because this project area is 2.7 river miles long, it may be implemented in phases. If the project is implemented in phases, we recommend starting upstream to propagate positive effects downstream. Protecting healthy riparian vegetation during implementation should be a priority.

7.1.4 Asotin Creek Mainstem - Project Area 10 (River Mile 12.6 to 13.0)

7.1.4.1 Site Description

Project Area **10 (PA-10)** begins near a working ranch at RM 12.6 and ends near a WDFW parking lot near RM 13.0. The channel is moderately sinuous with several active side channels and evidence of recent floodplain inundation. Riparian vegetation covers most of the valley bottom. Valley constriction increases near the downstream end of the PA at the apex of a fan on river left. This is a short PA that may be implemented in coordination with efforts on PA-11 directly upstream.

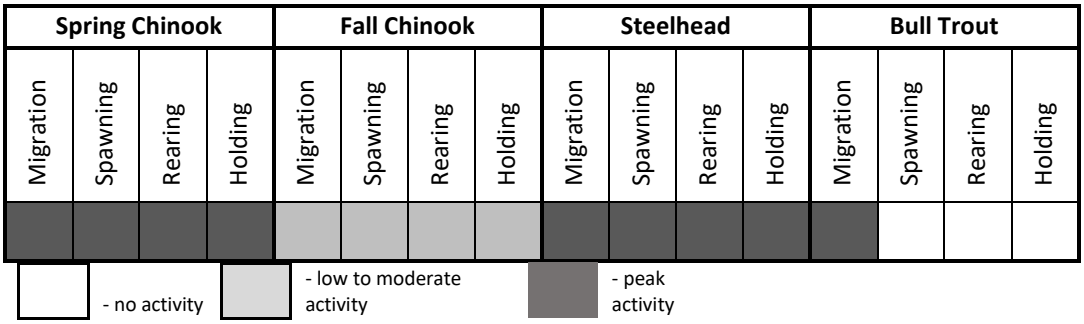
Basic descriptors of Project Area 10.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
12.6	13.0	0.4	Wandering Gravel Bed with Discontinuous Floodplain	High function	State/Private

Primary limiting factors in Project Area 10.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 10.



Restoration recommendations for Project Area 10.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect recovering fluvial and riparian processes between RM 12.6 and 13.0.
Remove Barriers and Reconnect Disconnected Habitats	Improve access to side channels and promote overbank flow.
Long-term Processes	Control invasive vegetation.
Short-term Processes	Add LWD between RM 12.6 and 13.0 in main channel and side channels.
Alternative Strategies	NA

7.1.4.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-10 is high and portions represent some of the best examples of the wandering gravel bed reach type on the mainstem of Asotin Creek. However, LWD is still limited and instream geomorphic and hydraulic complexity could be improved. Large active side channels exist, and flood channels appear to be accessible during regular flood events.

Riparian function is high and the area has departed little from historic estimates. The canopy is dominated by white alder and some black cottonwood. The understory is dense with native shrubs. Invasive vegetation is present in open areas, but does not appear to be encroaching.

7.1.4.3 Recommended Restoration Actions

Recommendations for PA-10 include protecting fluvial and riparian processes, improving access to side channels, and adding LWD to the main and side channels.

7.1.4.4 Geomorphic Implications

There are few locations on the mainstem Asotin Creek that are highly functioning. Protecting these areas and connecting them to adjacent restoration projects will help extend the ecological benefits of functioning fluvial processes. Adding LWD to the main channel will improve hydraulic and geomorphic complexity, and promote overbank flow into side channels and onto the floodplain.

7.1.4.5 Biological Benefits

Because of the dense canopy and regular inundation of flood channels, this PA may help moderate temperatures on the mainstem of Asotin Creek. Extending the healthy riparian zone to adjacent reaches should help buffer rising stream temperatures downstream. Adding LWD will promote the development of key habitat features for salmonids such as pools and shear zones. LWD will also improve sediment sorting to increase suitable spawning areas and concealment opportunities for salmonids.

7.1.4.6 Potential Challenges

During implementation, limiting damage to the recovering riparian zone should be a priority. Landowner permission will be required. Because this reach is a highly functioning wandering gravel bed, channel avulsions may occur and divert the main flow away from the current main channel. Therefore, adding LWD throughout the valley bottom should be considered.

7.1.5 Asotin Creek Mainstem - Project Area 11 (River Mile 13.0 to 15.7)

7.1.5.1 Site Description

Project Area **11 (PA-11)** begins on WDFW property at RM 13.0 and ends at the confluence of the North and South Forks of Asotin Creek at RM 15.7. Dry Gulch enters this PA at RM 13.7 and Charley Creek enters near RM 14.2. The stream flows through working ranches and crosses under a county bridge at RM 15.6. A USGS flow gauge is located at the county bridge and will provide valuable data during the planning process for this PA. This project area is relatively long and could be implemented in phases, using the Charley Creek confluence as a reasonable project reach break.

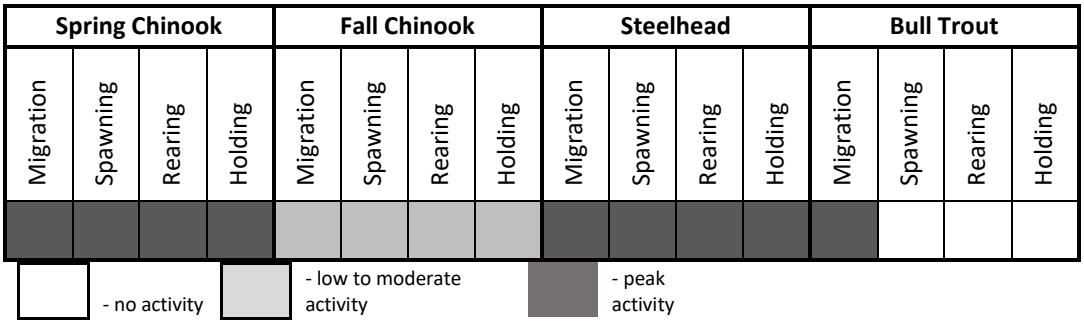
Basic descriptors of Project Area 11.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
13.0	15.7	2.7	Wandering Gravel Bed with Discontinuous Floodplain	Moderate function	State/Private

Primary limiting factors in Project Area 11.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 11.



Restoration recommendations for Project Area 11.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect recovering riparian and fluvial processes between RM 13.0 and 13.3.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect floodplain on river left between RM 13.9 and 14.6. Improve access to side channels and flood channels. Address levees between RM 14.6 and 14.7. Promote overbank flow.
Long-term Processes	Control invasive vegetation and upland vegetation encroachment. Riparian plantings in floodplain, in conjunction with improved floodplain access.
Short-term Processes	Add LWD to mainstem channel, side channels, and floodplain.
Alternative Strategies	Active grazing management may be suitable for controlling invasive vegetation.

7.1.5.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-11 is moderate primarily due to limited floodplain access. There are many relic side and flood channels in the valley bottom, but the channel is incised so access to secondary channels is limited. Between RM 13.9 and 14.6, the channel is pinned against the valley margin and will likely remain static without intervention. The channel bed and banks are armored by cobble and boulders, and poorly sorted.

Riparian function is variable throughout PA-11; however, most of the channel is shaded by a canopy of white alder and black cottonwood trees. In open areas and areas where the floodplain is disconnected, invasive vegetation can be pervasive.

7.1.5.3 Recommended Restoration Actions

Recommendations for PA-11 include adding LWD throughout the main and secondary channels, and improving access to the floodplain. Levees on river left near RM 14.6 and 14.7 should be considered for removal to improve floodplain connectivity and increase lateral accommodation space for the mainstem channel. Riparian and fluvial processes between RM 13.0 and 13.3 are recovering well and should be protected. Invasive vegetation should be

controlled, particularly in areas where the floodplain is disconnected. Riparian plantings should be considered throughout as floodplain connection is improved. Active grazing management may be a suitable method for controlling the spread of invasive vegetation.

7.1.5.4 Geomorphic Implications

Restoring riparian and floodplain function in PA-11 will extend the highly functioning conditions of PA-10 upstream. Removing the levees near RM 14.6 and 14.7 will improve floodplain connectivity and potentially allow the mainstem to enter its relic channel near the middle of the valley bottom between RM 13.9 and 14.6. Adding LWD throughout the mainstem will increase sediment retention and aggrade the channel over time. Raising the channel bed will promote overbank flows into relic side and flood channels, ultimately improving floodplain connection and riparian recovery.

7.1.5.5 Biological Benefits

Increasing the density of LWD will improve sediment sorting and create more suitable spawning and concealment areas for salmonids. Improving the regularity of floodplain inundation will help kickstart riparian recovery, particularly in areas where the floodplain is reconnected. Flood channels and backwaters will provide refuge during high flows for juvenile salmonids.

7.1.5.6 Potential Challenges

PA-11 is relatively long, so it could be implemented in phases. PA-12 (Charley Creek) is located within the valley bottom of PA-11, so coordinating efforts between the two projects will be necessary. The recommended actions will require landowner approval and should be implemented without disrupting agricultural viability of the working ranches within the PA.

7.1.6 Charley Creek - Project Area 12 (River Mile 0.0 to 0.6)

7.1.6.1 Site Description

Project Area **12 (PA-12)** is located between the confluence with the mainstem of Asotin Creek and RM 0.6, just upstream of the Asotin Creek Road crossing. Near the Asotin Creek confluence, the main channel has been armored with rip rap and is a restoration site implemented as part of the model watershed. The stream flows through a large stand of mature alder trees and there are small wetlands bordering the fan. Upstream and downstream of the fan are ranches with large pastures. The stream flows through a concrete open top culvert with a cattle guard to pass under Asotin Creek Road. Upstream of the culvert, the channel is anthropogenically confined to protect private infrastructure on river right.

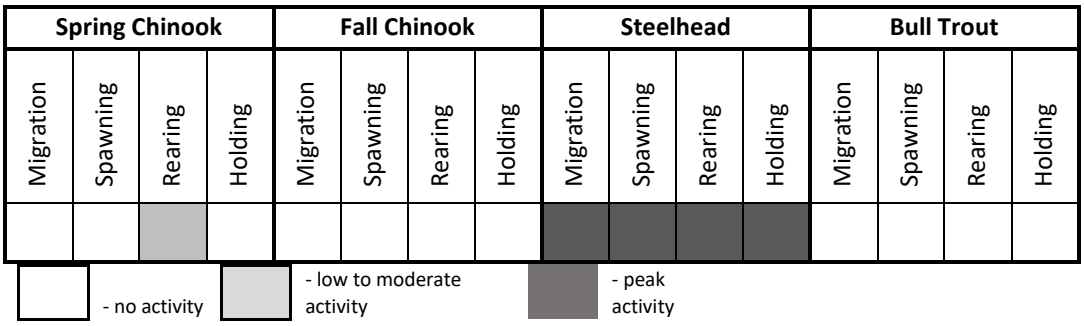
Basic descriptors of Project Area 12.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
0.0	0.6	0.6	Alluvial Fan	Moderate function	Private

Primary limiting factors in Project Area 12.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 12.



Restoration recommendations for Project Area 12.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Natural processes are impaired or disconnected throughout this PA.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect floodplain between RM 0.4 and 0.5. Promote overbank flow.
Long-term Processes	Invasive vegetation control throughout.
Short-term Processes	Add LWD between RM 0.0 and 0.3.
Alternative Strategies	Active grazing management may be suitable for controlling invasive vegetation.

7.1.6.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-12 is moderate, primarily due to an altered sediment regime, limited LWD, and anthropogenic confinement. Between RM 0.35 and 0.55, the channel is pinned against a primitive road on river left, and disconnected from its floodplain on river right. Past channel modifications downstream of the culvert crossing limit the potential for sediment aggradation as the fan encroaches into the Asotin Creek valley bottom.

Riparian function is moderate and dominated by young white alder with limited understory vegetation. Invasive Himalayan blackberry is pervasive downstream of the culvert. Wetlands are present adjacent to the fan, but have been reduced in size as Charley Creek and Asotin Creek have become disconnected from the floodplain.

7.1.6.3 Recommended Restoration Actions

Recommendations for PA-12 include reconnecting the floodplain between RM 0.4 and 0.5, adding LWD between RM 0.0 and 0.3, and controlling invasive vegetation throughout.

7.1.6.4 Geomorphic Implications

Adding LWD and reconnecting the floodplain will improve sediment retention and aggrade the channel over time. Locally increasing stream power using LWD structures will improve sediment sorting and encourage lateral migration across the fan. If the floodplain is accessed more regularly, the wetlands adjacent to this PA will increase in size and remain wet for longer periods providing important habitat for wildlife.

7.1.6.5 Biological Benefits

Increased densities of LWD between RM 0.0 and 0.3 will increase hydraulic and habitat diversity. LWD in the channel will increase roughness, create pools, and provide refuge.

7.1.6.6 Potential Challenges

Charley Creek has a stable hydrograph with limited competence to move substrate. Private infrastructure between RM 0.4 and 0.5 is within the historic floodplain. This project will require landowner approval, and planning should be coordinated with actions on PA-11.

7.1.7 Charley Creek - Project Area 14 (River Mile 1.9 to 2.4)

7.1.7.1 Site Description

Project Area **14 (PA-14)** is located between RM 1.9 and 2.4 and is within an Asotin Creek IMW control section.

Basic descriptors of Project Area 14.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
1.9	2.4	0.5	Planform Controlled with Discontinuous Floodplain	Moderate function	State

Primary limiting factors in Project Area 14.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 14.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 14.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Natural processes are impaired or disconnected throughout this PA.

Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow.
Long-term Processes	Control invasive vegetation and upland vegetation encroachment.
Short-term Processes	Add high density of LWD throughout.
Alternative Strategies	Active grazing management may be suitable for controlling invasive vegetation.

7.1.7.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-14 is moderate primarily due to incision, limited floodplain access, low hydraulic and geomorphic diversity, and low LWD density. The valley bottom is relatively narrow and side channels are rare; however, there is evidence of flood channels that are currently disconnected from the main channel.

Riparian function is moderate and covers less area than historic estimates. The canopy is dominated by young white alder, river birch, and occasional black cottonwood. The understory is dense and dominated by native shrubs. In open areas within the riparian zone, invasive and upland vegetation is encroaching towards the channel.

7.1.7.3 Recommended Restoration Actions

Recommendations for PA-14 include adding LWD in high density throughout and controlling invasive vegetation.

7.1.7.4 Geomorphic Implications

Adding high densities of LWD will increase hydraulic and geomorphic diversity, improve sediment retention and sorting, and aggrade the channel over time. As the channel aggrades, access to the floodplain and relic flood channels will improve.

7.1.7.5 Biological Benefits

Adding LWD would improve habitat diversity and increase key habitat features such as pools, shear zones, and riffles. LWD would locally modify hydraulics to promote sediment retention and improve sediment sorting, creating more spawning and concealment opportunities for salmonids.

7.1.7.6 Potential Challenges

Charley Creek road is primitive with several narrow sections that are difficult to navigate with wide vehicles.

7.1.8 Charley Creek - Project Area 15 (River Mile 2.4 to 3.1)

7.1.8.1 Site Description

Project Area **15 (PA-15)** is located between RM 2.4 and 3.1 and is within an Asotin Creek IMW treatment section. LWD was added in 2013 with the goal of improving instream habitat for steelhead. The structures added by the IMW project were effective, but relatively small and had minimal impact on improving floodplain connection. The channel has low sinuosity and the planform is heavily influenced by fans from adjacent steep ephemeral hillslopes. Because Charley Creek does not have the competence to rapidly erode the fan sediment, the main channel tends to alternate between either side of the valley, being temporarily confined by the fans and bedrock.

Basic descriptors of Project Area 15.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
2.4	3.1	0.7	Fan Controlled with Discontinuous Floodplain	Moderate function	State

Primary limiting factors in Project Area 15.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 15.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 15.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Natural processes are impaired or disconnected throughout this PA.
Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow.
Long-term Processes	Control invasive vegetation and riparian plantings in conjunction with improved floodplain access.
Short-term Processes	Add LWD throughout channel and newly created/accessed flood channels.
Alternative Strategies	Active grazing management may be suitable for controlling invasive vegetation.

7.1.8.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-15 is moderate primarily due to low hydraulic and geomorphic diversity and limited LWD. The channel is incised in many areas and dominated by planar runs and glides, even in constricted areas with higher gradient (e.g., RM 3.0). Fan controlled reaches have inherently less floodplain; however, flood channels that should be currently accessible are disconnected from the main channel.

Riparian function in PA-15 is moderate, but upwards of 95% of the historic vegetation has been lost. The result is a narrow strip of young white alder, river birch, and black cottonwood. The understory is relatively sparse and invasive vegetation is pervasive throughout the PA.

7.1.8.3 Recommended Restoration Actions

Recommendations for PA-15 include adding LWD throughout the main channel to promote overbank flows, and controlling invasive vegetation. Active grazing management may be a suitable alternative for controlling invasive and upland vegetation encroachment.

7.1.8.4 Geomorphic Implications

Hydraulic and geomorphic diversity has improved since the addition of LWD in 2013; however, the structures were relatively small and limited their impact to brief pockets near the main channel. Adding larger LWD and/or improving the current structures will further increase diversity, and promote overbank flow into relic flood channels. LWD will also improve sediment retention to help aggrade the channel.

7.1.8.5 Biological Benefits

Maintaining and improving LWD from the IMW project will improve habitat diversity and increase key habitat features for salmonids such as pools, shear zones, and cover. Increasing the density and size of LWD structures will improve water retention and promote overbank flows to help kickstart riparian recovery throughout PA-15. Riparian vegetation is likely limited because the water table has lowered as the stream channel became more incised. Retaining sediment to aggrade the channel will further improve access to the floodplain.

7.1.8.6 Potential Challenges

Charley Creek road is primitive with several narrow sections that may be difficult for wide vehicles to navigate.

7.1.9 Charley Creek - Project Area 16 (River Mile 3.1 to 5.5)

7.1.9.1 Site Description

Project Area **16 (PA-16)** is located between RM 3.1 and 5.5 and is within an Asotin Creek IMW treatment section. LWD was added in 2013 with the goal of improving instream habitat for steelhead. The structures added by the IMW project were effective, but relatively small and had minimal impact on improving floodplain connection. The remains of an old dam at RM 4.2 is restricting floodplain access on river left. The channel has low sinuosity and the planform is heavily influenced by fans from adjacent steep ephemeral hillslopes. Because Charley Creek does not have the competence to rapidly erode the fan sediment, the main channel tends to alternate between either side of the valley, being temporarily confined by the fans and bedrock.

Basic descriptors of Project Area 16.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
3.1	5.5	2.4	Fan Controlled with Discontinuous Floodplain	Limited function	State

Primary limiting factors in Project Area 16.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
X		X			X	

Fish species presence and use by life history stage in Project Area 16.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 16.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Natural processes are impaired or disconnected throughout this PA.
Remove Barriers and Reconnect Disconnected Habitats	Remove remnants of relic dam at RM 4.2 and improve access to flood channels and floodplain. Improve past LWD structures to promote more overbank flow.
Long-term Processes	Control invasive vegetation and extend past riparian planting efforts. Manage past willow plantings between RM 3.1 and 3.4.
Short-term Processes	Add LWD throughout and maintain LWD densities from the IMW project
Alternative Strategies	Active grazing management may be suitable for controlling invasive vegetation.

7.1.9.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-16 has limited function primarily due to low hydraulic and geomorphic diversity, poor sediment sorting, and limited floodplain connectivity. LWD added by the IMW project in 2013 improved hydraulic diversity locally, but due to Charley Creek's low competence, geomorphic change has been less prevalent. The channel is incised in many sections and is the primary cause for limited floodplain access and extensive cut banks. A large volume of sediment has aggraded upstream of the remnant dam at RM 4.2 and the channel is actively working through the deposition.

Riparian function is mostly poor and has largely departed from historic estimates throughout PA-16. The incised channel has likely resulted in a lowered water table, ultimately impacting riparian recovery.

7.1.9.3 Recommended Restoration Actions

Recommendations for PA-16 include removing the remains of the relic dam at RM 4.2, adding additional LWD and/or improving the LWD structures placed by the IMW project to explicitly promote overbank flow, controlling

invasive vegetation, managing past willow plantings between RM 3.1 and 3.4, and riparian plantings in conjunction with improved floodplain access.

7.1.9.4 Geomorphic Implications

Removing the remains of the relic dam will increase floodplain connection downstream, if additional work is completed to improve access to flood channels and the channel bed is raised. Increasing the density of LWD throughout PA-16 will improve hydraulic and geomorphic diversity, help aggrade the channel, and promote overbank flows. As the channel aggrades, floodplain connection improves, and the riparian zone recovers, channel stability will improve. The willow plantings between RM 3.1 and 3.4 are encouraging the channel to remain static; removing small patches of the willow in conjunction with LWD placement would improve access to the floodplain.

7.1.9.5 Biological Benefits

Several planting projects have been implemented in this reach in recent years, and their success would benefit from improved floodplain connection. Adding LWD to the channel and/or improving the current LWD structures would promote overbank flow and help kickstart riparian recovery. LWD in the channel would improve habitat diversity and increase the prevalence of key habitat features for salmonids.

7.1.9.6 Potential Challenges

Due to its length, this project could be implemented in phases. Charley Creek road is primitive with several narrow sections that may be difficult for wide vehicles to navigate. Removal of the dam will likely require special permitting and detailed design.

7.1.10 Charley Creek - Project Area 17 (River Mile 5.5 to 7.7)

7.1.10.1 Site Description

Project Area **17 (PA-17)** is located between RM 5.5 and 7.7, beginning on WDFW property and extending into the Umatilla National Forest. The remains of an old dam at RM 5.95 is imposing artificial confinement on the channel and briefly limiting floodplain access. The valley bottom is densely forested and the channel is moderately sinuous.

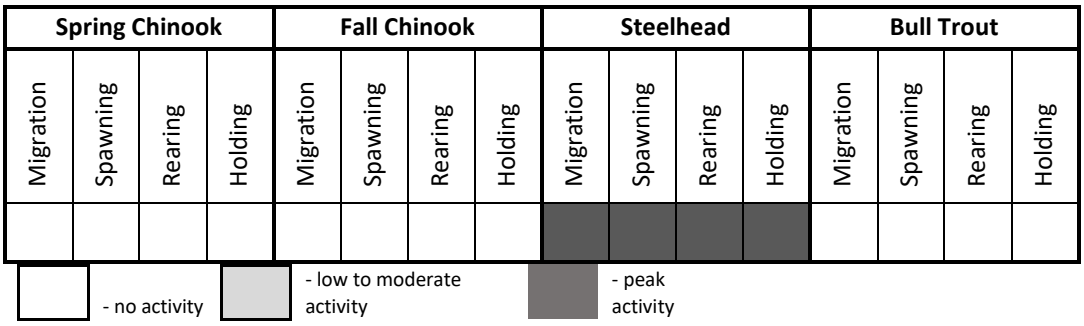
Basic descriptors of Project Area 17.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
5.5	7.7	2.2	Fan Controlled with Discontinuous Floodplain	Moderate function	State/Federal

Primary limiting factors in Project Area 17.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 17.



Restoration recommendations for Project Area 17.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Riparian processes should be protected throughout. Fluvial processes are impacted throughout.
Remove Barriers and Reconnect Disconnected Habitats	Remove relic dam at RM 5.95. Decommission road on river left but maintain access as required by Americans with Disabilities Act. Promote overbank flow.
Long-term Processes	NA
Short-term Processes	Add LWD throughout.
Alternative Strategies	Beaver introduction and management.

7.1.10.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-17 is moderate primarily due to limited geomorphic complexity and limited LWD. Areas with a deeply incised channel are separated by brief pockets of geomorphically diverse habitat typically forced by LWD jams. The remains of a relic dam at RM 5.95 are briefly impacting the sediment regime and floodplain connectivity. The access road on river left is interrupting hillslope sediment delivery to the valley bottom and channel.

Riparian function is relatively high and dominated by young conifers and a dense understory of native shrubs.

7.1.10.3 Recommended Restoration Actions

Recommendations for PA-17 include protecting riparian processes, removing remains of relic dam at RM 5.95, decommissioning the access road on river left, and adding LWD throughout. PA-17 is also a suitable candidate for beaver introduction and management.

7.1.10.4 Geomorphic Implications

Removing the dam remains will improve sediment transport processes and floodplain connectivity for a brief segment near RM 5.95. Decommissioning the road on river left will restore hillslope sediment processes by allowing colluvium to enter the channel and valley bottom rather than collecting on the road. Adding LWD will increase hydraulic and geomorphic diversity and aggrade the channel in incised sections over time. Improving conditions in this PA and connecting it with downstream restoration projects related to the IMW will create continuous sections of improved and/or recovering habitat.

7.1.10.5 Biological Benefits

Adding LWD in high densities will improve the prevalence of key habitat features such as pools, cover, spawning areas, and concealment opportunities for salmonids. Established beaver dam complexes would help aggrade the channel and increase water retention for the benefit of downstream reaches.

7.1.10.6 Potential Challenges

Charley Creek Road is primitive and has several narrow sections that would be difficult to navigate for wide vehicles. The road is not passable above RM 6.8. Because this PA is relatively long, it could be implemented in phases. The road is currently maintained for Americans with Disabilities (ADA) access, so decommissioning it may not be feasible.

7.1.11 Charley Creek - Project Area 18 (River Mile 7.7 to 8.4)

7.1.11.1 Site Description

Project Area **18 (PA-18)** is located between RM 7.7 and 8.4 beginning on WDFW property and entering the Umatilla National Forest near RM 8.0. Charley Creek road has been decommissioned at the USFS boundary.

Basic descriptors of Project Area 18.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
7.7	8.4	0.7	Planform Controlled with Discontinuous Floodplain	Moderate function	State/Federal

Primary limiting factors in Project Area 18.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 18.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity; - low to moderate activity; - peak activity

Restoration recommendations for Project Area 18.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Riparian processes should be protected throughout. Fluvial processes are impacted throughout.

Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow.
Long-term Processes	NA
Short-term Processes	Add LWD throughout.
Alternative Strategies	Beaver introduction and management.

7.1.11.2 Geomorphic, Floodplain, and Riparian Function

Geomorphic function in PA-18 is moderate, primarily due to limited geomorphic diversity and low LWD density. Pockets of good habitat and high geomorphic function are typically associated with small and infrequent LWD jams.

Riparian function is relatively high and is dominated by young conifers with a dense understory of native shrubs.

7.1.11.3 Recommended Restoration Actions

Recommendations for PA-18 include protecting riparian processes and adding LWD to the channel and floodplain. PA-18 is also a suitable candidate for beaver introduction and management.

7.1.11.4 Geomorphic Implications

Adding LWD to the channel would improve hydraulic and geomorphic diversity, improve sediment sorting, promote overbank flow, and activate small flood channels during regular floods.

7.1.11.5 Biological Benefits

Adding LWD would improve habitat diversity and increase the prevalence of key habitat features such as pools, cover, shear zones, undercut banks, spawning areas, and concealment opportunities for salmonids. Established beaver dam complexes will increase water retention for the benefit of downstream reaches, and greatly improve floodplain access during regular flood events.

7.1.11.6 Potential Challenges

Charley Creek road is decommissioned starting at the USFS boundary. The road leading up to the boundary is not passable for large vehicles, but can be accessed using ATVs. The remote location of this project would make it difficult to implement.

7.1.12 North Fork Asotin Creek - Project Area 19 (River Mile 0.0 to 0.9)

7.1.12.1 Site Description

Project Area **19 (PA-19)** begins at the confluence with the South Fork of Asotin Creek to form the mainstem of Asotin Creek and ends at RM 0.9 at the confluence with Lick Creek. The lower 0.3 miles is currently used as a firing range and wheat field operated by WDFW. The firing range runs parallel to the stream. Asotin Creek Road follows the reach on river left.

Basic descriptors of Project Area 19.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
0.0	0.9	0.9	Wandering Gravel Bed with Discontinuous Floodplain	Moderate function	State

Primary limiting factors in Project Area 19.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 19.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding
■	■	■	■					■	■	■	■	■		▒	▒

□ - no activity ▒ - low to moderate activity ■ - peak activity

Restoration recommendations for Project Area 19.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect riparian processes between RM 0.3 and 0.8. Fluvial processes are impacted throughout.
Remove Barriers and Reconnect Disconnected Habitats	Restore function of the floodplain on river left between RM 0.0 and 0.3. Improve access to flood channels and floodplain throughout. Promote overbank flow.
Long-term Processes	Control invasive vegetation and upland vegetation encroachment. Riparian plantings between RM 0.0 and 0.3 in conjunction with improved floodplain access.
Short-term Processes	Maintain and/or increase LWD densities from IMW project. Add LWD to explicitly target access to relic side channels.
Alternative Strategies	Relocate firing range.

7.1.12.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-19 is moderate, primarily due to low instream hydraulic and geomorphic diversity, limited LWD density, and limited floodplain access. The historic floodplain between RM 0.0 and 0.3 has been converted to a wheat field to provide food for wildlife and a firing range operated by WDFW. From RM 0.3 to 0.9, the channel is incised and has become disconnected to several side and flood channels. LWD placed by the IMW

project in 2014 has improved hydraulic and geomorphic diversity, but had minimal impact on improving floodplain connectivity.

Riparian function between RM 0.0 and 0.3 is relatively high, but is greatly reduced in area based on historic estimates. Riparian function is mostly full between RM 0.3 and 0.9. White alder and black cottonwood are the dominant canopy species, and there is a dense understory of native shrubs.

7.1.12.3 Recommended Restoration Actions

Recommendations for PA-19 include protecting riparian vegetation between RM 0.3 and 0.9, restoring the function of the floodplain on river left between RM 0.0 and 0.3, riparian plantings in the floodplain as access improves, and maintaining and/or increasing the density of LWD throughout. Additionally, relocating the firing range to a more suitable location should be considered.

7.1.12.4 Geomorphic Implications

Maintaining LWD densities placed by the IMW project will lead to continued improvement of hydraulic and geomorphic diversity throughout PA-19. Additional LWD would be beneficial, and future structures should be placed with the explicit goal of promoting overbank flow and accessing relic flood and side channels. Additionally, LWD would help aggrade the channel over time, further improving access to the floodplain.

7.1.12.5 Biological Benefits

Increased LWD densities would improve habitat diversity and increase the frequency of key habitat features for salmonids. Restoring the function of the floodplain between RM 0.0 and 0.3 will increase the amount of available habitat for ESA-listed species in this PA and help kickstart riparian recovery.

7.1.12.6 Potential Challenges

The firing range is very popular, so it would be a difficult proposition to relocate it to a more suitable location. Shell casings, target remains, and other trash litter the floodplain, and stray bullets have killed many trees in the riparian zone. The range is also a public safety hazard for people recreating and working in the stream.

7.1.13 North Fork Asotin Creek - Project Area 20 (River Mile 0.9 to 3.3)

7.1.13.1 Site Description

Project Area **20 (PA-20)** begins at the confluence with Lick Creek near RM 0.9 and extends upstream to RM 3.3. Asotin Creek Road turns away from the North Fork of Asotin Creek and follows Lick Creek. A small parking lot near RM 1.0 marks the start of a double-track trail that follows the stream for many miles.

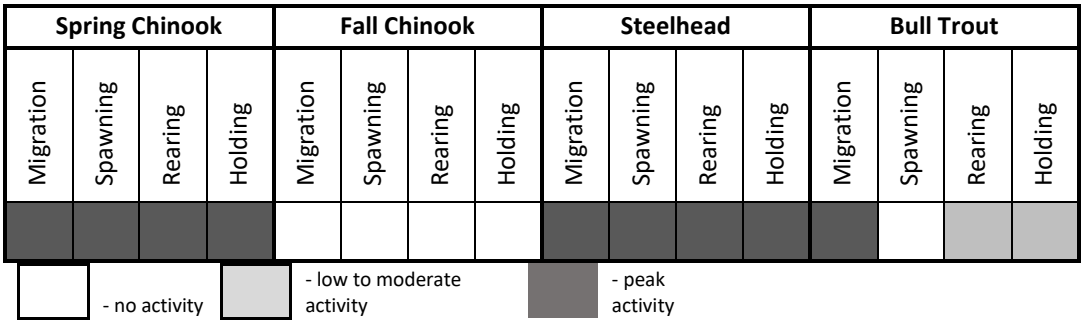
Basic descriptors of Project Area 20.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
0.9	3.3	2.4	Wandering Gravel Bed with Discontinuous Floodplain	Moderate function	State

Primary limiting factors in Project Area 20.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 20.



Restoration recommendations for Project Area 20.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect riparian processes between RM 1.3 and 3.3. Fluvial processes are impacted throughout this reach, except between RM 1.4 and 1.7.
Remove Barriers and Reconnect Disconnected Habitats	Restore floodplain function between RM 1.0 and 1.3. Improve access to side and flood channels. Add LWD to explicitly target access to relic side channels and promote overbank flow throughout. Promote overbank flow.
Long-term Processes	Control invasive vegetation between RM 1.0 and 1.3.
Short-term Processes	Maintain and/or increase LWD densities from IMW project between RM 0.9 and 2.6.
Alternative Strategies	Fuel reduction

7.1.13.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-20 is moderate, primarily due to low geomorphic diversity, limited LWD, and limited floodplain access. The floodplain on river left between RM 1.0 and 1.3 has been converted to a wheat field to provide food for wildlife and is not accessed during flood events. The stream and floodplain between RM 1.4 and 1.7 are well connected and functioning well. The channel between RM 1.9 and 3.3 lacks complexity and is incised in many sections. LWD structures placed by the IMW project between RM 0.9 and 2.6 improved complexity, but had minimal impact on improving floodplain access. Additional LWD should be placed with the goal of promoting overbank flow and accessing side and flood channels.

Riparian zone between RM 0.9 and 1.3 is high but most of the PA has been converted to agriculture and there is upland vegetation encroachment. Riparian function in the rest of the PA is mostly full and dominated by white alder and mixed conifer species.

7.1.13.3 Recommended Restoration Actions

Recommendations for PA-20 include protecting riparian processes between RM 1.3 and 3.3, protect fluvial processes between RM 1.4 and 1.7, restore floodplain function and control invasive vegetation between RM 1.0

and 1.3, and add LWD throughout. Fuel reduction in the valley bottom should be considered to reduce fire risk and provide on-site material for restoration efforts.

7.1.13.4 Geomorphic Implications

Geomorphic and riparian function are high between RM 1.4 and 1.7. Project actions in PA-20 should focus on extending the ecological benefits of this section to upstream and downstream reaches. LWD placed by the IMW project have improved hydraulic and geomorphic diversity in the channel, but have had little impact on improving floodplain connectivity. LWD additions and/or maintenance within the IMW treatment area should focus on promoting overbank flow and accessing side and flood channels. LWD additions between RM 2.6 and 3.3 would extend the IMW treatments further upstream, and increase hydraulic and geomorphic diversity.

7.1.13.5 Biological Benefits

Restoring the function of the floodplain and secondary channels between RM 1.0 and 1.3 will increase the amount of habitat for ESA-listed species in PA-20. Regular access and inundation of the floodplain will help riparian recovery as well. LWD additions will increase habitat diversity and increase the prevalence of key habitat features such as pools, mid-channel bars, spawning areas, and cover for salmonids. Regular access to flood channels and more frequent overbank flows will increase the potential for natural LWD recruitment into the channel.

7.1.13.6 Potential Challenges

The double-track trail provides the only access to PA-20, and most areas are only wide enough for an ATV. Due to the length of this PA, it may be implemented in phases.

7.1.14 North Fork Asotin Creek - Project Area 21 (River Mile 3.3 to 4.7)

7.1.14.1 Site Description

Project Area **21 (PA-21)** is located between RM 3.3 and 4.7. PA-21 is an isolated section of relatively continuous high quality habitat. Access to the PA is limited to a double-track trail on river left.

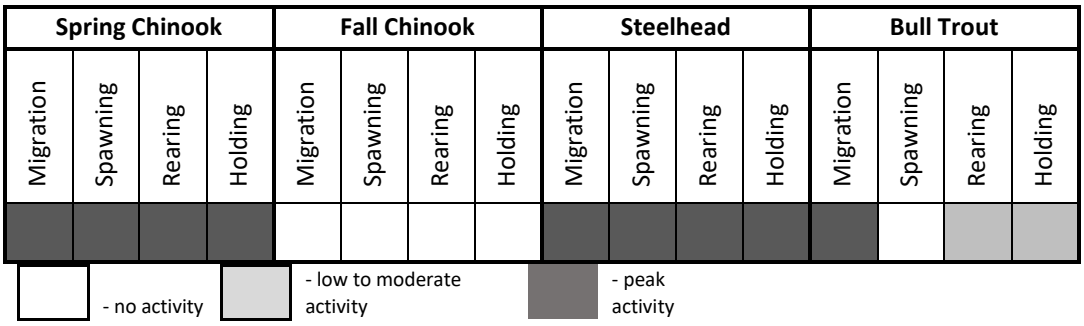
Basic descriptors of Project Area 21.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
3.3	4.7	1.4	Wandering Gravel Bed with Discontinuous Floodplain	High function	State

Primary limiting factors in Project Area 21.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 21.



Restoration recommendations for Project Area 21.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect recovering riparian and fluvial processes throughout.
Remove Barriers and Reconnect Disconnected Habitats	Improve access to side channels and promote overbank flow.
Long-term Processes	NA
Short-term Processes	Add LWD throughout.
Alternative Strategies	Fuel reduction. Beaver introduction and management.

7.1.14.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-21 is high. LWD is still limited over relatively long sections and instream geomorphic complexity is low in some sections.

Riparian function is mostly high to full throughout PA-21.

7.1.14.3 Recommended Restoration Actions

Recommendations for PA-21 include protecting recovering riparian and fluvial processes throughout, improving access to side channels, and adding LWD throughout to promote overbank flows. Fuel reduction should be considered to reduce fire risk and provide on-site material for LWD additions. PA-21 is also a suitable candidate for beaver introduction and management.

7.1.14.4 Geomorphic Implications

Adding LWD in sections with low complexity will improve hydraulic and geomorphic complexity, and connect pockets of isolated high-quality habitat. Side channels are prevalent throughout PA-21, but some are not active, and access could be improved during flood events at the minimum. LWD additions should focus on promoting overbank flow and improving access to side channels during regular flood events.

7.1.14.5 Biological Benefits

LWD additions will increase the prevalence of key habitat features such as pools, spawning areas, concealment opportunities, and cover for salmonids. Improved access to side channels during regular flood events would provide refuge for juvenile salmonids.

7.1.14.6 Potential Challenges

The double-track trail provides the only access to PA-21, and most areas are only wide enough for an ATV.

7.1.15 North Fork Asotin Creek - Project Area 22 (River Mile 4.7 to 5.8)

7.1.15.1 Site Description

Project Area **22 (PA-22)** is located between RM 4.7 and 5.8 and is only accessible by a double-track trail following the stream on river left.

Basic descriptors of Project Area 22.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
4.7	5.8	1.1	Wandering Gravel Bed with Discontinuous Floodplain	Moderate function	State/Federal

Primary limiting factors in Project Area 22.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 22.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity; - low to moderate activity; - peak activity

Restoration recommendations for Project Area 22.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect recovering riparian processes throughout.
Remove Barriers and Reconnect Disconnected Habitats	Restore floodplain function between RM 5.2 and 5.4. Improve access to floodplain and side channels and promote overbank flow.
Long-term Processes	NA
Short-term Processes	Add LWD throughout.

Alternative Strategies	Fuel reduction. Beaver introduction and management.

7.1.15.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-22 is moderate, primarily due to limited LWD and limited floodplain access. Geomorphic complexity is variable and diverse examples are typically associated with LWD jams. Side channels are prevalent, but many are disconnected from the main channel. A large complex of side channels and flood channels near the top of the PA are not currently utilized during regular flood events.

Riparian function is mostly high to full. The canopy is dominated by black cottonwood and mixed conifer species.

7.1.15.3 Recommended Restoration Actions

Recommendations for PA-22 include protecting riparian processes throughout, restoring floodplain function between RM 5.2 and 5.4, and adding LWD throughout to promote overbank flows. Fuel reduction should be considered to reduce fire risk and provide on-site material for LWD additions. PA-22 is also a suitable candidate for beaver introduction and management.

7.1.15.4 Geomorphic Implications

Adding LWD to the channel would improve geomorphic and hydraulic diversity, promote overbank flows, aggrade incised sections, and improve access to side channels.

7.1.15.5 Biological Benefits

LWD additions will improve habitat quality and increase the prevalence of key habitat features such as pools, undercut banks, shear zones, suitable spawning areas, concealment opportunities, and cover. Established beaver dam complexes would greatly improve floodplain access and retain water for the benefit of downstream reaches.

7.1.15.6 Potential Challenges

The double-track trail provides the only access to PA-22, and most areas are only wide enough for an ATV. The trail also becomes single-track near RM 5.4.

7.1.16 South Fork Asotin Creek - Project Area 28 (River Mile 0.0 to 3.9)

7.1.16.1 Site Description

Project Area **28 (PA-28)** begins at the confluence with the North Fork of Asotin Creek and ends at RM 3.9 at the South Fork Road bridge crossing. South Fork Road follows the entire length of PA-28 on river right. Habitat conditions throughout the PA are variable, but natural processes appear to be recovering.

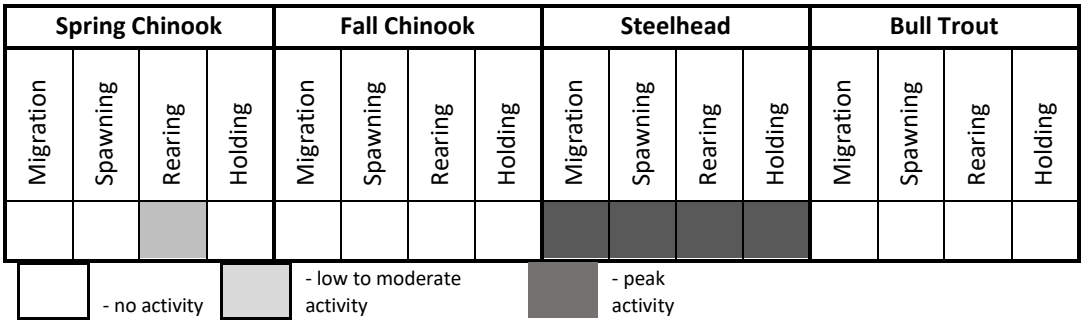
Basic descriptors of Project Area 28.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
0.0	3.9	3.9	Planform Controlled with Discontinuous Floodplain	Moderate function	State

Primary limiting factors in Project Area 28.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X		X	X	

Fish species presence and use by life history stage in Project Area 28.



Restoration recommendations for Project Area 28.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Maintain areas with recovering riparian and fluvial processes.
Remove Barriers and Reconnect Disconnected Habitats	Improve access to relic flood and side channels throughout and promote overbank flow.
Long-term Processes	Control invasive vegetation encroaching into the valley bottom.
Short-term Processes	Maintain density of LWD in IMW treatment sections. Add LWD throughout to extend coverage of IMW treatments.
Alternative Strategies	NA

7.1.16.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-28 is moderate, primarily due to incision, limited LWD outside of the IMW treatment, limited floodplain access, and low geomorphic diversity. PA-28 is still recovering from past catastrophic flood events. Many sections have natural boulder berms armoring the banks and restricting access to the floodplain. Boulders are prevalent in the channel and produce diverse hydraulics, but the boulders are not well-organized, so their geomorphic impact is minimal. The floodplain is not accessed regularly, and many areas are heavily armored by cobble sheets.

Riparian function is variable, but mostly limited to moderate with pockets of fully functioning riparian buffers. As the reach continues to recover from past floods, the riparian function will naturally recover slowly.

7.1.16.3 Recommended Restoration Actions

Recommendations for PA-28 include maintaining fully functioning riparian areas, controlling invasive vegetation, maintaining LWD densities in IMW treatment sections, and adding LWD throughout to extend the coverage of the IMW treatments. LWD additions should focus on improving geomorphic complexity and fish habitat, and promoting overbank flows. In some sections, direct removal of boulder berms or excavating access points to relic flood channels may be required.

7.1.16.4 Geomorphic Implications

Adding LWD will improve hydraulic and geomorphic complexity, help aggrade the stream bed in incised sections, and improve access to flood channels. LWD would also improve sediment sorting to create more diverse bed characteristics. LWD structures targeted at banks or direct excavation of banks to improve floodplain access would improve floodplain connectivity.

7.1.16.5 Biological Benefits

Adding LWD will improve habitat quality and increase the prevalence of key habitat features such as pools, undercut banks, cover, suitable spawning areas, concealment opportunities, and off-channel habitat for salmonids. Improving floodplain connectivity would help recovering riparian processes. Adding LWD would also increase hyporheic exchange and help buffer stream temperatures. As the riparian area continues to recover and the floodplain is inundated more frequently, stream temperatures will also decrease.

7.1.16.6 Potential Challenges

The bed and bank in PA-28 is heavily armored by boulders and cobble. Direct excavation may be required for best results. PA-28 is long and could be implemented in 2-3 phases. Because there is overlap with previous treatments completed by the IMW, project-level planning should include strategies for incorporating past efforts.

7.1.17 South Fork Asotin Creek - Project Area 29 (River Mile 3.9 to 4.3)

7.1.17.1 Site Description

Project Area **29 (PA-29)** begins at the South Fork Road bridge crossing and ends at RM 4.3. Warner Gulch enters the stream just downstream of RM 4.0 and, despite being ephemeral, has contributed substantial amounts of sediment to the channel several times in recent years. A meander project implemented in the late 90s extends from the South Fork Road bridge crossing to RM 4.0. Negative impacts from the 1996 flood are evident from RM 4.0 to 4.3.

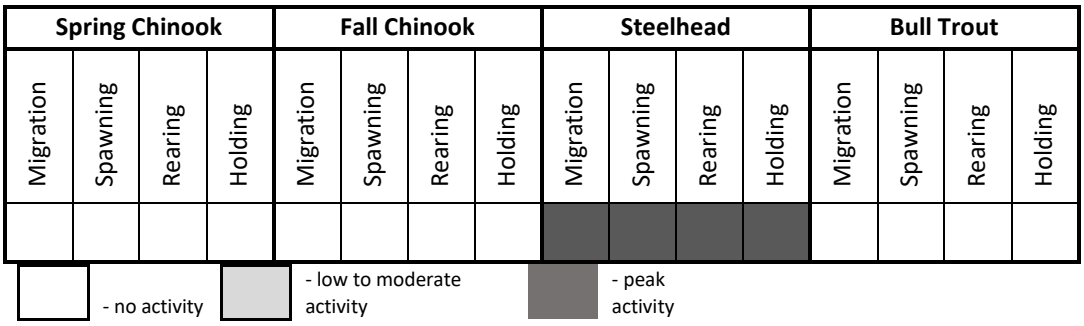
Basic descriptors of Project Area 29.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
3.9	4.3	0.4	Fan Controlled with Discontinuous Floodplain	Moderate function	State

Primary limiting factors in Project Area 29.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X		X	X	

Fish species presence and use by life history stage in Project Area 29.



Restoration recommendations for Project Area 29.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	NA
Remove Barriers and Reconnect Disconnected Habitats	Remove old levee near RM 4.0. Promote overbank flow.
Long-term Processes	Control invasive vegetation and upland vegetation encroachment.
Short-term Processes	Add LWD throughout to improve past restoration projects.
Alternative Strategies	NA

7.1.17.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-29 is moderate, primarily due to low geomorphic complexity and limited floodplain connectivity. The meander project at the bottom of the PA is stable and functioning as designed. An old levee near RM 4.0 is restricting access to low-lying floodplain pockets, and reducing the stream's ability to erode the fan produced by Warner Gulch.

Riparian function is poor and largely departed from historic estimates. Irregular floodplain inundation since the 1996 flood has likely contributed to the lack of fine sediment deposits on the floodplain, which is inhibiting riparian recovery.

7.1.17.3 Recommended Restoration Actions

Recommendations for PA-29 include removing the old levee near RM 4.0, controlling invasive vegetation and upland vegetation encroachment, and adding LWD throughout to improve on past restoration projects.

7.1.17.4 Geomorphic Implications

Adding LWD to the channel would improve hydraulic and geomorphic diversity, help aggrade the channel, and promote overbank flows. LWD added to the floodplain would help force deposits of fine sediment if floodplain access is improved. LWD structures added by the IMW project helped improve geomorphic complexity, but have had minimal impact on improving floodplain access. Future LWD additions should promote overbank flows and target low-lying areas to improve the regularity of floodplain inundation.

7.1.17.5 Biological Benefits

Adding LWD to pools within the meander project will increase the amount of available cover for juvenile salmonids. LWD throughout PA-29 would help reduce stream temperatures, increase habitat quality and increase the prevalence of key habitat features such as pools, cover, off-channel habitat, shear zones, suitable spawning areas, and concealment opportunities for salmonids. Increasing the regularity of floodplain inundation would help kickstart riparian recovery.

7.1.17.6 Potential Challenges

Access to the upper portion of PA-29 is limited to a very primitive trail which crosses the river several times via unmaintained fords. There is also the potential for LWD to rack against a small bridge where the South Fork Road crosses the creek and heads up Warner Gulch Road.

7.1.18 South Fork Asotin Creek - Project Area 31 (River Mile 4.9 to 9.2)

7.1.18.1 Site Description

Project Area **31 (PA-31)** is located in a remote area of the South Fork drainage, starting at RM 4.9 and ending at RM 9.2. Many sections show apparent impacts from the 1996 flood, but appear to be slowly recovering. The extent of available LIDAR data ends at RM 7.2, so detailed analysis of floodplain condition was not completed.

Basic descriptors of Project Area 31.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
4.9	9.2	4.3	Planform Controlled with Discontinuous Floodplain	Moderate function	State/Federal

Primary limiting factors in Project Area 31.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 31.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 31.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Natural processes are impaired in this project area.
Remove Barriers and Reconnect Disconnected Habitats	Improve access to flood channels and side channels and promote overbank flow.
Long-term Processes	Invasive vegetation control and riparian plantings as needed in conjunction with improved floodplain access.
Short-term Processes	Add LWD throughout.
Alternative Strategies	Fuel reduction. Beaver introduction and management.

7.1.18.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-31 is moderate, primarily due to incision, low hydraulic and geomorphic complexity, limited LWD, and poor floodplain access. There are several flood channels throughout the PA, but they are rarely accessed due to limited floodplain connectivity. The channel is homogenous and heavily armored by large cobble and boulders. The banks are also armored by similar material, restricting the stream's ability to migrate laterally and force access to relic side and flood channels.

Riparian function is mostly high and the size of the riparian area has departed very little from historic estimates. The canopy is dominated by white alder, black cottonwood, and the prevalence of mixed conifer species increases moving upstream.

7.1.18.3 Recommended Restoration Actions

Recommendations for PA-31 include improving access to the floodplain, side channels and flood channels, adding LWD throughout, and controlling invasive vegetation and riparian plantings in conjunction with improved floodplain access. Fuel reduction should be considered to reduce fire risk and provide on-site material for LWD additions. PA-31 is also a suitable candidate for beaver introduction and management, particularly upstream of RM 7.6.

7.1.18.4 Geomorphic Implications

Adding LWD will increase hydraulic and geomorphic complexity, help aggrade the channel in incised sections, promote overbank flows, and improve access to relic flood and side channels.

7.1.18.5 Biological Benefits

Adding LWD to the channel will improve habitat diversity and increase the prevalence of key habitat features such as pools, shear zones, cover, suitable spawning and concealment opportunities, and off-channel habitats. Improving access to the floodplain will promote riparian recovery and increase water retention for the benefit of downstream reaches. Increasing water exchange within the hyporheic zone and increasing the regularity of floodplain inundation may also buffer stream temperatures for downstream reaches.

7.1.18.6 Potential Challenges

PA-31 is remote and access is limited to a very primitive double-track trail that crosses the stream multiple times. This project area is very long so it may be implemented in multiple phases. Limiting damage to the recovering riparian area during implementation should be a priority.

GEORGE CREEK TIER 1 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

7.1.19 George Creek - Project Area 36 (River Mile 6.0 to 9.7)

7.1.19.1 Site Description

Project Area **36 (PA-36)** begins at the confluence of Stringtown Gulch at RM 6.0 and ends at an unnamed ephemeral tributary at RM 9.7. There is a gravel road that provides access to the PA on river left, but its condition gets progressively worse moving upstream.

Basic descriptors of Project Area 36.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
6.0	9.7	3.7	Planform Controlled with Discontinuous Floodplain	Moderate function	State/Private

Primary limiting factors in Project Area 36.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X		X	X	

Fish species presence and use by life history stage in Project Area 36.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 36.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Natural processes are impaired throughout the project area.
Remove Barriers and Reconnect Disconnected Habitats	Improve access to floodplain and flood channels and promote overbank flow.
Long-term Processes	Invasive vegetation control and riparian plantings in conjunction with improved floodplain access.
Short-term Processes	Add LWD throughout the channel and floodplain.
Alternative Strategies	NA

7.1.19.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-36 is moderate, primarily due to irregular floodplain access, limited LWD, and low hydraulic and geomorphic complexity. Numerous flood channels exist in the valley bottom, but few are accessed during regular bankfull events because in many sections the channel is incised, and the banks are heavily armored by cobble and boulders. Sections where the floodplain is accessible are typically more complex, have more LWD, and higher riparian function. Surface flow may be maintained into July, but typically becomes puddled or dry by August.

As much as 96% of the riparian extent has been reduced based on historic estimates. There are pockets of riparian that have moderate function (e.g., RM 6.7-6.8 and 7.0 to 7.1), but they are typically small and infrequent.

7.1.19.3 Recommended Restoration Actions

Recommendations for PA-36 include improving access to the floodplain and flood channels, adding LWD throughout the channel and floodplain, controlling invasive vegetation, and riparian plantings in conjunction with improved floodplain access.

7.1.19.4 Geomorphic Implications

Improving access to flood channels would help reconnect the floodplain and encourage lateral migration. Adding LWD in the channel would improve hydraulic and geomorphic complexity, help aggrade the channel in incised sections, and improve sediment and water retention. Adding LWD to the floodplain and accessible flood channels will increase fine sediment deposition across the valley bottom.

7.1.19.5 Biological Benefits

Increasing the regularity of floodplain inundation would help kickstart riparian recovery by increasing fine sediment deposition and improving water retention. As floodplain conditions improve, it would be beneficial to add riparian plantings to suitable locations. Flow within downstream reaches regularly goes subsurface by summer, so promoting actions that improve water retention may increase summer base flows and buffer stream temperatures downstream. Adding LWD would improve habitat diversity and increase the prevalence of key habitat features such as pools, cover, and suitable spawning areas.

7.1.19.6 Potential Challenges

PA-36 is remotely located and only accessible by a primitive gravel road that gets progressively worse moving upstream. The project area is very long so implementing in multiple phases may be necessary. There is very little LWD available on-site, so material for the proposed actions would need to be delivered. Because this reach goes subsurface in some years, immediately creating multiple side channels may increase puddled or dry conditions. Therefore, the goal should be to increase access to flood channels during bankfull events, but allow the stream to return to a single main channel as flows recede and fluvial processes recover. This project would require landowner approval.

7.1.20 George Creek - Project Area 37 (River Mile 9.7 to 10.9)

7.1.20.1 Site Description

Project Area **37 (PA-37)** is located far within the George Creek watershed between RM 9.7 and 10.9. Access to this PA is very limited.

Basic descriptors of Project Area 37.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
9.7	10.9	1.2	Planform Controlled with Discontinuous Floodplain	Moderate function	Private

Primary limiting factors in Project Area 37.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X		X	X	

Fish species presence and use by life history stage in Project Area 37.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity; - low to moderate activity; - peak activity

Restoration recommendations for Project Area 37.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Natural processes are impaired throughout the project area.

Remove Barriers and Reconnect Disconnected Habitats	Improve access to floodplain and flood channels and promote overbank flow.
Long-term Processes	Invasive vegetation control. Riparian plantings in conjunction with improved floodplain access.
Short-term Processes	Add LWD throughout channel and floodplain
Alternative Strategies	NA

7.1.20.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-37 is moderate, primarily due to irregular floodplain access, limited LWD, and low hydraulic and geomorphic complexity. There are many flood channels in the valley bottom, but few are accessed during bankfull events. The channel is dominated by planar features with heavy armoring on the bed and banks. Surface flow is typically maintained into August, but some sections may become puddled.

Riparian function is variable but mostly moderate, and the extent of the riparian zone has decreased greatly in area based on historic estimates. The density of riparian vegetation is highest directly adjacent to the stream channel, and relatively sparse on the floodplain. The dominant canopy species are various willows, white alder, and some black cottonwood.

7.1.20.3 Recommended Restoration Actions

Recommendations for PA-37 include improving access to flood channels and the regularity of floodplain inundation, adding LWD throughout the channel and floodplain, invasive vegetation control, and riparian plantings in conjunction with improved floodplain access.

7.1.20.4 Geomorphic Implications

Improving access to flood channels would help reconnect the floodplain and encourage lateral migration. Adding LWD to the channel would improve hydraulic and geomorphic complexity, help aggrade the channel in incised sections, and improve sediment and water retention. Adding LWD to the floodplain and accessible flood channels will increase fine sediment deposition across the valley bottom.

7.1.20.5 Biological Benefits

Increasing the regularity of floodplain inundation would help kickstart riparian recovery by increasing fine sediment deposition and improving water retention. As floodplain conditions improve, it would be beneficial to add riparian plantings to suitable locations. Like PA-36, improving water retention may extend summer base flows and buffer stream temperatures for downstream reaches. Adding LWD would improve habitat diversity and increase the prevalence of key habitat features such as pools, cover, and suitable spawning areas.

7.1.20.6 Potential Challenges

Access to PA-37 is very limited. There is little LWD available on-site to implement the recommended actions, so material would need to be delivered. This project would require landowner approval.

7.1.21 Tenmile Creek - Project Area 68 (River Mile 3.1 to 4.8)

7.1.21.1 Site Description

Project Area **68 (PA-68)** is located between RM 3.1 and 4.8. The stream channel parallels the Snake River and is separated from it by Weissenfels Ridge. Ecological conditions vary greatly through PA-68, transitioning between relatively complex sections with wide riparian buffers to homogenous sections with no riparian vegetation.

Basic descriptors of Project Area 68.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
3.1	4.8	1.7	Planform Controlled with Discontinuous Floodplain	Moderate function	Private

Primary limiting factors in Project Area 68.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 68.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 68.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect recovering riparian and fluvial processes between RM 3.2 and 3.3, 3.5 and 3.8.
Remove Barriers and Reconnect Disconnected Habitats	Improve access to floodplain and flood channels and promote overbank flow.
Long-term Processes	Invasive vegetation control. Riparian plantings in conjunction with improved floodplain access.
Short-term Processes	Add LWD to the channel and floodplain.

Alternative Strategies	NA

7.1.21.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-68 is moderate with brief pockets of recovering fluvial and riparian processes. The primary limitations to geomorphic and floodplain condition include limited floodplain access, irregularity of floodplain inundation, limited LWD, and low hydraulic and geomorphic complexity. Flows usually go subsurface by the middle of summer, but may remain puddled in sections with a dense riparian canopy.

The riparian function in PA-68 is mostly limited, and the extent of the riparian area has greatly decreased based on historic estimates. However, there are pockets of riparian with moderate function that appear to be recovering, including RM 3.2-3.3 and 3.5-3.8. The canopy is dominated by white alder and black cottonwood.

7.1.21.3 Recommended Restoration Actions

Recommendations for PA-68 include protecting recovering riparian and fluvial processes between RM 3.2-3.3 and RM 3.5-3.8, adding LWD to the channel and floodplain, controlling invasive vegetation, and riparian plantings as floodplain access improves.

7.1.21.4 Geomorphic Implications

Improving access to flood channels will improve floodplain connection. Increasing the regularity of floodplain inundation will help kickstart riparian recovery, and promote lateral migration. Adding LWD to the channel would improve hydraulic and geomorphic diversity, promote overbank flows, and increase sediment and water retention. Adding LWD the floodplain to conjunction with improved floodplain access will promote fine sediment deposition and improve floodplain conditions.

7.1.21.5 Biological Benefits

There are few pockets of recovering riparian areas in Tenmile Creek, so protecting these areas with higher ecological function and extending their coverage should be a priority. Adding LWD to the channel would improve habitat diversity and increase the prevalence of key habitat features such as pools, cover, suitable spawning areas, margin-attached bars, and concealment opportunities. LWD may also increase water retention and improve hyporheic exchange which could extend summer base flows and buffer stream temperatures downstream. Improve floodplain access and LWD in the floodplain would help kickstart riparian recovery and help connect pockets of higher quality riparian areas.

7.1.21.6 Potential Challenges

PA-68 is remotely located in the Tenmile Creek watershed. A primitive dirt road follows the stream on river right. This project would require landowner acceptance.

7.1.22 Tenmile Creek - Project Area 69 (River Mile 4.8 to 7.6)

7.1.22.1 Site Description

Project Area **69 (PA-69)** is located high within the Tenmile Creek watershed between RM 4.8 and 7.6. Geomorphic and riparian function is variable throughout the reach. Valley confinement fluctuates, but for most of the PA the channel is partly confined.

Basic descriptors of Project Area 69.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
4.8	7.6	2.8	Planform Controlled with Discontinuous Floodplain	Moderate function	Private

Primary limiting factors in Project Area 69.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X		X	X	

Fish species presence and use by life history stage in Project Area 69.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 69.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect recovering riparian and fluvial processes between RM 5.8 and 6.1, and RM 6.3 and 6.8.
Remove Barriers and Reconnect Disconnected Habitats	Improve access to flood channels and floodplain and promote overbank flow.
Long-term Processes	Control invasive vegetation and upland vegetation encroachment.
Short-term Processes	Add LWD throughout channel and floodplain.
Alternative Strategies	NA

7.1.22.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-69 is moderate in most areas, but there are pockets where riparian and fluvial processes are recovering well. In most areas, the channel is incised and the bed and banks are armored by large cobble and boulders. The valley constriction is variable throughout this reach, so a lack of floodplain access in some areas (e.g., RM 5.0 to 5.3) is not an indicator of lower function. However, instream hydraulic and geomorphic complexity is relatively low throughout the PA. In wider areas, flood channels exist but are rarely accessed during flood events.

Riparian function is generally moderate and the extent of the riparian zone has departed little from historic estimates. Riparian vegetation is nearly non-existent between RM 7.3 and 7.5. The canopy is dominated by white alder and black cottonwood.

7.1.22.3 Recommended Restoration Actions

Recommendations for PA-69 include protecting recovering riparian and fluvial processes between RM 5.8-6.1 and RM 6.3-6.8, improving access to flood channels and the floodplain, adding LWD throughout the channel and floodplain, invasive vegetation control, and riparian plantings in conjunction with improved floodplain access.

7.1.22.4 Geomorphic Implications

Sections with highly functioning fluvial processes are relatively rare in Tenmile Creek, therefore these areas should be protected and extended. Sections in between the proposed protection areas should be targeted for restoration to extend continuous sections of highly functioning habitats. Improving access to flood channels will increase floodplain connectivity and promote lateral migration where the valley bottom has accommodation space. Adding LWD to the channel will increase hydraulic and geomorphic complexity, help aggrade the channel, and improve sediment and water retention. Adding LWD to the floodplain and flood channels will promote fine sediment deposition and water retention in the valley bottom.

7.1.22.5 Biological Benefits

Adding LWD to the channel will improve habitat diversity and increase the prevalence of key habitat features such as pools, suitable spawning areas, concealment opportunities, and cover. LWD may also increase hyporheic exchange and slow water transport times which may extend summer base flows and buffer stream temperatures for downstream reaches. Improved floodplain access and LWD in the floodplain will improve the rate of riparian recovery by encouraging fine sediment deposition and increasing water retention in the valley bottom.

7.1.22.6 Potential Challenges

Access to PA-69 is limited to a primitive dirt road on river right. The quality of the road decreases moving upstream. There is little LWD on-site to implement the recommended actions, so material would need to be delivered. Due to the length of PA-69, it may be necessary to implement the proposed actions in phases.

7.1.23 Tenmile Creek - Project Area 71 (River Mile 10.3 to 11.4)

7.1.23.1 Site Description

Project Area **71 (PA-71)** begins at RM 10.3 and ends at the confluence with Mill Creek at RM 11.4. There are multiple private primitive roads to and paralleling this reach, making access to this remote reach difficult. Fans from steep ephemeral hillslopes regularly push the channel from either side of the valley margin, but the stream appears to have the competence to move the material, creating large cut banks at the toe of the fans.

Basic descriptors of Project Area 71.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
10.3	11.4	1.1	Planform Controlled with Discontinuous Floodplain	Moderate function	Private

Primary limiting factors in Project Area 71.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X		X	X	

Fish species presence and use by life history stage in Project Area 71.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 71.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Riparian and fluvial processes are impaired throughout the project area.
Remove Barriers and Reconnect Disconnected Habitats	Improve access to flood channels and floodplain and promote overbank flow.
Long-term Processes	Riparian plantings in conjunction with improved floodplain access between RM 11.0 and 11.4.
Short-term Processes	Add LWD throughout channel and floodplain.
Alternative Strategies	NA

7.1.23.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-71 is moderate, primarily due to low hydraulic and geomorphic diversity, limited floodplain access, and irregular floodplain inundation. The channel varies from incised to braided through this reach as the stream attempts to rework large pockets of sediment deposition. Large sections of this reach are likely recovering from historic flood events and land use disturbance, and typically appear braided with very few structural elements in the channel. Typically, these sections also have puddled or no surface flow during late summer months. Channel substrate is uniformly distributed and poorly sorted, primarily composed of unembedded cobbles. Boulders act as the primary instream structural element, but rarely occur in clusters or ribs, so their morphological impact is minimal.

Riparian function in PA-71 is generally moderate, but some sections have no riparian vegetation. White alder are the dominant canopy species but there are several cottonwood groves and patches of willow.

7.1.23.3 Recommended Restoration Actions

Recommendations for PA-71 include improving access to flood channels and the floodplain, adding LWD throughout the channel and floodplain, and riparian plantings in conjunction with improved floodplain access.

7.1.23.4 Geomorphic Implications

Adding LWD to the channel will improve hydraulic and geomorphic diversity, promote overbank flows, and increase sediment and water retention. LWD would also improve sediment sorting to disrupt the uniform distribution of large substrate throughout the project area. LWD could be used to direct flows towards relic flood channels to promote floodplain inundation during bankfull flood events. LWD in the floodplain would encourage fine sediment deposition and increase water retention in the valley bottom.

7.1.23.5 Biological Benefits

LWD additions will improve habitat diversity and increase key habitat features such as pools, margin-attached bars, suitable spawning areas, concealment opportunities, and undercut banks. LWD would also encourage hyporheic exchange and slow water transport times, which may extend summer base flows and buffer stream temperatures for downstream reaches. Increasing the regularity of floodplain inundation would help kickstart riparian recovery in areas devoid of vegetation. Riparian plantings in conjunction with improved floodplain access between RM 11.0 and 11.4 would help create a continuous riparian canopy connecting to downstream sections.

7.1.23.6 Potential Challenges

There are no roads providing direct access to this project area. This project would require landowner approval.

COUSE CREEK TIER 1 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

7.1.24 Couse Creek - Project Area 78 (River Mile 0.1 to 1.4)

7.1.24.1 Site Description

Project Area **78 (PA-78)** begins at the Snake River Road bridge crossing and RM 0.1 and ends near an unnamed ephemeral tributary at RM 1.4. Couse Creek Road follows the stream on river left for the entire project area. Channel confinement is variable and heavily influenced by fans from adjacent steep ephemeral hillslopes. The adjacent hillslopes contribute substantial amounts of colluvium that the stream does not have the competence to move during regular flood events.

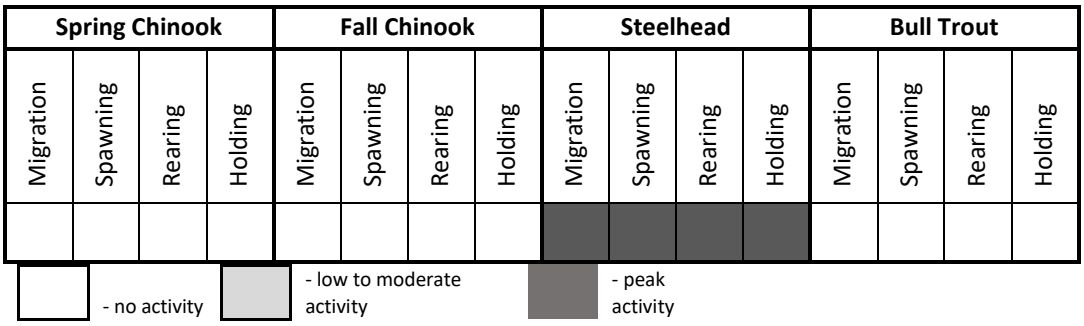
Basic descriptors of Project Area 78.

RM Start	RM End	RM Length	Reach Type	Geomorphic function	Landownership
0.1	1.4	1.3	Fan Controlled with Discontinuous Floodplain	Moderate function	Private

Primary limiting factors in Project Area 78.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 78.



Restoration recommendations for Project Area 78.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Riparian and fluvial processes are impacted throughout this project area.
Remove Barriers and Reconnect Disconnected Habitats	Improve access to flood channels and promote overbank flow.
Long-term Processes	Control invasive vegetation.
Short-term Processes	Organize boulders between RM 0.1 and 0.3. Add LWD to the channel and floodplain throughout.
Alternative Strategies	NA

7.1.24.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-78 is moderate, primarily due to low geomorphic diversity, limited floodplain access, and excessive colluvium deposits. Large boulders from colluvial inputs provide the primary source for hydraulic and geomorphic diversity, which is typical in fan controlled reach types. The floodplain is inherently narrow; however, flood channels do exist and are not accessed regularly. The channel substrate is poorly sorted and heavily armored by large cobble.

Riparian function is generally moderate, and most sections have departed little from historic estimates. Invasive vegetation is encroaching into the valley bottom, particularly between RM 0.4-0.6 and RM 1.0-1.3.

7.1.24.3 Recommended Restoration Actions

Recommendations for PA-78 include improving access to flood channels, controlling invasive vegetation encroachment, organizing boulders into cluster or ribs between RM 0.1 and 0.3, and adding LWD to the channel and floodplain throughout.

7.1.24.4 Geomorphic Implications

Improving access to flood channels will improve floodplain connectivity. The addition of boulders between RM 0.1 and 0.3 and LWD throughout may improve hydraulic and geomorphic complexity, promote overbank flows, improve access to flood channels, and improve sediment sorting.

7.1.24.5 Biological Benefits

Adding LWD to the channel will improve habitat diversity and increase key habitat features such as pools, suitable spawning habitat, and cover. LWD within flood channels will create high flow refuge in off-channel habitats. Improving access to flood channels will expedite riparian recovery by retaining water in the floodplain and encouraging fine sediment deposition. Organizing boulders near the bottom of the PA will improve habitat quality and fish passage through the high gradient section.

7.1.24.6 Potential Challenges

Unsecured wood may impact the Snake River Road bridge during large floods. The project will require landowner approval.

8 TIER 2 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

ALPOWA CREEK TIER 2 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

8.1.1 Alpowa Creek - Project Area 56 (River Mile 0.0 to 0.6)

8.1.1.1 Site Description

Project Area **56 (PA-56)** is located along Alpowa Creek between RM 0.0 to 0.6. The PA is within an alluvial fan at the confluence of Alpowa Creek with the Snake River. Highway 12 crosses the PA at RM 0.5 and confines the fan on river right. Geomorphic function is moderate due to limited structural complexity and input of LWD. Two dominant channels flow across the fan. Riparian function ranges from poor to good due to non-native trees and invasive weeds. Flows in Alpowa Creek are spring dominated and has the most stable flows of any of the streams we assessed.

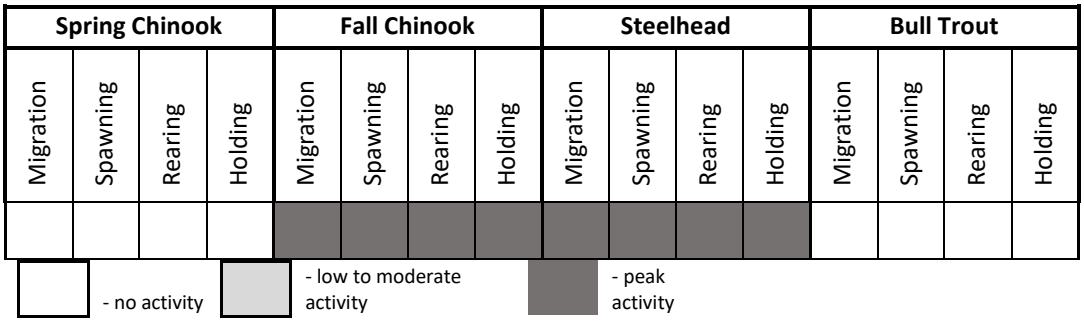
Basic descriptors of Project Area 56.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	0.7	0.7	Alluvial Fan	Moderate	Private

Primary limiting factors in Project Area 56.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X	X		X	

Fish species presence and use by life history stage in Project Area 56.



Restoration recommendations for Project Area 56.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature native riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect flood channel. Promote overbank flow in channel and add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA.

8.1.1.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-56 is moderate due to limited geomorphic or structural element diversity. The channels are relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is poor to moderate.

8.1.1.3 Recommended Restoration Actions

Recommendations for PA-56 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation. We also noted in our assessment that pelican predation of smolts should be assessed, as pelicans are often seen congregating at the mouth of Alpowa Creek.

8.1.1.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

8.1.1.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat.

8.1.1.6 Potential Challenges

The backwater effect of Snake River above Lower Granite dam influences behavior of the fan and impacts sediment transport from Alpowas Creek. Proximity to Highway 12 increases risk of restoration.

8.1.2 Alpowa Creek - Project Area 57 (River Mile 0.6 to 3.0)

8.1.2.1 Site Description

Project Area **57 (PA-57)** is located along Alpowa Creek between RM 0.6 to 3.0. The PA is within a partly confined valley setting but is heavily confined by an orchard and ranch operation from RM 0.6 to 2.7. Geomorphic function is limited due to low structural complexity and input of LWD. Riparian function is poor throughout because the riparian area is very narrow. The riparian area is dominated by mature cottonwood overstory and invasive bramble understory. Flows in Alpowa Creek are spring dominated.

Basic descriptors of Project Area 57.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.7	3.0	2.3	Planform Controlled with Discontinuous Floodplain	Limited	Private

Primary limiting factors in Project Area 57.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X	X		X	

Fish species presence and use by life history stage in Project Area 57.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity; - low to moderate activity; - peak activity

Restoration recommendations for Project Area 57.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature native riparian vegetation throughout.

Remove Barriers and Reconnect Disconnected Habitats	Reconnect flood channel. Promote overbank flow in channel and add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA.

8.1.2.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-57 is limited due to low geomorphic or structural element diversity. The channel is highly incised, relatively simple, and side channels and overbank flow are rare. Floodplain and riparian function is poor because orchard operations confine the floodplain to ~ 50 feet.

8.1.2.3 Recommended Restoration Actions

Recommendations for PA-57 include removing or setting back levees, especially between RM 0.7 to 2.2 and 2.6 to 2.7., reconnecting side and flood channels throughout, promoting overbank flow, adding structural elements to improve geomorphic function and aggrade the channel, riparian planting, and control of non-native vegetation.

8.1.2.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

8.1.2.5 Biological Benefits

Reconnecting side and flood channels, and adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat.

8.1.2.6 Potential Challenges

The proximity to the orchard increases the risk of any restoration significantly.

8.1.3 Alpowa Creek - Project Area 58 (River Mile 3.0 to 4.1)

8.1.3.1 Site Description

Project Area **58 (PA-58)** is located along Alpowa Creek between RM 3.0 to 4.1. Highway 12 borders the PA on river left throughout but is located on the hillside well above the floodplain. The PA is within a confined valley setting. Geomorphic function is limited due to low structural complexity and lack of LWD. Riparian function is limited to moderate throughout because the riparian is dominated by a narrow band of mature alder. Flows in Alpowa Creek are spring dominated.

Basic descriptors of Project Area 58.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
3.0	4.1	1.1	Confined with Occasional Floodplain Pockets	Limited	Private

Primary limiting factors in Project Area 58.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 58.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 58.

Protect and Maintain Natural Processes	Protect mature native riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect flood channels. Promote overbank flow in channel and add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA.

8.1.3.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-58 is limited due to low geomorphic or structural element diversity. The channels are relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is poor to moderate.

8.1.3.3 Recommended Restoration Actions

Recommendations for PA-58 include reconnecting flood channels, promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

8.1.3.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

8.1.3.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat.

8.1.3.6 Potential Challenges

Increased risk to the orchard downstream from addition of LWD.

8.1.4 Pow Wah Kee Gulch - Project Area 61 (River Mile 1.4 to 2.3)

8.1.4.1 Site Description

Project Area **61 (PA-61)** is located along Pow Wah Kee Gulch, a tributary to Alpowa Creek that enters at RM 3.0. Pow Wah Kee Gulch is a relatively long watershed (~ 20 miles), but the headwaters are below 4,500 feet elevation which limits flow. However, there are small springs throughout Pow Wah Kee that sustain some riparian vegetation and surface flow for short periods each year. The headwaters are in loess uplands which are dominated by dryland farming. The geomorphic function of this PA is moderate and the flow goes subsurface over much of the entire length of the PA. Fish use of this PA is limited and likely restricted to the lower reach during years with high flow

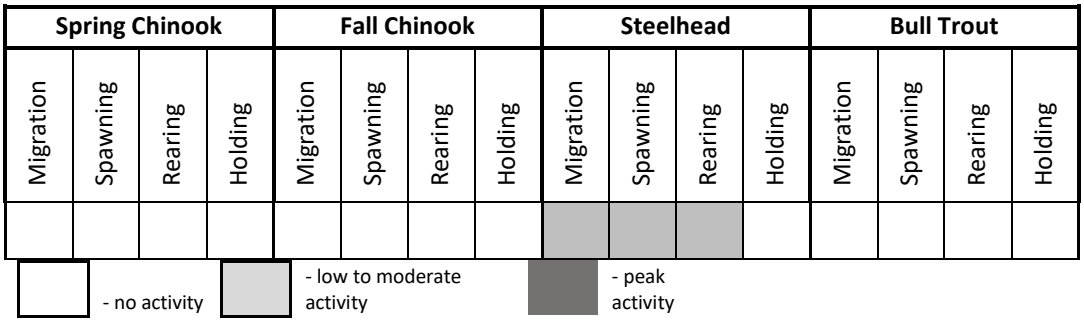
Basic descriptors of Project Area 61.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
1.4	2.3	0.9	Planform Controlled with Discontinuous Floodplain	Moderate	Private

Primary limiting factors in Project Area 61.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X		X	X	

Fish species presence and use by life history stage in Project Area 61.



Restoration recommendations for Project Area 61.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment and protect recovering riparian habitat.
Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting in reconnected floodplain habitat and invasive vegetation control throughout.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

8.1.4.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-61 is limited due to low or no flow, lack of structural elements, and agricultural activities in the watershed. The channel is well defined, floodplain and riparian areas are narrow, but the function is moderate to high likely because of spring flows.

8.1.4.3 Recommended Restoration Actions

Recommendations for PA-61 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

8.1.4.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

8.1.4.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of large portion of Pow Wah Kee Creek may provide some benefits to downstream flow.

8.1.4.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow.

ASOTIN CREEK TIER 2 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

8.1.5 Asotin Creek Mainstem - Project Area 03 (River Mile 3.2 to 5.6)

8.1.5.1 Site Description

Project Area **03 (PA-03)** is located on Asotin Creek from the confluence of Asotin Creek with George Creek at RM 3.2 upstream to where the valley starts to narrow at RM 5.6. The PM is within a partly confined valley setting. The land use is predominately working ranches and the density of houses is less than downstream of George Creek. The PA alternates between larger pockets of near fully functioning riparian habitat dominated by mature cottonwood and alder, to heavily impacted large sections of floodplain that are disconnected by levees or rip rap. The disconnected areas are used for wintering cattle and other agricultural practices. The mainstem of Asotin Creek has been moved to the far right side of the valley to accommodate the agricultural areas.

Basic descriptors of Project Area 03.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
3.2	5.6	2.4	Planform Controlled with Discontinuous Floodplain	Limited	Private

Primary limiting factors in Project Area 03.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X		X	X	

Fish species presence and use by life history stage in Project Area 03.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding
■	■	■	■	■	■	■	■	■	■	■	■	■			■

□ - no activity ■ - low to moderate activity ■ - peak activity

Restoration recommendations for Project Area 03.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation, particularly between RM 3.5 to 4.0 and 5.2 to 5.5.

Remove Barriers and Reconnect Disconnected Habitats	Remove or set back levees between RM 3.2 to 3.4 and 4.1 to 4.3 to increase lateral accommodation space for natural development of complex geomorphic units and increase floodplain connectivity. Reconnect relic side channels between RM 3.5 and 4.2 and 5.2 to 5.5. Promote overbank flow into active side channels and floodplain.
Long-term Processes	Invasive vegetation control adjacent to and within cattle wintering areas.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Investigate other locations for wintering cattle that is not in the floodplain or increase the width of the riparian buffer (e.g., an area was developed on the uphill side of the road to winter cattle in Couse Creek).

8.1.5.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-03 is limited largely due to anthropogenic confinement restricting access to the floodplain (particularly near cattle wintering areas), and a lack of structural elements. The channel has been reduced to single thread and straightened in most of the PA. Geomorphic and hydraulic diversity is low and there are very few structural elements aside from occasional LWD. Aside from the mouth of Asotin Creek, PA-03 includes the widest valley bottom and historic floodplain among the target watersheds. However, the channel has been effectively cut off from the floodplain for most of the PA. There are a few opportunities to increase floodplain connection which would improve geomorphic function.

Riparian function in this reach is variable, ranging from limited to full. There are some examples in the PA where riparian function is high to full (e.g., RM 3.5 and 4.2 and 5.2 to 5.5). However, there are several long sections where riparian vegetation is limited to a thin extent along the channel margin. Alder and cottonwood are the dominant canopy species in PA-03 and likely provide adequate shade to the stream channel.

8.1.5.3 Recommended Restoration Actions

Recommendations for PA-03 include setting back levees between RM 3.2 to 3.4 and 4.1 to 4.3, reconnecting side channels especially at the bottom and top of the PA, protecting and enhancing riparian areas, and increasing structural elements throughout the project area.

8.1.5.4 Geomorphic Implications

Levee setbacks will increase lateral accommodation space for the channel to naturally develop complex geomorphic units such as secondary channels and mid-channel bars. Setting back some of the identified levees would also improve floodplain connection and potentially reduce flood hazards downstream. Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

8.1.5.5 Biological Benefits

Widening the channel through levee setbacks would improve riparian function and the development of critical habitat features for ESA-listed fish species, such as complex pools and spawning areas. Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat.

8.1.5.6 Potential Challenges

The cattle wintering areas are important areas for local ranchers and it may be difficult and expensive to relocate these areas out of the floodplain. The WDFW adult trap is just downstream of the Cloverland Bridge and the Asotin Creek IMW has a PIT tag array at the bridge – these important monitoring components could be damaged by mobile wood installations.

8.1.6 Asotin Creek Mainstem - Project Area 07 (River Mile 7.4 to 8.4)

8.1.6.1 Site Description

Project Area 07 (PA-07) is located along the mainstem of Asotin Creek between RM 7.3 to 8.3 in a constricted bedrock valley where the channel is 100% confined by the valley walls. The channel's shape and sinuosity are controlled by the valley margin and the PA has no floodplain. Asotin Creek Road runs along entire project area on river left and limits colluvium deposits from adding some more structure to the channel/bed.

Basic descriptors of Project Area 07.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
7.4	8.4	1.0	Bedrock Canyon	Moderate	Private

Primary limiting factors in Project Area 07.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 07.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding
■	▒	■	▒	■	■	■	■	■	■	■	■	■			▒

□ - no activity ▒ - low to moderate activity ■ - peak activity

Restoration recommendations for Project Area 07.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout.

Remove Barriers and Reconnect Disconnected Habitats	Reconnect small flood channel between RM 7.8 to 7.9.
Long-term Processes	NA
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

8.1.6.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-07 is moderate. The road limits colluvial inputs from the river left hillslope, which is causing a low geomorphic and hydraulic diversity. Colluvium provides an important source of structural elements in confined streams such as bedrock canyons. Although the channel flows along a road, the sinuosity is still imposed by the valley margin. The floodplain is very limited in this PA because of the bedrock canyon. However, there is a thin strip of relatively full functioning riparian, which should be maintained/protected from encroachment by the road.

8.1.6.3 Recommended Restoration Actions

Add LWD jams on outside bends and boulders sporadically to improve geomorphic and hydraulic complexity, promote overbank flow, provide flow refugia and edge habitat.

8.1.6.4 Geomorphic Implications

Adding LWD on the outside bends would provide valuable edge habitat in this confined PA. Placed boulders would aggregate overtime into boulder “ribs” perpendicular to the flow and further provide flow refugia in this PA.

8.1.6.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat.

8.1.6.6 Potential Challenges

The bedrock canyon is so narrow that installing LWD will be difficult and prone to movement during high flows. The small side channels and lack of floodplain do not provide much area to accommodate flood flows and there is some risk of impacting Asotin Creek Road along the entire length of this PA.

8.1.7 Asotin Creek Mainstem - Project Area 08 (River Mile 8.4 to 9.9)

8.1.7.1 Site Description

Project Area **08 (PA-08)** is located between RM 8.4 and 9.9 on the mainstem Asotin Creek and includes the area around the historic Headgate Dam that was modified in 2016 to provide unrestricted access to fish passage. There is a small county park and public access site at Headgate Dam, and a recent instream restoration project to prevent head cutting after the removal of the dam. There is also a small pond on river left at RM 9.6 that provides fishing opportunities for children and seniors. The road is located on the far left side of the valley and does not restrict the floodplain, but some levees and farm properties at the top and bottom of the PA do disconnect the floodplain. The channel is forced over to the far right of the valley and likely cannot migrate across the valley due to rip rap or

old levees. There are large floodplain areas that could be reconnected in this PA and there iso the potential to create wetland habitats.

Basic descriptors of Project Area 08.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
8.4	9.9	1.5	Planform Controlled with Discontinuous Floodplain	Limited	Private

Primary limiting factors in Project Area 08.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 08.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 08.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect small stands of mature cottonwood and alder.
Remove Barriers and Reconnect Disconnected Habitats	Remove or set back levees at RM 8.8. to 8.9, 9.2 to 9.8, and 9.8 to 9.9 to increase lateral accommodation space. Reconnect flood and side channels between 8.6 to 8.9, 9.0 to 9.2, and RM 9.6 to 9.7. Promote overbank flow.
Long-term Processes	Invasive weed control and riparian planting especially between RM 8.4 to 9.2.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Promote wetland development in current pasture to help reduce downstream flood hazard.

8.1.7.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-08 is limited due to the amount of straightening of the channel, disconnected floodplain and lack of LWD. The stream has clearly been realigned to flow along the bedrock on the far right of the valley and is likely maintained there by old rip rap and levee structures (most of which were not visible on the LiDar). Riparian function range from moderate to poor and are patchy throughout the PA. Around Headgate Dam there are some mature patches of cottonwood and alder, but large portions of historic floodplain are dominated by pasture that are heavily overgrown with invasive vegetation.

8.1.7.3 Recommended Restoration Actions

Recommendations for PA-08 include removing or setting back existing levees, reconnecting flood and side channels, installing LWD throughout the reach to promote overbank flow, add wood to the floodplain to increase roughness, and promoting the creation of a wetland downstream of Headgate Dam on river left. Other recommended actions include the control of invasive vegetation and planting of riparian species in areas of reconnected floodplain.

8.1.7.4 Geomorphic Implications

Levee setbacks will increase lateral accommodation space for the channel to naturally develop complex geomorphic units such as secondary channels and mid-channel bars. Setting back some of the identified levees would also improve floodplain connection and potentially reduce flood hazards downstream. Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

8.1.7.5 Biological Benefits

Widening the channel through levee setbacks would improve riparian function and the development of critical habitat features for ESA-listed fish species, such as complex pools and spawning areas. Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat.

8.1.7.6 Potential Challenges

Headgate dam and the fishing pond are very popular local landmarks and recreational sites. Restoration actions to promote floodplain reconnection could be controversial and limit day use and camping opportunities. This PA is also directly above a residence and efforts to promote the creation of a wetland and connect flood channels could increase the risk of flooding of private property.

8.1.8 Charley Creek - Project Area 13 (River Mile 0.6 to 1.9)

8.1.8.1 Site Description

Project Area **13 (PA-13)** is located on the mainstem of Charley Creek directly above the Asotin Creek Road crossing between RM 0.6 to 1.9. Charley Creek is a small (10-15 feet wide) tributary to Asotin Creek approximately 14 miles upstream from the town of Asotin. Charley Creek has numerous springs that provide relatively consistent flows and temperatures throughout the year. The WDFW owns most of the property in Charley Creek above the Asotin Creek Road crossing up to RM 6.5 and manages the area for wildlife. This PA is within a CREP buffer and Charley Creek is fenced on both sides. Charley Creek road extends along the length of the PA on the far left of the valley and generally does not restrict floodplain access. There is some conversion of riparian areas to grassland due to historic overwintering of cattle along the stream, but much of the riparian function is moderate to high. An

extensive riparian planting program was initiated in this PA in 2015 and it has been very successful at establishing plants due to an extensive network of irrigation pipes.

Basic descriptors of Project Area 13.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.6	1.9	1.3	Planform Controlled with Discontinuous Floodplain	Limited	State

Primary limiting factors in Project Area 13.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 13.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 13.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue to maintain riparian planting by watering and weed control.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect small flood channels between RM 0.8 to 0.9, 1.1 to 1.2, and 1.7. Promote overbank flow throughout by adding LWD.
Long-term Processes	Control invasive weeds.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Grazing strategies to reduce invasive weeds.

8.1.8.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-13 is limited due to a lack of LWD, limited hydraulic complexity, and incision limiting the frequency of overbank flows. Although there is relatively healthy riparian habitat throughout the PA,

there is a lack of LWD and geomorphic diversity is low. Floodplains and flood channels are rarely inundated because of incision.

8.1.8.3 Recommended Restoration Actions

Recommendations for PA-13 include maintaining and enhancing the riparian plantings, controlling invasive weeds, and adding LWD to increase geomorphic function and promote overbank flow into flood channels.

8.1.8.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

8.1.8.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Reconnecting the flood channels provides high flow refugia and off-channel rearing opportunities.

8.1.8.6 Potential Challenges

There is an under sized concrete culvert at the bottom of this PA that Charley Creek flows through to pass under Asotin Creek Road. Wood additions directly upstream of the culvert will increase the risk that debris gets caught in the culvert and threatens the road. Replacement of the culvert would be very expensive because the road would need to be realigned to meet new standards.

8.1.9 Lick Creek - Project Area 27 (River Mile 4.8 to 6.4)

8.1.9.1 Site Description

Project Area **27 (PA-27)** is located on Lick Creek along the Lick Fork road between RM 4.8 to 6.4, ending near the County boundary. The valley is more confined and the reach type changes to a confined steep headwater reach. The Lick Fork road generally does not impact the PA as it runs along the toe of the hillslope on river left. The geomorphic and riparian function improve in this PA compared to downstream PAs on Lick Creek, and the riparian function is mostly high to near full – transitioning from deciduous dominated to conifer dominated. The channel would likely react quickly to instream restoration work as the riparian continues to recover. This reach would benefit from LWD additions.

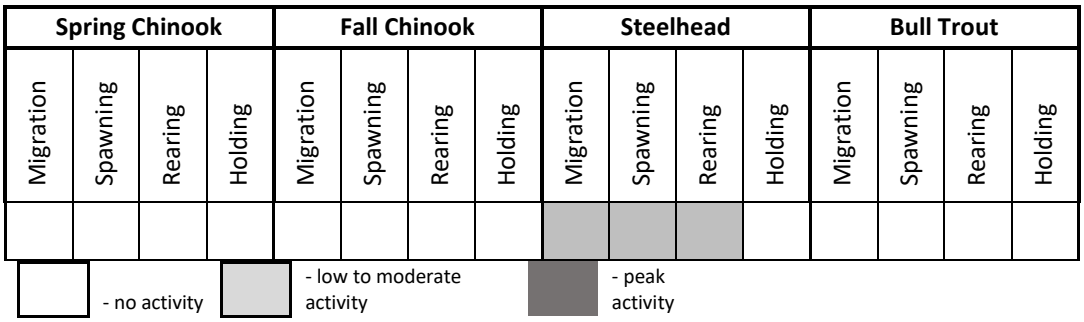
Basic descriptors of Project Area 27.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
4.8	6.4	1.6	Confined Steep Headwater	Moderate	State/Federal

Primary limiting factors in Project Area 27.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X		X	X	

Fish species presence and use by life history stage in Project Area 27.



Restoration recommendations for Project Area 27.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Invasive vegetation control along the Lick Fork road.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

8.1.9.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-27 is moderate, primarily due to limited LWD and limited opportunities for floodplain connection, even though floodplain pockets are abundant. Lick Fork road is adjacent to the creek, and its primary impact is limiting colluvial inputs from south facing hillslopes. Colluvium is an important and common structural element in confined reach types.

8.1.9.3 Recommended Restoration Actions

Recommendations for PA-27 include adding LWD to increase channel complexity and aggrade the channel, promoting overbank flow, controlling invasive vegetation, and riparian planting.

8.1.9.4 Geomorphic Implications

LWD additions will improve geomorphic function, promote overbank flow, and increase riparian function and floodplain connection.

8.1.9.5 Biological Benefits

Fish use is presumed to be minimal in Lick Creek, but geomorphic improvements will increase rearing capacity for juvenile steelhead, and LWD additions will improve riparian function and groundwater recharge, extending flows downstream.

8.1.9.6 Potential Challenges

Restoration in this PA has lower risk than downstream PAs because the stream is more confined and the road is not confining the floodplain. The fish barrier in the downstream PA should be removed before restoring this PA.

8.1.10 South Fork Asotin Creek - Project Area 30 (River Mile 4.3 to 4.9)

8.1.10.1 Site Description

Project Area **30 (PA-30)** is located along South Fork Asotin Creek between RM 4.3 to 4.9. There is access to this PA by a rough trail that crosses the South Fork at unmaintained fords several times. There is evidence of recent severe flooding throughout this PA. The bed and floodplain surface is very coarse, dominated by cobble and boulders There is minimal shrub or ground cover, and the channel lacks structure and is straightened and single thread through the PA. However, cottonwood trees are common and recovering across the floodplain. There are several boulder and log drop restoration structures constructed in the late 1990's that are providing some pool habitat. The Asotin Creek Intensively Monitored project maintains a fish and habitat monitoring site in this PA and also has installed 30-40 wood structures. This PA also includes a small river right tributary entering at RM 4.7 that flows for most of the year. The trail along the South Fork is a popular recreational access point to the upper watershed.

Basic descriptors of Project Area 30.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
4.3	4.9	0.6	Planform Controlled with Discontinuous Floodplain	Limited	State

Primary limiting factors in Project Area 30.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 30.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 30.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect recovering riparian throughout.

Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow.
Long-term Processes	Invasive vegetation control along the South Fork trail. Long-term goal should include relocating the trail on the side hill or toe of the slope as the river starts to occupy more of the historic floodplain (reduce or remove the stream crossings)
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading.

8.1.10.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-30 is limited due to large floods, most recently in 1996/97. The bed and floodplain material is very coarse, the channel is straight, confined to one side of the valley or the other, and there is limited geomorphic diversity or structural elements. The restoration in the latter 1990s and early 2000's added some geomorphic diversity to the PA and the Asotin IMW has added 30-40 log structures that are improving geomorphic functions. The floodplain and riparian function is limited partly because there is no regular overbank flow. There are limited sources of LWD and the vegetation, though recovering, is sparse.

8.1.10.3 Recommended Restoration Actions

Recommendations for PA-30 include reconnecting existing flood and side channels, installing LWD to promote overbank flow, protecting existing riparian areas, control of invasive weeds along the trail, and planting of riparian species in areas of reconnected floodplain.

8.1.10.4 Geomorphic Implications

Connecting relic side channels and promoting flows into flood channels will help reconnect the floodplain, improve riparian function, increase recruitment of LWD, and create greater geomorphic diversity. The addition of structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

8.1.10.5 Biological Benefits

South Fork Asotin Creek is an important and productive steelhead stream in Asotin Creek. The restoration actions will likely lead to improved spawning conditions by promoting more sediment sorting and increased cover, and improved juvenile habitat by promoting more flow refugia, off-channel habitat, cover, winter concealment sites, and improved feeding conditions.

8.1.10.6 Potential Challenges

Access to the PA will deteriorate as the river begins to have more overbank flow and reoccupy the historic floodplain. Introduction of the trail to the toe of the slope or side-hill would be a good long-term strategy.

8.1.11 George Creek - Project Area 35 (River Mile 3.5 to 6.0)

8.1.11.1 Site Description

Project Area **35 (PA-35)** is located along George Creek between RM 3.5 to 6.0. George Creek road runs along the length of the PA on river left. The road is generally along the toe of the river left hillslope and does not disconnect floodplain habitat. WDFW owns the property in this PA. The valley is partly confined and there are discontinuous floodplain pockets throughout the PA. The primary limiting factors are low geomorphic and hydraulic diversity due to a lack of structural elements. The channel planform is appropriate for most of the reach, but there are several disconnected side channels due to low amounts of LWD. The PA is dominated by planar geomorphic units such as runs and glides, and there are few pools. Flow does go subsurface in short sections throughout the PA but not as often as in lower George Creek. We suspect that these subsurface flows are mostly natural due to changes in the elevation of the bedrock in relation to the thickness of the alluvium. Riparian function is patchy and mirror the availability of surface water. There is also high sediment load in this PA from tributaries, historic landslides, and historic landuse practices in the uplands.

Basic descriptors of Project Area 35.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
3.5	6.0	2.5	Planform Controlled with Discontinuous Floodplain	Moderate	State

Primary limiting factors in Project Area 35.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 35.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 35.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect recovering riparian throughout.

Remove Barriers and Reconnect Disconnected Habitats	Reconnect short flood channels between RM 3.7 to 3.8 and near the upstream end of the PA. Promote overbank flow throughout.
Long-term Processes	Invasive vegetation control and riparian planting, targeting areas where floodplain is reconnected and areas of heavy grazing.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Use alternative grazing strategies to control weeds.

8.1.11.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-35 is moderate due to limited geomorphic or structural element diversity. The channel is relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is moderate to high and mostly improving. Much of the floodplain lacks structural elements, reducing surface roughness and limiting fine sediment deposition during floods. Parts of the PA where riparian vegetation is limited are mostly due to natural subsurface flows. However, past floods and intensive land use may have exacerbated subsurface flows.

8.1.11.3 Recommended Restoration Actions

Recommendations for PA-35 include protection the recovering riparian, reconnecting flood channels, adding LWD throughout the channel and floodplain, riparian planting in areas of floodplain reconnection, and controlling invasive weeds.

8.1.11.4 Geomorphic Implications

Connecting relic flood channels and promoting overbank flow will help reconnect the floodplain, improve riparian function, lead to a greater source of LWD in the future, and create geomorphic diversity. Adding structural elements in the channel will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Increasing roughness on the floodplain will encourage fine sediment deposition during high flow events.

8.1.11.5 Biological Benefits

Despite the subsurface and flashy flows, George Creek is an important and productive steelhead stream in Asotin Creek. The proposed restoration actions will likely lead to improved spawning conditions by promoting more sediment sorting and increased cover, and improved juvenile habitat by promoting more flow refugia, off-channel habitat, cover, winter concealment sites, and improved feeding conditions. Increasing the frequency of overbank flows in combination with improved floodplain roughness will create more areas suitable for plantings and natural riparian vegetation recruitment.

8.1.11.6 Potential Challenges

High stream temperatures may limit the value of improved habitat conditions. Extensive restoration up stream may improve flow and temperature in this PA. George Creek road could be impacted by restoration actions, and portions may need to be relocated. High sediment loads could affect ability to install LWD structures and create floodplain conditions suitable for riparian establishment.

8.1.12 George Creek - Project Area 38 (River Mile 10.9 to 11.4)

8.1.12.1 Site Description

Project Area **38 (PA-38)** is located along George Creek between RM 10.9 to 11.4. George Creek road runs along the length of the PA on river right. The road is along the toe of the river left hillslope and does not disconnect floodplain habitat. The valley is confined and there are occasional floodplain pockets throughout the PA. The primary limiting factors are low geomorphic and hydraulic diversity, caused by a lack of structural elements. The channel planform is appropriate for most of the reach, but there are several disconnected flood channels due to low amounts of LWD. There are some parts of the PA where flow goes subsurface, but not as often as in lower George Creek. We suspect that subsurface flows are mostly natural due to changes in the elevation of the bedrock in relation to the thickness of the alluvium. Riparian function is patchy and mirror the availability of surface water.

Basic descriptors of Project Area 38.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
10.9	11.4	0.5	Confined with Occasional Floodplain Pockets	Moderate	Private

Primary limiting factors in Project Area 38.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X			X	

Fish species presence and use by life history stage in Project Area 38.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 38.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect recovering riparian throughout.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect short flood channels between RM 11.0 to 11.2 and 11.3 to 11.4. Promote overbank flow throughout.
Long-term Processes	Invasive vegetation control and riparian planting, targeting areas where floodplain is reconnected and areas of heavy grazing.

Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Use alternative grazing strategies to control weeds.

8.1.12.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-38 is moderate due to limited geomorphic or structural element diversity. The channel is relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is moderate to high and mostly improving. Parts of the PA where riparian vegetation is limited are often caused by natural subsurface flows. However, past floods and intensive land use may have exacerbated subsurface flows.

8.1.12.3 Recommended Restoration Actions

Recommendations for PA-38 include protecting the recovering riparian, reconnecting flood channels, promoting overbank flow, adding LWD throughout, riparian planting in areas of floodplain reconnection, and controlling invasive weeds.

8.1.12.4 Geomorphic Implications

Connecting relic flood channels and promoting overbank flow will help reconnect the floodplain, improve riparian function leading to a greater source of LWD in the future, and create more geomorphic diversity. Adding structural elements in the channel will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

8.1.12.5 Biological Benefits

Despite the subsurface and flashy flows, George Creek is an important and productive steelhead stream in Asotin Creek. The proposed restoration actions will likely lead to improved spawning conditions by promoting more sediment sorting and increasing cover, and improved juvenile habitat by promoting more flow refugia, off-channel habitat, cover, winter concealment sites, and improved feeding conditions.

8.1.12.6 Potential Challenges

There does not appear to be significant challenges to restoration implementation in this PA.

PINTLER CREEK TIER 2 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

8.1.13 Pintler Creek - Project Area 49 (River Mile 1.7 to 2.3)

8.1.13.1 Site Description

Project Area **49 (PA-49)** is located along Pintler Creek between RM 1.7 to 2.3. Pintler Creek road runs along the length of the PA on river right. The road is generally along the toe of the hillslope and does not disconnect any floodplain habitat. The PA is within confined valley with coarse, poorly sorted bed material, a poorly defined channel, and poor riparian function. The flow in this PA goes subsurface or puddles in late spring or early summer and although there is some debate, it is generally recognized that the subsurface flows naturally occurred in this PA prior to European settlement. Because the valley is confined there is less sediment deposition occurring here compared to PA-46 downstream and hence the geomorphic conditions are moderate.

Basic descriptors of Project Area 49.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
1.7	2.3	0.6	Confined with Occasional Floodplain Pockets	Moderate	State

Primary limiting factors in Project Area 49.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 49.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 49.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation, especially between RM 1.7 to 1.95.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect a flood channel. Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

8.1.13.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-49 is moderate due to limited geomorphic or structural element diversity. The channel planform is relatively complex and perennial side channels and overbank flow are rare. Floodplain and riparian is patchy and has limited to moderate function depending on the presence of surface flows or puddles. Riparian vegetation is limited mostly in areas of natural subsurface flows. However, past floods and intensive land use may have exacerbated subsurface flows.

8.1.13.3 Recommended Restoration Actions

Recommendations for PA-49 include reconnecting a side channel, promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

8.1.13.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

8.1.13.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create suitable rearing and spawning habitat. Restoration of a large portion of Pintler Creek may provide some benefits to downstream flow.

8.1.13.6 Potential Challenges

Areas of subsurface flow will be a challenge for riparian planting.

8.1.14 Pintler Creek - Project Area 51 (River Mile 3.6 to 7.9)

8.1.14.1 Site Description

Project Area **51 (PA-51)** is located along Pintler Creek between RM 3.6 to 7.9. The PA is within a confined valley with moderate geomorphic and riparian function. The flow in this PA is more consistent and supports recovering riparian habitat dominated by deciduous species such as willow, alder, and cottonwood. Limiting factors are low geomorphic complexity and LWD. Kelly Creek enters Pintler Creek at RM 3.6.

Basic descriptors of Project Area 51.

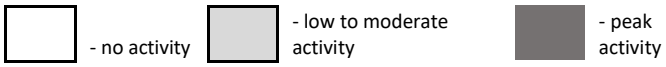
RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
3.6	7.9	4.3	Confined with Occasional Floodplain Pockets	Moderate	State

Primary limiting factors in Project Area 51.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 51.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding



Restoration recommendations for Project Area 51.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect a small flood channel. Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

8.1.14.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-51 is moderate due to limited geomorphic or structural element diversity. The channel is relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is mostly moderate and improving.

8.1.14.3 Recommended Restoration Actions

Recommendations for PA-51 include reconnecting a flood channel, promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

8.1.14.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

8.1.14.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Restoration of a large portion of Pintler Creek may provide some benefits to downstream flow.

8.1.14.6 Potential Challenges

There are no significant challenges in this PA.

8.1.15 Pintler Creek - Project Area 52 (River Mile 0.0 to 0.8)

8.1.15.1 Site Description

Project Area **52 (PA-52)** is a tributary to Pintler Creek joining Pintler Creek at RM 7.9. There is active dryland farming occurring on upslope and upstream. Riparian function is moderate. The flow in this PA is heavily influenced by a sediment ponds upstream of the PA. The ponds appear to capture and block off stream flows during low flow periods. The PA is within a confined valley with moderate geomorphic and riparian function. The flow in this PA appears to be more consistent than upstream PAs and supports recovering riparian habitat dominated by deciduous species such as willow, alder, and cottonwood. Limiting factors are low geomorphic complexity and LWD.

Basic descriptors of Project Area 52.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	0.8	0.8	Confined with Occasional Floodplain Pockets	Moderate	Private

Primary limiting factors in Project Area 52.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X			X	

Fish species presence and use by life history stage in Project Area 52.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity; - low to moderate activity; - peak activity

Restoration recommendations for Project Area 52.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Redesign ponds to be allow greater flow and sediment to pass downstream during low flow periods. Check ponds for structural integrity as some appear to be unstable. Reconnect a small flood channel. Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.

Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

8.1.15.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-52 is moderate due to limited geomorphic or structural element diversity. The channel is relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is mostly moderate and improving.

8.1.15.3 Recommended Restoration Actions

Recommendations for PA-52 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

8.1.15.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

8.1.15.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Restoration of a large portion of Pintler Creek may provide some benefits to downstream flow.

8.1.15.6 Potential Challenges

The area is remote and has limited access which will increase the cost of restoring this PA.

8.1.16 Pintler Creek - Project Area 53 (River Mile 0.8 to 2.2)

8.1.16.1 Site Description

Project Area **53 (PA-53)** is a tributary to Pintler Creek between RM 0.8 to 2.2. There is active dryland farming occurring on both sides of the stream. Riparian function is moderate. The flow in this PA is heavily influenced by sediment ponds upstream of this PA. The ponds appear to capture and block off stream flows during low flow periods. The PA is within a confined valley with moderate geomorphic and riparian function. There is a large ranch operation in this PA and riparian function is poor to moderate. The flow in this PA is more consistent and supports recovering riparian habitat dominated by deciduous species such as willow, alder, and cottonwood. Limiting factors are low geomorphic complexity and LWD. There is a bridge crossing at RM 9.3.

Basic descriptors of Project Area 53.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership

0.8	2.2	1.4	Confined with Occasional Floodplain Pockets	Moderate	Private

Primary limiting factors in Project Area 53.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X			X	

Fish species presence and use by life history stage in Project Area 53.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 53.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Redesign ponds to be allow greater flow and sediment to pass downstream during low flow periods. Check ponds for structural integrity as some appear to be unstable. Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Protect mature riparian vegetation especially throughout.

8.1.16.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-53 is moderate due to limited geomorphic or structural element diversity. The channel is relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is poor to moderate.

8.1.16.3 Recommended Restoration Actions

Recommendations for PA-53 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

8.1.16.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

8.1.16.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Restoration of a large portion of Pintler Creek may provide some benefits to downstream flow.

8.1.16.6 Potential Challenges

The ranch infrastructure and bridge crossing could present a challenge when designing and implementing restoration.

8.1.17 Pintler Creek - Project Area 54 (River Mile 2.2 to 3.2)

8.1.17.1 Site Description

Project Area **54 (PA-54)** is located along Pintler Creek between RM 2.2 to 3.2. There is active dryland farming occurring on both sides of the stream. Riparian function is moderate. The flow in this PA is heavily influenced by a large sediment ponds upstream of this PA. The ponds appear to capture and block off stream flows during low flow periods. The PA is within a confined valley with limited geomorphic and riparian function. The PA is within an agricultural setting with active dryland farming occurring on both sides of the stream. Riparian function is poor to moderate. The flow in this PA is heavily influenced by a several sediment ponds including one large one at the upstream end of the PA that appears to capture and block off stream flows during low flow periods. Limiting factors are low geomorphic complexity, LWD, and riparian function. Steelhead distribution does not extend into this PA.

Basic descriptors of Project Area 54.

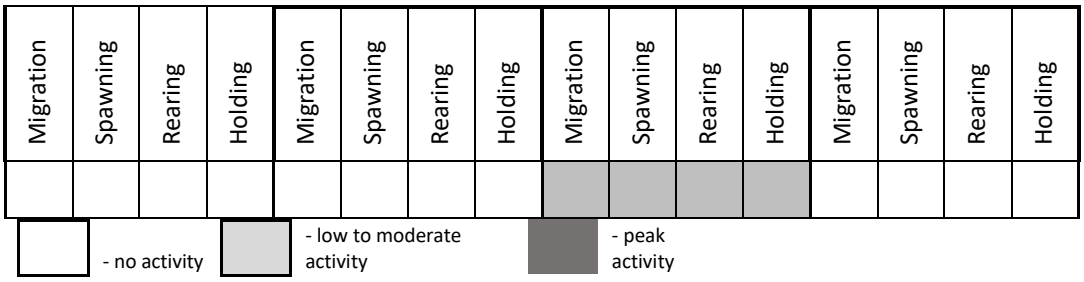
RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
10.1	11.2	1.1	Confined with Occasional Floodplain Pockets	Limited	Private

Primary limiting factors in Project Area 54.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X			X	

Fish species presence and use by life history stage in Project Area 54.

Spring Chinook	Fall Chinook	Steelhead	Bull Trout



Restoration recommendations for Project Area 54.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Minimize sediment inputs from fields. Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Redesign ponds to be allow greater flow and sediment to pass downstream during low flow periods. Check ponds for structural integrity as some appear to be unstable. Promote overbank flow in channel and add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Alternative grazing strategies

8.1.17.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-54 is moderate due to limited geomorphic or structural element diversity. The channel is relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is limited to moderate.

8.1.17.3 Recommended Restoration Actions

Recommendations for PA-54 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

8.1.17.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

8.1.17.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Restoration of a large portion of Pintler Creek may provide some benefits to downstream flow.

8.1.17.6 Potential Challenges

The ranch infrastructure and bridge crossing could present a challenge when designing restoration.

8.1.18 Pintler Creek - Project Area 55 (River Mile 7.9 to 9.5)

8.1.18.1 Site Description

Project Area **55 (PA-55)** is located in along Pintler Creek between RM 7.9 to RM 7.9. The PA is within a confined valley with moderate geomorphic and riparian function. There is active dryland farming occurring on both sides of the stream. Riparian function is moderate. The flow in this PA is heavily influenced by a two large sediment ponds approximately 3 miles upstream of this PA. The ponds appear to capture and block off stream flows during low flow periods. Limiting factors are low geomorphic complexity, LWD, and riparian function. Steelhead distribution extends into this PA.

Basic descriptors of Project Area 55.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
7.9	9.5	1.6	Confined with Occasional Floodplain Pockets	Moderate	Private

Primary limiting factors in Project Area 55.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 55.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 55.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Redesign ponds to be allow greater flow and sediment to pass downstream during low flow periods. Check ponds for structural integrity as some appear to be unstable. Promote overbank flow in channel and add structural elements throughout to improve

	hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Protect mature riparian vegetation especially throughout.

8.1.18.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-55 is moderate due to limited geomorphic or structural element diversity. The channel is relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is poor to moderate.

8.1.18.3 Recommended Restoration Actions

Recommendations for PA-55 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

8.1.18.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

8.1.18.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Restoration of a large portion of Pintler Creek may provide some benefits to downstream flow.

8.1.18.6 Potential Challenges

Redesigning the ponds to improve flow and sediment dynamics.

TENMILE CREEK TIER 2 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

8.1.19 Tenmile Creek - Project Area 64 (River Mile 0.3 to 1.1)

8.1.19.1 Site Description

Project Area **64 (PA-64)** is located along Tenmile Creek between RM 0.3 to 1.1. Weisssenfels road runs along the toe of the river left hillslope, and does not disconnect floodplain habitat. There are active ranching operations in this PA and CREP fencing to protect riparian habitat. The valley is partly confined and there are discontinuous floodplain pockets throughout the PA. The primary limiting factors are low geomorphic and hydraulic diversity, most likely attributed to extensive levees and rip rap that disconnect the floodplain, and a lack of structural elements. This section is dominated by planar geomorphic units such as runs and glides, and there are few pools. Flow does go subsurface or puddles in short sections throughout the PA. Low flow conditions are mostly natural due to changes in the elevation of the bedrock in relation to the thickness of the alluvium. Riparian function is patchy and mirror the availability of surface water. There is also high sediment load in this PA from tributaries, historic landslides, and upland farming practices.

Basic descriptors of Project Area 64.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.3	1.1	0.8	Planform Controlled with Discontinuous Floodplain	Limited	Private

Primary limiting factors in Project Area 64.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 64.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 64.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment and protect recovering riparian habitat.
Remove Barriers and Reconnect Disconnected Habitats	Remove or set back levees throughout. Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting in reconnected floodplain habitat and invasive vegetation control throughout.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

8.1.19.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-64 is limited due to low or no flow, extensive levees and rip rap that confine the floodplain, a lack of structural elements, and agricultural activities in the watershed. Floodplain and riparian function is limited and there are patches and narrow strips of mature riparian vegetation.

8.1.19.3 Recommended Restoration Actions

Recommendations for PA-64 include removing or setting back levees, promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

8.1.19.4 Geomorphic Implications

Setting back levees will increase accommodation space and the width of the floodplain, and adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain, and controlling invasive weeds will improve riparian function and provide a source of LWD.

8.1.19.5 Biological Benefits

Setting back levees will provide more off-channel habitat and adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of a large portion of Tenmile Creek may provide some benefits to downstream flow.

8.1.19.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow, and active ranching and infrastructure will limit the potential to set back levees.

8.1.20 Tenmile Creek - Project Area 65 (River Mile 1.1 to 1.9)

8.1.20.1 Site Description

Project Area **65 (PA-65)** is located along Tenmile Creek between RM 1.1 to 1.9. Weisssenfels road runs along the toe of the river right hillslope and does not significantly disconnect floodplain habitat. There is a bridge crossing at RM 1.1 and at RM 1.55. There is CREP fencing to protect riparian habitat throughout the PA. The valley is partly confined and there are discontinuous floodplain pockets throughout the PA. The primary limiting factors are low geomorphic and hydraulic diversity due to a lack of structural elements. The PA is dominated by planar geomorphic units such as runs and glides, and there are few pools. Flow does go subsurface or puddles in short sections throughout the PA. Low flow conditions are mostly natural due to changes in the elevation of the bedrock in relation to the thickness of the alluvium. There is also high sediment load in this PA from tributaries, historic landslides, and upland farming practices. However, there is extensive riparian mature vegetation throughout the PA.

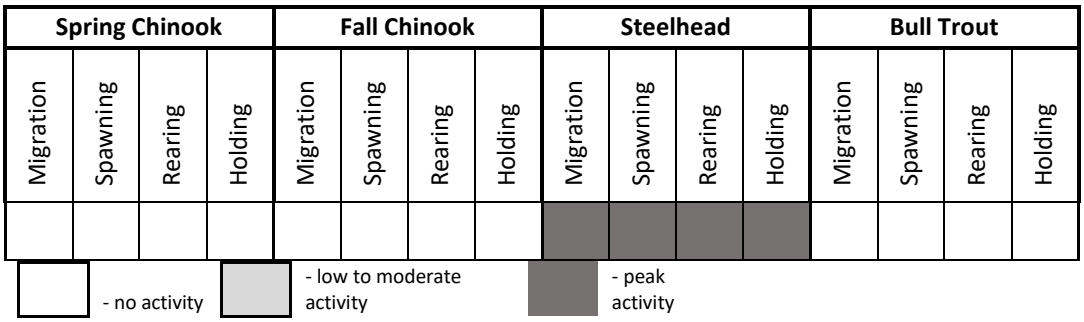
Basic descriptors of Project Area 65.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
1.1	1.9	0.8	Planform Controlled with Discontinuous Floodplain	Moderate	Private

Primary limiting factors in Project Area 65.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 65.



Restoration recommendations for Project Area 65.

Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment and protect recovering riparian habitat. Protect extensive mature riparian vegetation.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect side and flood channels and promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting in reconnected floodplain habitat and invasive vegetation control, mainly between RM 1.8 to 1.9.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

8.1.20.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-65 is moderate due to low or no flow, lack of structural elements, and agricultural activities in the watershed. Floodplain and riparian function is moderate to high due to extensive mature riparian vegetation throughout the PA.

8.1.20.3 Recommended Restoration Actions

Recommendations for PA-65 include reconnecting side and flood channels throughout, promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

8.1.20.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a future source of LWD.

8.1.20.5 Biological Benefits

adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of a large portion of Tenmile Creek may provide some benefits to downstream flow.

8.1.20.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow. Two bridge crossings in the PA increase the risk of LWD additions.

8.1.21 Tenmile Creek - Project Area 70 (River Mile 7.6 to 10.3)

8.1.21.1 Site Description

Project Area **70 (PA-70)** is located high within the Tenmile Creek watershed between RM 7.6 to 10.3. Geomorphic and riparian function is generally limited but variable throughout the reach. Valley confinement fluctuates, but for most of the PA the channel is partly confined.

Basic descriptors of Project Area 70.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
7.6	10.3	2.7	Planform Controlled with Discontinuous Floodplain	Limited	Private

Primary limiting factors in Project Area 70.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X			X	

Fish species presence and use by life history stage in Project Area 70.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 70.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect recovering riparian and fluvial processes throughout.
Remove Barriers and Reconnect Disconnected Habitats	Improve access to side and flood channels and floodplain, and promote overbank flow.
Long-term Processes	Control invasive vegetation and upland vegetation encroachment.

Short-term Processes	Add LWD throughout channel and floodplain.
Alternative Strategies	NA

8.1.21.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-70 is limited in most areas, but there are pockets where riparian and fluvial processes are recovering. The channel is mostly poorly defined and the bed and banks are armored by cobble and boulders. Instream hydraulic and geomorphic complexity is relatively low throughout the PA. In wider areas, flood channels exist but are rarely accessed during flood events.

The riparian function is generally limited to moderate and the extent of the riparian zone has decreased from historic estimates.

8.1.21.3 Recommended Restoration Actions

Recommendations for PA-70 include protecting recovering riparian and fluvial habitat, reconnecting side and flood channels, promoting overbank flow, adding LWD throughout the channel and floodplain, invasive vegetation control, and riparian plantings in conjunction with improved floodplain access.

8.1.21.4 Geomorphic Implications

Improving access to flood channels will increase floodplain connectivity and promote lateral migration where the valley bottom has accommodation space. Adding LWD to the channel will increase hydraulic and geomorphic complexity, help aggrade the channel, and improve sediment and water retention. Adding LWD to the floodplain and flood channels will promote fine sediment deposition and water retention in the valley bottom.

8.1.21.5 Biological Benefits

Adding LWD to the channel will improve habitat diversity and increase the prevalence of key habitat features such as pools, suitable spawning areas, concealment opportunities, and cover. LWD may also increase hyporheic exchange and slow water transport times, which may extend summer base flows and buffer stream temperatures for downstream reaches. Improved floodplain access and LWD in the floodplain will encourage riparian recovery by increasing fine sediment deposition and water retention in the valley bottom.

8.1.21.6 Potential Challenges

Access to PA-70 is very limited. There is little LWD on-site to implement the recommended actions, so material would need to be delivered.

8.1.22 Tenmile Creek - Project Area 76 (River Mile 0.0 to 1.0)

8.1.22.1 Site Description

Project Area **76 (PA-76)** is a tributary (TM_06) to Tenmile Creek. The PA starts at the confluence with Tenmile Creek at RM 14.5. The valley is confined and the hillslopes are steep and heavily forested. The geomorphic, riparian, and floodplain function are high. These areas would be ideal beaver introduction areas. The primary limiting factors are a pond near the upper portion of the PA, and low geomorphic and hydraulic diversity caused by a lack of structural elements. This PA has steelhead present.

Basic descriptors of Project Area 76.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	1.0	1.0	Confined with Occasional Floodplain Pockets	Moderate	Private

Primary limiting factors in Project Area 76.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 76.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 76.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and the channel and maintain access for recreation.
Remove Barriers and Reconnect Disconnected Habitats	Redesign the sediment pond to promote natural sediment and flow processes.
Long-term Processes	Invasive vegetation control along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reducing forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

8.1.22.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-76 is mostly high and recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and a lack of LWD entering the

channel. A large sediment pond in the upper portion of the PA is also disrupting natural sediment and flow processes.

8.1.22.3 Recommended Restoration Actions

Recommendations for PA-76 include conserving riparian areas, redesigning the sediment pond to promote natural sediment and flow processes, and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

8.1.22.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

8.1.22.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

8.1.22.6 Potential Challenges

Redesigning the sediment pond to reestablish natural sediment and flow process.

COUSE CREEK TIER 2 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

8.1.23 Couse Creek - Project Area 77 (River Mile 0.0 to 0.1)

8.1.23.1 Site Description

Project Area **77 (PA-77)** is located at the mouth of Couse Creek between RM 0.0 to 0.1. Couse Creek enters the Snake River approximately 12 miles upstream from the town of Asotin. The Snake River road crosses over Couse Creek at RM 0.05 and there is a boat ramp and parking area at the mouth. The reach type is an alluvial fan. The elevation of the Snake River changes depending on the operation of dams downstream (e.g., Lower Granite) and upstream (e.g., Hells Canyon) and this can create a partial/temporary barrier for fish trying to access Couse Creek. The headwaters of Couse Creek are mostly below 4,000 feet elevation and dryland farming is the dominant activity in the watershed. Due to the watershed characteristics, stream temperatures are relatively warm, flows are more flashy, and stream sections go dry. Despite the different watershed characteristics, Couse Creek has a run of approximately 20-50 adult steelhead.

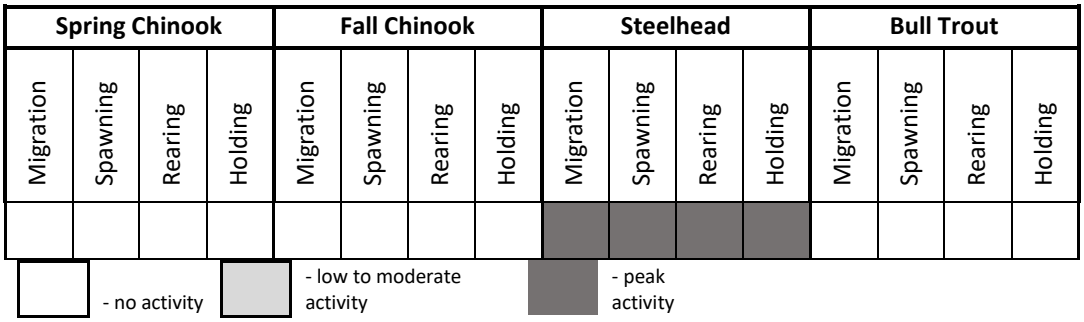
Basic descriptors of Project Area 77.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	0.1	0.1	Alluvial Fan	Moderate	Private

Primary limiting factors in Project Area 77.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X	X	X	X	X

Fish species presence and use by life history stage in Project Area 77.



Restoration recommendations for Project Area 77.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment and protect recovering riparian habitat.
Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	NA
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Conduct barrier assessment at the mouth.

8.1.23.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-77 is limited due to low flows, lack of structural elements, agricultural activities in the watershed, and varying levels of the Snake River, which affect the development and maintenance of channels across the alluvial fan. The floodplain and riparian areas are narrow and their function is limited.

8.1.23.3 Recommended Restoration Actions

Recommendations for PA-77 include promoting overbank flow, adding structural elements to improve geomorphic function, and conducting a barrier assessment at the mouth.

8.1.23.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

8.1.23.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat.

8.1.23.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow.

9 TIER 3 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

ALPOWA CREEK TIER 3 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

9.1.1 Paige Creek - Project Area 59 (River Mile 0.0 to 0.7)

9.1.1.1 Site Description

Project Area **59 (PA-59)** is located along Paige Creek, which is a tributary to Alpowa Creek entering at RM 0.7. There are two ranch properties along the creek upstream of the PA, and here are small springs that sustain some riparian vegetation and surface flow for short periods each year. The headwaters of Paige Creek are in loess uplands, which are dominated by dryland farming. Although the Paige Creek drainage is almost 15 miles long, the majority of the PA has a poorly defined channel, the substrate is coarse cobble and boulder, and riparian vegetation is almost absent. The geomorphic function is limited and the flow goes subsurface over much of the entire length of the creek annually. Fish use of this PA (and Paige Creek) is limited and likely restricted to the lower part of the PA during years with high flow.

Basic descriptors of Project Area 59.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	0.7	0.7	Confined with Occasional Floodplain Pockets	Limited	Private

Primary limiting factors in Project Area 59.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X		X	X	

Fish species presence and use by life history stage in Project Area 59.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 59.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment and protect recovering riparian habitat.
Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting in reconnected floodplain habitat and invasive vegetation control throughout.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.1.2 Geomorphic, Floodplain, and Riparian function

The geomorphic function in PA-59 is limited due to low or no flow, lack of structural elements, and agricultural activities in the watershed. The channel is poorly defined, and floodplain and riparian function is poor.

9.1.1.3 Recommended Restoration Actions

Recommendations for PA-59 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

9.1.1.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

9.1.1.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of a large portion of Paige Creek may provide some benefits to downstream flow.

9.1.1.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow.

9.1.2 Pow Wah Kee Gulch - Project Area 60 (River Mile 0.0 to 1.4)

9.1.2.1 Site Description

Project Area 60 (PA-60) is located in Pow Wah Kee Gulch, a tributary to Alpowa Creek that enters at RM 3.0. Pow Wah Kee Gulch is a relatively long watershed (~ 20 miles), but the headwaters are below 4,500 feet elevation which limits the flow. However, there are small springs throughout Pow Wah Kee that sustain some riparian vegetation and surface flow for short periods each year. The headwaters are in loess uplands which are dominated by dryland farming. The geomorphic function of this PA is limited, and the flow goes subsurface over much of the

entire length of the PA. Fish use of this PA is limited and likely restricted to the lower reach during years with high flow.

Basic descriptors of Project Area 60.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	1.4	1.4	Planform Controlled with Discontinuous Floodplain	Limited	Private

Primary limiting factors in Project Area 60.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X		X	X	

Fish species presence and use by life history stage in Project Area 60.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 60.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment and protect recovering riparian habitat.
Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting in reconnected floodplain habitat and invasive vegetation control throughout.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.2.2 Geomorphic, Floodplain, and Riparian function

The geomorphic function in PA-60 is limited due to low or no flow, lack of structural elements, and agricultural activities in the watershed. The channel is well defined, floodplain and riparian areas are narrow, but the function is moderate to high likely because of spring flows.

9.1.2.3 Recommended Restoration Actions

Recommendations for PA-60 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

9.1.2.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

9.1.2.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of a large portion of Pow Wah Kee Creek may provide some benefits to downstream flow.

9.1.2.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow.

9.1.3 Pow Wah Kee Gulch - Project Area 62 (River Mile 2.3 to 3.9)

9.1.3.1 Site Description

Project Area **62 (PA-62)** is located in Pow Wah Kee Gulch, a tributary to Alpowa Creek that enters at RM 3.0. Pow Wah Kee Gulch is a relatively long watershed (~ 20 miles), but the headwaters are below 4,500 feet elevation which limits flow. However, there are small springs throughout Pow Wah Kee that sustain some riparian vegetation and surface flow for short periods each year. The headwaters are in loess uplands that are dominated by dryland farming. The geomorphic function of this PA is limited and the flow goes subsurface over much of the entire length of the PA. Fish use of this PA is limited and likely restricted to the lower reach during years with high flow.

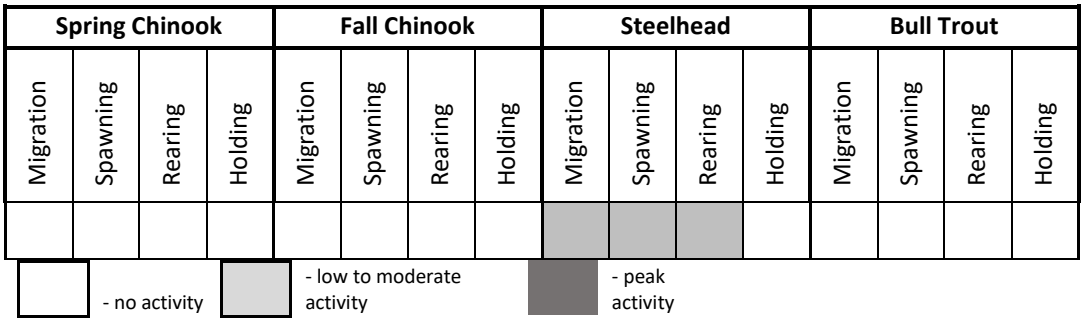
Basic descriptors of Project Area 62.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
2.3	3.9	1.6	Planform Controlled with Discontinuous Floodplain	Limited	Private

Primary limiting factors in Project Area 62.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X		X	X	

Fish species presence and use by life history stage in Project Area 62.



Restoration recommendations for Project Area 62.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment and protect recovering riparian habitat and areas around springs (RM 2.7 and 3.2).
Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting in reconnected floodplain habitat and invasive vegetation control throughout.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.3.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-62 is limited due to low flows, lack of structural elements, and agricultural activities in the watershed. The channel is well defined, floodplain and riparian areas are narrow, but the function is moderate to high likely because of spring flows.

9.1.3.3 Recommended Restoration Actions

Recommendations for PA-62 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

9.1.3.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

9.1.3.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of a large portion of Pow Wah Kee Creek may provide some benefits to downstream flow.

9.1.3.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow.

ASOTIN CREEK TIER 3 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

9.1.4 Asotin Creek Mainstem - Project Area 01 (River Mile 0.0 to 0.4)

9.1.4.1 Site Description

Project Area **01 (PA-01)** is located between the confluence of Asotin Creek and the left bank of the Snake River and the upstream end of Asotin City Park. Highway 129 bisects the PA and a short section on river left downstream of the highway is leveed to protect the town of Asotin from flooding. The entire PA is part of the historic alluvial fan at the mouth of Asotin Creek, especially the areas on river right including the courthouse and high school track and football field. A sewage treatment plant and a marina within Chief Looking Glass Park are also located within this PA. Large amounts of gravel move through this area, and the sediment dynamics fluctuate between storage and transport depending on spring flows in Asotin and George Creeks and the backwater effect of the Snake River, which can change the base-level control. This PA could become a showcase for the county by investing in information kiosks that describe the historic and current importance of steelhead, chinook, lamprey, and sucker spawning runs, the ongoing restoration and research in the watershed, and by integrating flood control measures into restoration designs. However, these efforts would be expensive and require coordination of the city planners, county conservation district, state and federal agencies, and a multitude of private landowners.

Basic descriptors of Project Area 01.

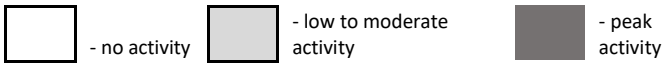
RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	0.4	0.4	Alluvial Fan	Limited	Private

Primary limiting factors in Project Area 01.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X		X	X	

Fish species presence and use by life history stage in Project Area 01.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding



Restoration recommendations for Project Area 01.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature vegetation in thin riparian corridor.
Remove Barriers and Reconnect Disconnected Habitats	Set back levees to increase accommodation space to improve geomorphic function and increase floodplain connectivity. Reconnect flood channel between 0.0 and 0.1 on river left.
Long-term Processes	Invasive vegetation control throughout.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic conditions, increase fish cover and flow refugia, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Active grazing management in riparian areas to target invasive vegetation (e.g., Himalayan blackberry).

9.1.4.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-01 is limited due to extensive levees and development (business, residences, and roads). Almost the entire floodplain is disconnected and the channel was straightened. There is low geomorphic diversity and very limited flow refugia because of the lack of structural elements in the channel. There is a thin corridor of riparian vegetation dominated by mostly mature alder and a variety of non-native understory.

9.1.4.3 Recommended Restoration Actions

Recommendations for PA-01 include setting back levees to increase floodplain areas, reconnecting side channels to accommodate high flows, and adding some structural elements to improve geomorphic function. Control of non-native vegetation is also required throughout the PA.

9.1.4.4 Geomorphic Implications

Levee setbacks will increase lateral accommodation space and allow the channel to develop complex geomorphic units such as secondary channels and mid-channel bars. Setting back some of the identified levees would also improve floodplain connection and potentially reduce flood hazards downstream. Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

9.1.4.5 Biological Benefits

Widening the channel through levee setbacks would improve riparian function and the development of critical habitat features for ESA-listed fish species, such as complex pools and spawning areas. Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat.

9.1.4.6 Potential Challenges

The proposed actions would require complex coordination between a large number of landowners and agencies. There are many individual landowners in PA-01, so achieving continuity between project actions may be difficult.

There is also high risk that restoration actions could fail or compromise infrastructure and residences. However, there have been very large floods that have caused damage in this area and there will likely be large floods in the future. There is the potential to minimize the damage of future floods by building more accommodation space in this PA, though a more comprehensive restoration plan including multiple PAs upstream would be the best option.

9.1.5 Asotin Creek Mainstem - Project Area 04 (River Mile 5.6 to 6.0)

9.1.5.1 Site Description

Project Area **04 (PA-04)** is located between RM 5.6 and 6.0 in a confined reach on the mainstem Asotin Creek. The river continues to be forced to the right side of the valley and presumably held there by rip rap, although we were not able to survey the private land and no levees or rip rap were identified on the LiDAR imagery. A small group of residences occur in this PA, and it appears that some terraces were developed to accommodate the private houses and possibly protect them from floods. There is one opportunity to expand floodplain access in this PA by reconnecting a side channel between RM 5.9 to 6.0.

Basic descriptors of Project Area 04.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
5.6	6.0	0.4	Confined with Occasional Floodplain Pockets	Limited	Private

Primary limiting factors in Project Area 04.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X		X	X	

Fish species presence and use by life history stage in Project Area 04.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity; - low to moderate activity; - peak activity

Restoration recommendations for Project Area 04.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation, particularly between RM 5.9 and 6.0.

Remove Barriers and Reconnect Disconnected Habitats	Reconnect flood channel at RM 5.9 to 6.0.
Long-term Processes	Invasive vegetation control throughout.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Active grazing management in riparian areas to target invasive vegetation (e.g., Himalayan blackberry).

9.1.5.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic condition in PA-04 is limited due to the residences, terraces, and likely moving of the river to the far right of the valley (and being held there by rip rap). However, this PA is within a naturally confined section of the stream, and therefore likely did not have highly complex geomorphic conditions. There is low geomorphic diversity and very limited flow refugia because a lack of structural elements in the channel. There is a thin corridor of riparian vegetation dominated by mostly mature alder and a variety of non-native understory.

9.1.5.3 Recommended Restoration Actions

Recommendations for PA-04 include adding LWD throughout to improve geomorphic conditions, reconnecting the short side channel between RM 5.9 to 6.0, and control of invasive vegetation throughout.

9.1.5.4 Geomorphic Implications

Reconnecting the side channel could provide a small amount of high flow accommodation and add some complexity to the otherwise single thread channel. Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

9.1.5.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Reconnecting the side channel could provide high flow refugia and off-channel rearing opportunities.

9.1.5.6 Potential Challenges

The high density of residences in this PA limits potential actions and increases the costs. Addition of LWD will have to be carefully located to minimize risk to property.

9.1.6 Asotin Creek Mainstem - Project Area 05 (River Mile 6.0 to 7.0)

9.1.6.1 Site Description

Project Area **05 (PA-05)** is located between RM 6.0 and 7.0 in a confined reach on the mainstem Asotin Creek. The floodplain in this PA is naturally narrow because the valley is confined by steep side hills. There is only one residence at the bottom of the reach, and riparian function ranges from high to full. There are four short side channels that could be reconnected in this PA between RM 6.0. to 6.1, 6.2 to 6.4, 6.7 to 6.75, and 6.8 to 7.0.

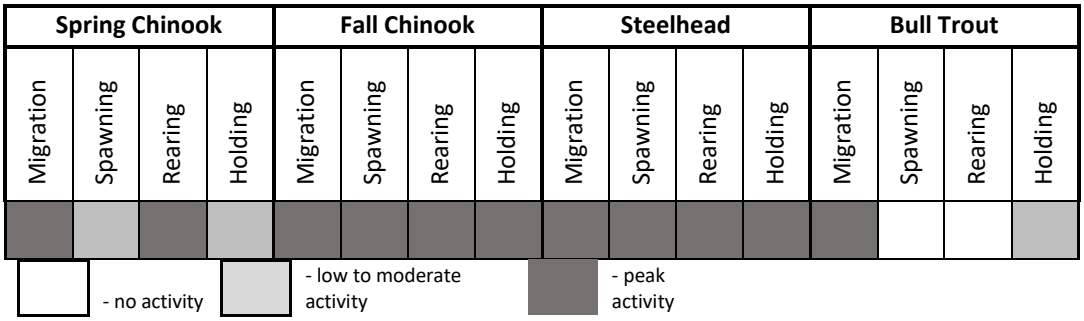
Basic descriptors of Project Area 05.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
6.0	7.0	1.0	Confined with Occasional Floodplain Pockets	Moderate	Private

Primary limiting factors in Project Area 05.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X		X	X	

Fish species presence and use by life history stage in Project Area 05.



Restoration recommendations for Project Area 05.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect flood channel between RM 6.0. to 6.1 and multiple relic side channels between 6.2 to 6.4, 6.7 to 6.75, and 6.8 to 7.0.
Long-term Processes	Invasive vegetation control from 6.0 to 6.1.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.6.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic condition in PA-05 is moderate; however, the area is naturally confined and would not have had highly complex geomorphic conditions prior to settlement. There is low geomorphic diversity and very limited flow refugia because of a lack of structural elements in the channel, although naturally the density of structural

elements would have been low compared to less confined reaches. Riparian function is high; mature alder and cottonwood dominate the overstory with a variety of non-native and native understory plants throughout.

9.1.6.3 Recommended Restoration Actions

Recommendations for PA-05 include adding LWD throughout to improve geomorphic conditions, the reconnection of a few short side channels and a short flood channel through the PA, and control of invasive vegetation, mostly in the lower section of this PA.

9.1.6.4 Geomorphic Implications

Reconnecting the side channel could provide a small amount of high flow accommodation and add some complexity to the otherwise single thread channel. Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. However, this PA has a naturally low geomorphic complexity compared to other less confined PAs.

9.1.6.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Reconnecting the side channel could provide high flow refugia and off-channel rearing opportunities.

9.1.6.6 Potential Challenges

Asotin Creek road is close to the stream throughout the PA and any addition of LWD would require careful placement to protect the road. Bridge access to a residence on river right at the bottom of the PA must also be protected..

9.1.7 Lick Creek - Project Area 24 (River Mile 0.0 to 0.2)

9.1.7.1 Site Description

Project Area **24 (PA-24)** is located on Lick Creek and Lick Fork road borders the PA on river left, along with a large parking/camping area. The North Fork Asotin Creek trail begins here and a rough access road used by hikers, horses, bikes, and WDFW/USFS staff crosses Lick Creek at a ford 100 yards from the confluence with North Fork Asotin Creek. A wheat field managed by WDFW borders the creek on river right. The stream was realigned to flow straight down Lick Fork road. Historically, it flowed into the North Fork Creek valley and then ran parallel to North Fork Creek, entering several hundred yards further downstream than it does today.. The PA is within an alluvial fan that is currently confined by the road, wheat field, and camping area.

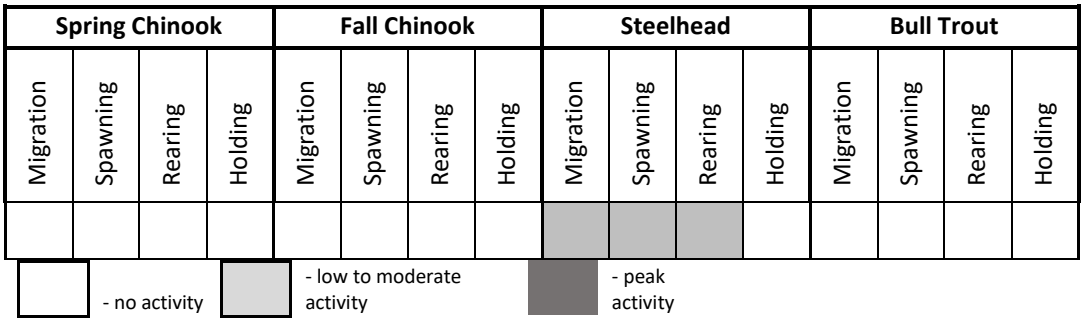
Basic descriptors of Project Area 24.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	0.2	0.2	Alluvial Fan	Limited	State

Primary limiting factors in Project Area 24.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X		X	X	

Fish species presence and use by life history stage in Project Area 24.



Restoration recommendations for Project Area 24.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect historic channel between RM 0.0 to 0.1
Long-term Processes	Invasive vegetation control along the Lick Fork road, trailhead, and camping/parking lot.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.7.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-24 is limited due to a parking lot, which diverts the stream channel and increases confinement, altering the sediment balance from depositional to erosional. The stream is incised, LWD is limited, and sediment sorting is poor. Riparian function is limited because of the confining features and development adjacent to the PA.

9.1.7.3 Recommended Restoration Actions

Recommendations for PA-24 include reconnecting the historic channel so that the stream flows to the north of the North Fork trailhead and parking lot. Addition of LWD throughout the PA and control of invasive weeds around parking lot and trailhead are also recommended.

9.1.7.4 Geomorphic Implications

The realignment of the road and stream to historic conditions, while a significant project, would allow a continuous, large section of floodplain to be reconnected.

9.1.7.5 Biological Benefits

Returning the reach to its original length will increase flow and temperature refugia, provide rearing opportunities, and increase geomorphic diversity throughout.

9.1.7.6 Potential Challenges

Work in this PA is higher risk because the trailhead, trail, camping area, and Lick Creek road could all be adversely impacted by restoration actions. The area is heavily used and public concerns would need to be considered before any work was initiated.

9.1.8 Lick Creek - Project Area 25 (River Mile 0.2 to 2.0)

9.1.8.1 Site Description

Project Area **25 (PA-25)** is located on Lick Creek along the Lick Fork road between RM 0.2 to 2.0. The valley is confined and the road further confines Lick Creek for the length of the PA, limiting the geomorphic and riparian function. However, the channel would likely react quickly to instream restoration work as the riparian recovers. This reach would benefit from LWD additions.

Basic descriptors of Project Area 25.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.2	2.0	1.8	Confined with Occasional Floodplain Pockets	Limited	State

Primary limiting factors in Project Area 25.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
X	X	X		X	X	

Fish species presence and use by life history stage in Project Area 25.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 25.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	NA

Long-term Processes	Invasive vegetation control along the Lick Fork road.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.8.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-25 is limited because of Lick Fork road. The floodplain is limited by the presence of the road, and riparian function is poor to moderate.

9.1.8.3 Recommended Restoration Actions

Recommendations for PA-25 include addition of LWD.

9.1.8.4 Geomorphic Implications

LWD additions will improve geomorphic function, promote overbank flow, and increase riparian function and floodplain connection.

9.1.8.5 Biological Benefits

Fish use is presumed to be minimal in Lick Creek, but geomorphic improvements will increase rearing capacity for juvenile steelhead.

9.1.8.6 Potential Challenges

Restoration in this PA has higher risk because the road extends the entire length of the PA and is within or confining the floodplain throughout.

9.1.9 Lick Creek - Project Area 26 (River Mile 2.0 to 4.8)

9.1.9.1 Site Description

Project Area **26 (PA-26)** is located on Lick Creek along the Lick Fork road between RM 2.0 to 4.8. The valley is confined and the road further confines Lick Creek for the length of the PA, which limits geomorphic and riparian function. However, the channel would likely react quickly to instream restoration work as the riparian continues to recover. This reach would benefit from LWD additions. Lick Creek passes through a double culvert at approximately RM 3.8 near at the junction of Lick Fork Road and USFS road NF-351. The culvert crossing was found to be a barrier to upstream fish migration in 2008. There is evidence of heavy grazing pressure in this PA with numerous trails, ground disturbance, and invasive weeds.

Basic descriptors of Project Area 26.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
2.0	4.8	2.8	Confined with Occasional Floodplain Pockets	Limited	State

Primary limiting factors in Project Area 26.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
X	X	X		X	X	

Fish species presence and use by life history stage in Project Area 26.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 26.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout, and riparian planting to rehabilitate over grazed areas.
Remove Barriers and Reconnect Disconnected Habitats	Replace or repair the culvert to allow unimpeded passage for juvenile steelhead (undetermined if fish are present).
Long-term Processes	Invasive vegetation control along the Lick Fork road.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.9.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-26 is limited primarily due to incision, limited LWD, and limited opportunities for floodplain connection, even though floodplain pockets are abundant. Lick Fork road is adjacent to the creek, and its primary impact is to limit colluvial inputs from south facing hillslopes. Colluvium is an important and common structural element in confined reach types.

9.1.9.3 Recommended Restoration Actions

Recommendations for PA-26 include adding LWD to increase channel complexity and promoting overbank flow by aggrading the stream bed. Consider invasive vegetation management and riparian planting projects. Implement planting in conjunction with strategies that promote overbank flow.

9.1.9.4 Geomorphic Implications

LWD additions will improve geomorphic function, promote overbank flow, and increase riparian function and floodplain connection.

9.1.9.5 Biological Benefits

Fish use is presumed to be minimal in Lick Creek but geomorphic improvements will increase rearing capacity for juvenile steelhead.

9.1.9.6 Potential Challenges

Restoration in this PA is higher risk because the road extends the entire length of the PA and is within or confining the floodplain throughout.

GEORGE CREEK TIER 3 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

9.1.10 George Creek - Project Area 33 (River Mile 0.0 to 0.5)

9.1.10.1 Site Description

Project Area **33 (PA-33)** is located at the mouth of George Creek between RM 0.0 to 0.5. George Creek enters Asotin Creek at RM 3.2 just below the Cloverland Bridge crossing. George Creek road runs along the length of this PA on river left but does not disconnect any floodplain habitat. There are several properties in this PA on both sides of the creek, and large areas of historic floodplain are disconnected by levees and rip rap. George Creek makes up almost 40% of the Asotin Creek watershed but has less high elevation areas, higher stream temperatures, and more flashy flows than Asotin Creek. Despite the different watershed characteristics, George Creek has a large run of adult steelhead and supports bull trout rearing and spawning in the upper tributaries.

Basic descriptors of Project Area 33.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	0.5	0.5	Wandering Gravel Bed with Discontinuous Floodplain	Limited	Private

Primary limiting factors in Project Area 33.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 33.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 33.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout, and riparian planting to rehabilitate disturbed areas.
Remove Barriers and Reconnect Disconnected Habitats	Remove or set back levees at RM 0.3. to 0.5 to increase lateral accommodation space. Reconnect side channel between 0.1 to 0.2. Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control, especially between RM 0.4 to 0.5.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.10.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-33 is limited because of confinement of the floodplain and channel, past flooding and oversupply of sediment, flashy flows, and limited structural elements and geomorphic diversity. There is limited floodplain and only a thin strip of riparian vegetation through this PA. However, there are mature cottonwood and alder stands that should be protected.

9.1.10.3 Recommended Restoration Actions

Recommendations for PA-33 include removing or setting back levees at the upstream end of the PA, adding LWD throughout, controlling invasive weeds, and riparian planting in reconnected floodplain areas.

9.1.10.4 Geomorphic Implications

Removing or setting back levees and reconnecting a small side channel will provide more accommodation space for high flows and geomorphic diversity. LWD additions will improve geomorphic function, promote overbank flow, and increase riparian function and floodplain connection.

9.1.10.5 Biological Benefits

Above this PA, George Creek goes subsurface annually after spring flows. Restoration actions in this PA could provide refugia for fish as flows go subsurface upstream. More structural and geomorphic diversity could also provide habitat for fish flow refugia.

9.1.10.6 Potential Challenges

Residences and George Creek Road could be impacted by any restoration actions in this PA, limiting the opportunity to reconnect floodplain habitat.

9.1.11 George Creek - Project Area 34 (River Mile 0.5 to 3.5)

9.1.11.1 Site Description

Project Area **34 (PA-34)** is located along lower George Creek between RM 0.5 to 3.5. George Creek road runs along the length of the PA on river left except at two locations where the road crosses the creek. The first crossing is a bridge at RM 1.5 and the second crossing is a ford at RM 1.7. The road is generally along the toe of the river left hillslope and does not disconnect any floodplain habitat. There is one ranch in this PA with numerous out buildings, and cattle are wintered within the historic floodplain. Pintler Creek enters this PA at RM1.6. Much of the PA is a wide, unconfined valley with coarse unsorted bed material, a poorly defined channel, and extremely poor riparian function. The majority of the flow in this PA goes subsurface in late spring or early summer and although there is some debate, it is generally recognized that the subsurface flows naturally occurred in this PA prior to European settlement. Based on the character of the valley setting and location on the watershed, it appears that this PA is an area of significant sediment deposition and active geomorphic change. There are large sources of sediment upstream that are likely to continue to make this PA a very dynamic area. The PA is roughly divided into a privately owned section in the lower half and a state owned (WDFW) property in the upper half of the PA. Two large restoration projects were implemented in the PA. A designed meander channel was constructed in the late 1990s between RM 0.5 to 1.5, and in 2013 a meander and LWD addition project was implemented between RM 2.4 to 3.2. The lower remeander project has also had several riparian planting projects initiated to establish vegetation along the designed channel.

Basic descriptors of Project Area 34.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.5	3.5	3.0	Wandering Gravel Bed with Discontinuous Floodplain	Limited	State/Private

Primary limiting factors in Project Area 34.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 34.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 34.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands of upper George Creek to limit fine sediment and protect recovering riparian habitat.
Remove Barriers and Reconnect Disconnected Habitats	Let the river adjust to sediment inputs and do not try to create a channel.
Long-term Processes	Riparian planting and invasive vegetation control throughout.
Short-term Processes	Add structural elements between RM 0.5 to 1.5 and allow river to adjust to sediment inputs to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.11.2 Geomorphic, Floodplain, and Riparian Function

The Geomorphic Function in PA-34 is limited because of the dynamic nature and large supply of sediment to this PA from upstream sources. The subsurface flow and coarse substrate make it difficult to recover riparian habitat. The designed channel in the lower portion of the PA is filling with excess sediment and the stream is then leaving the designed channel. The less designed channel on the WDFW property in the upper half of the PA is still adjusting to the addition of large pieces of unsecured wood and construction of engineered log jams. Monitoring of these two restoration approaches should help to understand how best to improve conditions in these and other similar challenging areas in the future.

9.1.11.3 Recommended Restoration Actions

Recommendations for PA-34 include removing and/or not maintaining gravel berms in the lower half of the PA, strategically adding LWD throughout the expansive floodplain to encourage development of multiple channels, controlling invasive weeds, and riparian planting in reconnected floodplains.

9.1.11.4 Geomorphic Implications

Removing or setting back levees and reconnecting a small side channel will provide more accommodation space for high flows and geomorphic diversity. LWD additions will improve geomorphic function, promote overbank flow, and increase riparian function and floodplain connection.

9.1.11.5 Biological Benefits

Flow goes subsurface annually after spring flows throughout much of this PA. It is unlikely that flow conditions will change, despite the large investments in restoration over the last few decades. Even if surface flows were restored in this PA, the lack of riparian vegetation and extreme exposure to warming would likely create stream temperature conditions that could not support juvenile fish trying to rear in this section. However, additions of wood will improve migration conditions for adults, extend the flow period, improve floodplain and riparian function, recharge groundwater, and potentially provide cooler water to downstream reaches and Asotin Creek.

9.1.11.6 Potential Challenges

The valley and watershed setting of this PA presents a significant challenge to managers. There is a natural desire to improve floodplain and riparian function because the current conditions are barren and flows go subsurface.

However, these conditions may be relatively natural based on the reach type, sediment supply, and location in the watershed. Any investment in restoration in this PA will have a relatively high risk of failure if the goals are to convert the very dynamic nature of the site into a more stable and predictable single thread stream channel.

9.1.12 Ayers Gulch - Project Area 44 (River Mile 0.0 to 0.9)

9.1.12.1 Site Description

Project Area **44 (PA-44)** is located along Ayers Gulch, which is a tributary to Pintler Creek. Ayers Gulch enters Pintler Creek at RM 1.7 and the headwaters of Ayers Gulch are in loess uplands, which are dominated by dryland farming. There is a defined channel, the substrate is coarse cobble and boulder, and there is deciduous dominated riparian vegetation along the lower mile of Ayers. The geomorphic function is moderate and the flow goes subsurface annually after spring floods.

Basic descriptors of Project Area 44.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	0.9	0.9	Confined with Occasional Floodplain Pockets	Moderate	State

Primary limiting factors in Project Area 44.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X			X	

Fish species presence and use by life history stage in Project Area 44.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 44.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands of upper Ayers Creek to limit excess fine sediment and protect recovering riparian habitat.
Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.

Long-term Processes	Riparian planting in reconnected floodplain habitat and invasive vegetation control throughout.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.12.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-44 is moderate due to limited geomorphic or structural element diversity. The channel is relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is mostly moderate and improving. Riparian tends to be limited in portions of the PA where there are natural subsurface flows. However, past floods and intensive land use may have exacerbated subsurface flows.

9.1.12.3 Recommended Restoration Actions

Recommendations for PA-44 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

9.1.12.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

9.1.12.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Restoration of a large portion of Ayers Gulch may provide some benefits to downstream flow.

9.1.12.6 Potential Challenges

There do not appear to be any significant challenges in this PA.

9.1.13 Kelly Creek - Project Area 45 (River Mile 0.0 to 1.4)

9.1.13.1 Site Description

Project Area **45 (PA-45)** is located along Kelly Creek, which is a tributary to Pintler Creek. Kelly Creek enters Pintler Creek at RM 3.7 and the headwaters of Kelly Creek are in loess uplands, which are dominated by dryland farming. There is a defined channel, the substrate is coarse cobble and boulder, with deciduous dominated riparian vegetation along the lower mile and a half of Kelly Creek. The geomorphic function is moderate and the flow goes subsurface annually after spring floods.

Basic descriptors of Project Area 45.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	1.4	1.4	Confined with Occasional Floodplain Pockets	Moderate	State

Primary limiting factors in Project Area 45.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X			X	

Fish species presence and use by life history stage in Project Area 45.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 45.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands of upper Ayers Creek to limit excess fine sediment and protect recovering riparian habitat.
Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting in reconnected floodplain habitat and invasive vegetation control throughout.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.13.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-45 is moderate due to limited geomorphic or structural element diversity. The channel is relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is mostly moderate and improving. Riparian vegetation is limited in portions of the PA where there are natural subsurface flows. However, past floods and intensive land use may have exacerbated subsurface flows.

9.1.13.3 Recommended Restoration Actions

Recommendations for PA-45 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

9.1.13.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

9.1.13.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Restoration of a large portion of Kelly Creek may provide some benefits to downstream flow.

9.1.13.6 Potential Challenges

There do not appear to be any significant challenges in this PA.

9.1.14 Pintler Creek - Project Area 46 (River Mile 0.0 to 0.8)

9.1.14.1 Site Description

Project Area **46 (PA-46)** is located along lower Pintler Creek between RM 0.0 to 0.8. Pintler Creek is a tributary to George Creek and enters George Creek at RM 1.4. Pintler Creek road runs along the length of the PA, crossing from river left to river right at RM 0.2. There is one ranch in this PA with numerous out buildings, and cattle are wintered within the historic floodplain. The PA is a wide, unconfined valley with coarse unsorted bed material, a poorly defined channel, and extremely poor riparian function. The flow in this PA goes subsurface in late spring or early summer and although there is some debate, it is generally recognized that the subsurface flows naturally occurred in this PA prior to European settlement. Based on the character of the valley setting and location on the watershed, it appears that this PA is an area of significant sediment deposition and active geomorphic change. There are large sources of sediment upstream that are likely to continue to make this PA a very dynamic area. A small spring enters the PA at RM 0.6 from river right.

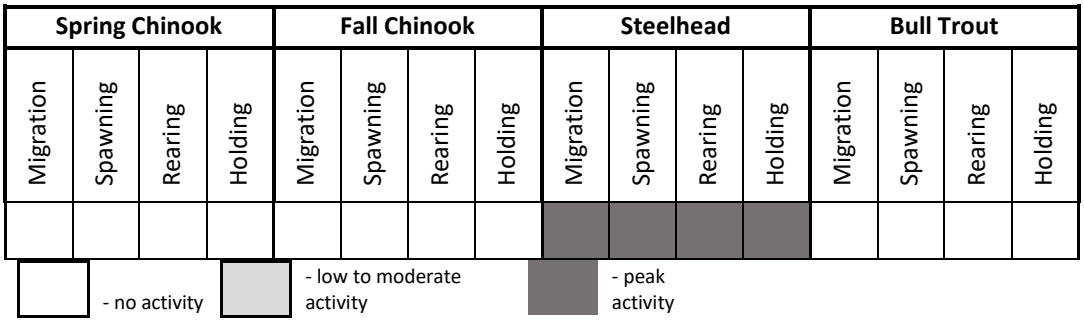
Basic descriptors of Project Area 46.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	0.8	0.8	Wandering Gravel Bed with Discontinuous Floodplain	Limited	State/Private

Primary limiting factors in Project Area 46.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 46.



Restoration recommendations for Project Area 46.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect flood channels throughout. Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.14.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-46 is limited because of the dynamic nature and large supply of sediment to this PA from upstream sources. The subsurface flow and coarse substrate make recovering riparian habitat extremely difficult. When large flows occur, they completely rework the floodplain and no defined channel or side channel is maintained.

9.1.14.3 Recommended Restoration Actions

Recommendations for PA-46 include promoting the reconnection of flood channels, overbank flow, strategically adding LWD throughout the expansive floodplain to encourage development of multiple channels, controlling invasive weeds, and riparian planting in reconnected floodplains.

9.1.14.4 Geomorphic Implications

Reconnecting flood channels may help to develop multiple channels and geomorphic diversity. LWD additions will improve geomorphic function, promote overbank flow, and increase riparian function and floodplain connection.

9.1.14.5 Biological Benefits

Flow goes subsurface annually after spring flows throughout the PA. It is unlikely that flow conditions will change, and even if surface flows could be restored in this PA, the lack of riparian vegetation and extreme exposure to

warming would likely create stream temperature conditions that could not support juvenile fish trying to rear in this section. However, additions of wood will improve migration conditions for adults, extend the flow period, improve floodplain and riparian function, recharge groundwater, and potentially provide cooler water to downstream reaches and Asotin Creek.

9.1.14.6 Potential Challenges

The valley and watershed setting of this PA presents a significant challenge to managers. There is a natural desire to improve floodplain and riparian function because the current conditions are barren and flows go subsurface. However, these conditions may be relatively natural based on the reach type, sediment supply, and location in the watershed. Any investment in restoration in this PA will have a relatively high risk of failure if the goals are to convert the very dynamic nature of the site into a more stable and predictable single thread stream channel

9.1.15 Pintler Creek - Project Area 47 (River Mile 0.8 to 1.4)

9.1.15.1 Site Description

Project Area **47 (PA-47)** is located along Pintler Creek between RM 0.8 to 1.4. Pintler Creek road runs along the length of the PA on river right. The road is generally along the toe of the hillslope and does not disconnect any floodplain habitat. The PA is within a confined valley with coarse, poorly sorted bed material, a poorly defined channel, but with moderate riparian function. The flow in this PA goes subsurface or puddles in late spring or early summer and although there is some debate, it is generally recognized that the subsurface flows naturally occurred in this PA prior to European settlement. Because the valley is confined there is less sediment deposition occurring here compared to the PA downstream and hence the geomorphic conditions are moderate.

Basic descriptors of Project Area 47.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.8	1.4	0.6	Confined with Occasional Floodplain Pockets	Moderate	State

Primary limiting factors in Project Area 47.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 47.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity; - low to moderate activity; - peak activity

Restoration recommendations for Project Area 47.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect a side channel and flood channel. Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.15.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-47 is moderate due to limited geomorphic or structural element diversity. The channel is relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is mostly moderate and improving. Riparian vegetation is limited in portions of the PA with natural subsurface flows. However, past floods and intensive land use may have exacerbated subsurface flows.

9.1.15.3 Recommended Restoration Actions

Recommendations for PA-47 include reconnecting a side and flood channel, promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

9.1.15.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

9.1.15.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Restoration of a large portion of Pintler Creek may provide some benefits to downstream flow.

9.1.15.6 Potential Challenges

Subsurface flow will be a challenge for riparian planting.

9.1.16 Pintler Creek - Project Area 48 (River Mile 1.4 to 1.7)

9.1.16.1 Site Description

Project Area **48 (PA-48)** is along Pintler Creek between RM 1.4 to 1.7. Pintler Creek road runs along the length of the PA on river right. The road is generally along the toe of the hillslope and does not disconnect any floodplain habitat. The PA is within a confined valley with coarse, poorly sorted bed material, a poorly defined channel, and

moderate riparian function. The flow in this PA goes subsurface or puddles in late spring or early summer and although there is some debate, it is generally recognized that the subsurface flows naturally occurred in this PA prior to European settlement. Because the valley is confined there is less sediment deposition occurring here compared to the PA downstream and hence the geomorphic conditions are moderate. Ayers Gulch enters Pintler Creek at RM 1.7.

Basic descriptors of Project Area 48.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
1.4	1.7	0.3	Confined with Occasional Floodplain Pockets	Moderate	State

Primary limiting factors in Project Area 48.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 48.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 48.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect mature riparian vegetation throughout.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect a side channel. Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.16.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-48 is moderate due to limited geomorphic or structural element diversity. The channel is relatively simple and side channels and overbank flow are rare. Floodplain and riparian function is mostly moderate and improving. Riparian vegetation is limited in areas of natural subsurface flows. However, past floods and intensive landuse may have exacerbated subsurface flows.

9.1.16.3 Recommended Restoration Actions

Recommendations for PA-48 include reconnecting a side channel, promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

9.1.16.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

9.1.16.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Restoration of a large portion of Pintler Creek may provide some benefits to downstream flow.

9.1.16.6 Potential Challenges

Riparian planting will be difficult in areas of subsurface flow.

9.1.17 Pintler Creek - Project Area 50 (River Mile 2.3 to 3.6)

9.1.17.1 Site Description

Project Area **50 (PA-50)** is located along Pintler Creek between RM 2.3 to 3.6. Pintler Creek road runs along the length of the PA and generally occurs within the floodplain. The PA is within a confined valley with coarse, poorly sorted bed material, a poorly defined channel, and poor riparian function. The flow in this PA goes subsurface or puddles in late spring or early summer and it is generally recognized that the subsurface flows naturally occurred in this PA prior to European settlement. Because the valley is confined, there is less sediment deposition occurring here compared to the PA-46 downstream; however, the geomorphic function is limited because of the lack of any riparian habitat and structural elements to create and maintain geomorphic complexity.

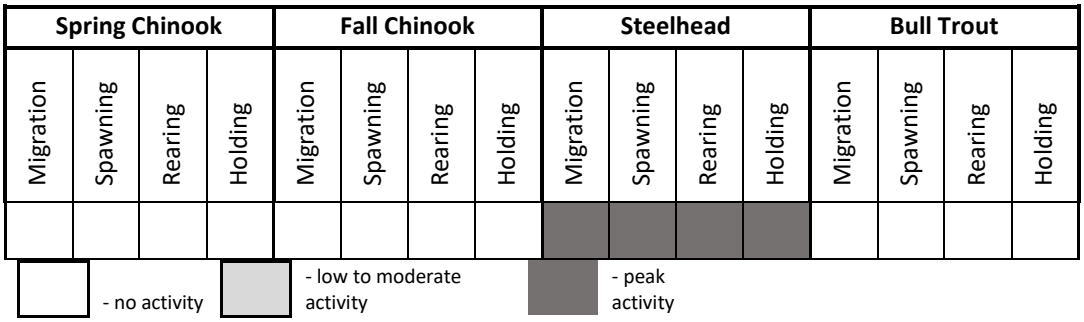
Basic descriptors of Project Area 50.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
2.3	3.6	1.3	Confined with Occasional Floodplain Pockets	Limited	State

Primary limiting factors in Project Area 50.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 50.



Restoration recommendations for Project Area 50.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	NA
Remove Barriers and Reconnect Disconnected Habitats	Reconnect side and flood channels. Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.17.2 Geomorphic, Floodplain, and Riparian function

The geomorphic function in PA-50 is limited due to low riparian and structural diversity. The channel is undefined and side channels and overbank flow are rare. Floodplain and riparian function is limited and do not appear to be recovering. Extended subsurface flows are preventing riparian reestablishment.

9.1.17.3 Recommended Restoration Actions

Recommendations for PA-50 include reconnecting side and flood channels, promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

9.1.17.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

9.1.17.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing and spawning habitat. Restoration of a large portion of Pintler Creek may provide some benefits to downstream flow.

9.1.17.6 Potential Challenges

Riparian planting may be difficult in areas of subsurface flow.

TENMILE CREEK TIER 3 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

9.1.18 Tenmile Creek - Project Area 63 (River Mile 0.0 to 0.3)

9.1.18.1 Site Description

Project Area **63 (PA-63)** is located at the mouth of Tenmile Creek between RM 0.0 to 0.3. Tenmile Creek enters the Snake River approximately 5 miles upstream from the town of Asotin. The Snake River road crosses over Tenmile Creek at RM 0.2. The reach type is an alluvial fan, but the fan is confined between extensive levees throughout the PA. The elevation of the Snake River changes depending on the operation of dams downstream (e.g., Lower Granite) and upstream (e.g., Hells Canyon) and this can create a partial/temporary barrier for fish trying to access Tenmile Creek. The headwaters of Tenmile Creek are mostly below 4,000 feet elevation and dryland farming is the dominant activity in the watershed. Due to the watershed characteristics, stream temperatures are relatively warm, flows are more flashy, and stream sections go dry more often than the mainstem of Asotin Creek. Despite the different watershed characteristics, Tenmile has a run of approximately 50-100 adult steelhead.

Basic descriptors of Project Area 63.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	0.3	0.3	Alluvial Fan	Limited	Private

Primary limiting factors in Project Area 63.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	X

Fish species presence and use by life history stage in Project Area 63.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity; - low to moderate activity; - peak activity

Restoration recommendations for Project Area 63.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment and protect recovering riparian habitat.

Remove Barriers and Reconnect Disconnected Habitats	Remove or set back levees throughout. Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	NA
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	Conduct barrier assessment at the mouth.

9.1.18.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-63 is limited due to extensive levees, low flows, lack of structural elements, agricultural activities in the watershed, and varying levels of the Snake River, which affects the development and maintenance of channels across the alluvial fan. The floodplain and riparian areas are narrow and their function is limited.

9.1.18.3 Recommended Restoration Actions

Recommendations for PA-63 include removing or setting back levees throughout, promoting overbank flow, adding structural elements to improve geomorphic function, and conducting a barrier assessment at the mouth.

9.1.18.4 Geomorphic Implications

Setting back levees will increase accommodation space and adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

9.1.18.5 Biological Benefits

Setting back levees would allow the fan to function more naturally and may limit the development of a flow barrier. Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat.

9.1.18.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow and a large house at the mouth of river right will limit the amount of levee setback that is possible.

9.1.19 Tenmile Creek - Project Area 66 (River Mile 1.9 to 2.3)

9.1.19.1 Site Description

Project Area **66 (PA-66)** is located along Tenmile Creek between RM 1.9 to 2.3. Weisssenfels Ridge road runs up onto the river right ridge. Tenmile Creek is not confined by the road in this PA. The valley is partly confined and but the character of the channel changes to less defined and flow goes subsurface throughout this PA for the majority of the year. The primary limiting factors are low or no flow, oversupply of sediment, and less geomorphic and hydraulic diversity due to fewer structural elements. This section is dominated by very coarse substrate and an undefined channel. Low flow conditions are mostly natural due to changes in the elevation of the bedrock in relation to the thickness of the alluvium.

Basic descriptors of Project Area 66.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
1.9	2.3	0.4	Planform Controlled with Discontinuous Floodplain	Limited	Private

Primary limiting factors in Project Area 66.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 66.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 66.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect flood channel between RM 1.9 to 2.0 and promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting in reconnected floodplain habitat and invasive vegetation control throughout.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.19.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-66 is limited due to sediment load, low or no flow, lack of structural elements, and agricultural activities in the watershed. Floodplain and riparian function is limited due to low flow and sediment load throughout the PA.

9.1.19.3 Recommended Restoration Actions

Recommendations for PA-66 include reconnecting flood channels, promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

9.1.19.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time. Riparian planting in areas with reconnected floodplain and controlling invasive weeds will improve riparian function and provide a source of LWD.

9.1.19.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of a large portion of Tenmile Creek may provide some benefits to downstream flow.

9.1.19.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow.

9.1.20 Tenmile Creek - Project Area 67 (River Mile 2.3 to 3.1)

9.1.20.1 Site Description

Project Area **67 (PA-67)** is located along Tenmile Creek between RM 2.3 to 3.1. A small unnamed road runs along the toe of the hillslope and crosses Tenmile Creek at a ford at RM 2.75. The road does not confine Tenmile Creek in this PA. The valley is confined, flow goes subsurface or puddles throughout this PA and the riparian function is moderate to high. The primary limiting factors are low or no flow, oversupply of sediment, high stream temperatures, and limited geomorphic and hydraulic diversity due to few structural elements. This section is dominated by very coarse substrate and an undefined channel. Low flow conditions are mostly natural due to changes in the elevation of the bedrock in relation to the thickness of the alluvium.

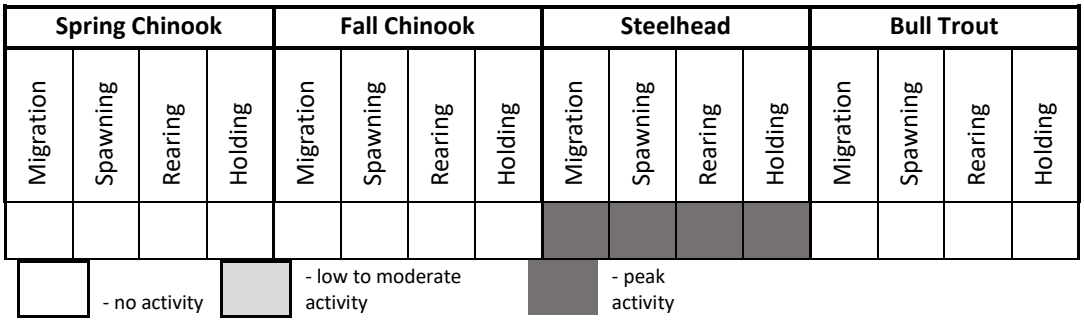
Basic descriptors of Project Area 67.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
2.3	3.1	0.8	Confined with Occasional Floodplain Pockets	Moderate	Private

Primary limiting factors in Project Area 67.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 67.



Restoration recommendations for Project Area 67.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment and protect large sections of mature riparian vegetation between RM 2.7 to 3.1.
Remove Barriers and Reconnect Disconnected Habitats	Promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	NA
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

9.1.20.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-67 is moderate due to sediment load, low or no flow, lack of structural elements, and agricultural activities in the watershed. Floodplain and riparian function is moderate to high.

9.1.20.3 Recommended Restoration Actions

Recommendations for PA-67 include protecting a large section of mature riparian vegetation, promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

9.1.20.4 Geomorphic Implications

Protecting riparian vegetation will improve stream temperatures. Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

9.1.20.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of a large portion of Tenmile Creek may provide some benefits to downstream flow.

9.1.20.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow.

COUSE CREEK TIER 3 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

9.1.21 Couse Creek - Project Area 79 (River Mile 1.4 to 3.5)

9.1.21.1 Site Description

Project Area **79 (PA-79)** is located along Couse Creek between RM 1.4 to 3.5. Couse Creek road runs along the toe of the river left hillslope and does not confine the channel. The valley has numerous debris fans that do confine the channel. Flow goes subsurface or puddles throughout this PA and riparian function is limited. The primary limiting factors are low or no flow, oversupply of sediment, high stream temperatures, and limited geomorphic and hydraulic diversity due to a lack of structural elements. The PA is dominated by very coarse substrate and an undefined channel. Low flow conditions are mostly natural due to changes in the elevation of the bedrock in relation to the thickness of the alluvium.

10 TIER 4 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

ASOTIN CREEK - TIER 4 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

10.1.1 North Fork Asotin Creek - Project Area 23 (River Mile 5.8 to 10.2)

10.1.1.1 Site Description

Project Area **23 (PA-23)** is located along North Fork Asotin Creek between RM 5.8 to 10.2, to the county boundary just below the confluence of the North Fork with the Middle Fork. There is a rough road and two track trail along river left to the US Forest Service Boundary and then the trail becomes a single track. The road currently does not impact the majority of the PA. The geomorphic function is high along most of this PA and riparian function is near full over much of the length. Large diameter ponderosa pine and cottonwood are common and in general, there is limited invasive species except for along trails. The US Forest Service may conduct timber harvesting in this area, and protection of riparian areas and thoughtful access to timber should be a top priority. A large proportion of the steelhead and spring chinook runs in Asotin Creek spawn and rear in this PA.

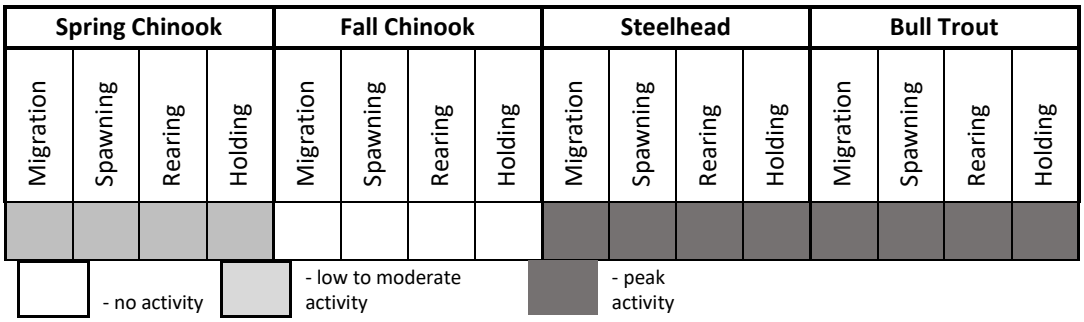
Basic descriptors of Project Area 23.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
5.8	10.2	4.4	Wandering Gravel Bed with Discontinuous Floodplain	High	Federal

Primary limiting factors in Project Area 23.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 23.



Restoration recommendations for Project Area 23.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain or decommission the roads & trails to limit impacts to riparian habitat and the channel.
Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Invasive vegetation control along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.1.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-23 is mostly high and the PA is recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and lack of LWD entering the channel.

10.1.1.3 Recommended Restoration Actions

Recommendations for PA-23 include conserving these areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.1.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.1.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

10.1.1.6 Potential Challenges

Wildfire potential is high because of increases in stand density, fire suppression, and age of the forests. Because the area is relatively remote and road access is limited, active management will be more logistically challenging.

10.1.2 South Fork Asotin Creek - Project Area 32 (River Mile 9.2 to 11.3)

10.1.2.1 Site Description

Project Area **32 (PA-32)** is located along South Fork Asotin Creek between RM 9.2 and 11.3. This PA is located on USFS property and the geomorphic and riparian function is high. The valley bottom and gullies are dominated by mature conifer and there are two river right tributaries coming into this PA. The main management goal for this PA is conservation.

Basic descriptors of Project Area 32.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
9.2	11.3	2.1	Confined with Occasional Floodplain Pockets	High	Federal

Primary limiting factors in Project Area 32.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 32.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 32.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and channel, and maintain access for recreation.

Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Invasive vegetation control along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.2.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-32 is mostly high and the PA is recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and lack of LWD entering the channel.

10.1.2.3 Recommended Restoration Actions

Recommendations for PA-32 include conserving these areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.2.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.2.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

10.1.2.6 Potential Challenges

Wildfire potential is high because of increases in stand density, fire suppression, and age of the forests. Because the area is relatively remote and road access is limited, active management will be more logistically challenging.

GEORGE CREEK - TIER 4 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

10.1.3 George Creek - Project Area 39 (River Mile 11.4 to 16.0)

10.1.3.1 Site Description

Project Area **39 (PA-39)** is located along upper George Creek between RM 11.4 to 16.0. George Creek road runs along the length of the PA, crossing several times at fords. The road is along the toe of the river left hillslope and does not disconnect floodplain habitat. The valley is confined and there are occasional floodplain pockets throughout the PA. The primary limiting factors are low geomorphic and hydraulic diversity, caused by a lack of structural elements. There are some parts of the PA where flow goes subsurface but not as often as in lower George Creek. We suspect that subsurface flows are mostly natural due to changes in the elevation of the bedrock in relation to the thickness of the alluvium. Riparian function is high to full but patchy, and mirror the availability of surface water. Several headwater tributaries enter this PA and both bull trout and steelhead are present.

Basic descriptors of Project Area 39.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
11.4	16.0	4.6	Confined with Occasional Floodplain Pockets	High	Private

Primary limiting factors in Project Area 39.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 39.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 39.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and channel, and maintain access for recreation.
Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Invasive vegetation control along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.3.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-39 is mostly high and recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and lack of LWD entering the channel.

10.1.3.3 Recommended Restoration Actions

Recommendations for PA-39 include conserving riparian areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.3.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.3.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

10.1.3.6 Potential Challenges

Wildfire potential is high because of increases in stand density, fire suppression, and age of the forests. Because the area is relatively remote and road access is limited, active management will be more logistically challenging.

10.1.4 George Creek - Project Area 40 (River Mile 16.0 to 20.1)

10.1.4.1 Site Description

Project Area **40 (PA-40)** is located along upper George Creek between RM 16.0 to 20.1. George Creek road runs along the length of the PA, crossing several times at fords. This PA is in the headwaters of George Creek and generally the geomorphic, riparian, and floodplain function are high. The stream is confined in a narrow valley setting with steep, forested side hills. Numerous USFS roads access portions of the PA but mostly from the top down – there are only old remnants of roads along the creek. The primary limiting factors are low geomorphic and hydraulic diversity, caused by a lack of structural elements. There are several headwater tributaries that enter this PA and bull trout and steelhead are present.

Basic descriptors of Project Area 40.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
16.0	20.1	4.1	Confined Steep Headwater	High	Private/Federal

Primary limiting factors in Project Area 40.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions

					X	

Fish species presence and use by life history stage in Project Area 40.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity; - low to moderate activity; - peak activity

Restoration recommendations for Project Area 40.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and channel, and maintain access for recreation.
Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Control invasive vegetation along old roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.4.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-40 is mostly high and recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and lack of LWD entering the channel.

10.1.4.3 Recommended Restoration Actions

Recommendations for PA-40 include conserving riparian areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.4.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.4.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern. This is also a priority area to conserve bull trout in George Creek.

10.1.4.6 Potential Challenges

Wildfire potential is high because of increases in stand density, fire suppression, and age of the forests. Because the area is relatively remote and road access is limited, active management will be more logistically challenging.

10.1.5 George Creek - Project Area 41 (River Mile 0.0 to 1.6)

10.1.5.1 Site Descriptions

Project Area **41 (PA-41)** is a tributary (GC_04) to the upper George Creek, entering George Creek at RM 14.0. The valley setting is confined and there are occasional floodplain pockets throughout the PA. The stream is confined in a narrow valley setting with steep, forested side hills. Numerous USFS roads access portions of the PA but mostly from the top down – there are only old remnants of roads along the creek. There is limited geomorphic and hydraulic diversity, caused by a lack of structural elements. There are several intermittent headwater tributaries that form this tributary PA. The area has both bull trout and steelhead present.

Basic descriptors of Project Area 41.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	1.6	1.6	Confined with Occasional Floodplain Pockets	High	Private

Primary limiting factors in Project Area 41.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 41.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity; - low to moderate activity; - peak activity

Restoration recommendations for Project Area 41.

Restoration Strategy	Recommended Restoration Actions

Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and channel, and maintain access for recreation.
Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Invasive vegetation control along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.5.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-41 is mostly high and recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and lack of LWD entering the channel.

10.1.5.3 Recommended Restoration Actions

Recommendations for PA-41 include conserving riparian areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.5.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.5.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

10.1.5.6 Potential Challenges

Wildfire potential is high because of increases in stand density, fire suppression, and age of the forests. Because the area is relatively remote and road access is limited, active management will be more logistically challenging.

10.1.6 George Creek Tributary - Project Area 42 (River Mile 0.0 to 1.6)

10.1.6.1 Site Description

Project Area **42 (PA-42)** is tributary (GC_05) to the upper George Creek entering George Creek at RM 16.0. The valley setting is confined and there are occasional floodplain pockets throughout the PA. The stream is confined in a narrow valley setting with steep, forested side hills. Numerous USFS roads access portions of the PA but mostly from the top down – there are only old remnants of roads along the creek. The primary limiting factors are low geomorphic and hydraulic diversity, caused by a lack of structural elements. There are several intermittent

headwater tributaries that form this tributary PA. The area has both bull trout and steelhead present. There are several headwater tributaries that enter this PA and this area is used by bull trout and steelhead.

Basic descriptors of Project Area 42.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	1.6	1.6	Confined with Occasional Floodplain Pockets	High	Private

Primary limiting factors in Project Area 42.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 42.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 42.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and channel, and maintain access for recreation.
Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Invasive vegetation control along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.6.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-42 is mostly high and recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and a lack of LWD entering the channel.

10.1.6.3 Recommended Restoration Actions

Recommendations for PA-42 include conserving riparian areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.6.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.6.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

10.1.6.6 Potential Challenges

Wildfire potential is high because of increases in stand density, fire suppression, and age of the forests. Because the area is relatively remote and road access is limited, active management will be more logistically challenging.

10.1.7 George Creek Tributary - Project Area 43 (River Mile 0.0 to 4.7)

10.1.7.1 Site Description

Project Area **43 (PA-43)** is a tributary (GC_06) to George Creek and enters George Creek at RM 16.3. This PA is in the headwaters of George Creek and generally the geomorphic, riparian, and floodplain function are high. The stream is confined in a narrow valley setting with steep, forested side hills. Numerous USFS roads access portions of the PA but mostly from the top down – there are only old remnants of roads along the creek. The primary limiting factors are low geomorphic and hydraulic diversity, caused by a lack of structural elements. There are several headwater tributaries that enter this PA, and this area has both bull trout and steelhead present.

Basic descriptors of Project Area 43.

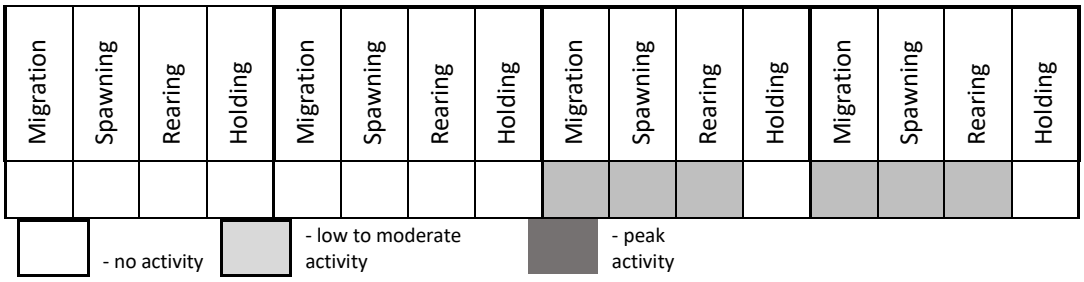
RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	4.7	4.7	Confined Steep Headwater	High	Private/Federal

Primary limiting factors in Project Area 43.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 43.

Spring Chinook	Fall Chinook	Steelhead	Bull Trout



Restoration recommendations for Project Area 43.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and channel, and maintain access for recreation.
Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Control invasive vegetation along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.7.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-43 is mostly high and recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and lack of LWD entering the channel.

10.1.7.3 Recommended Restoration Actions

Recommendations for PA-43 include conserving riparian areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.7.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.7.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

10.1.7.6 Potential Challenges

Wildfire potential is high because of increases in stand density, fire suppression, and age of the forests. Active management will be more logistically challenging because the area is relatively remote and road access is limited.

TENMILE CREEK - TIER 4 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

10.1.8 Tenmile Creek - Project Area 72 (River Mile 11.4 to 14.6)

10.1.8.1 Site Description

Project Area **72 (PA-72)** is located along Tenmile Creek in the upper watershed. The PA starts at the confluence of Mill Creek at RM 11.4. The geomorphic, riparian, and floodplain functions are high. The stream is confined in a narrow valley setting with steep, forested side hills. The primary limiting factors are limited geomorphic and hydraulic diversity caused by a lack of structural elements. There are several headwater tributaries that enter this PA, and this area has steelhead present.

Basic descriptors of Project Area 72.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
11.4	14.6	3.2	Confined with Occasional Floodplain Pockets	High	Private

Primary limiting factors in Project Area 72.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 72.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 72.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and channel, and maintain access for recreation.

Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Invasive vegetation control along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.8.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-72 is mostly high and recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and a lack of LWD entering the channel.

10.1.8.3 Recommended Restoration Actions

Recommendations for PA-72 include conserving riparian areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.8.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.8.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

10.1.8.6 Potential Challenges

Wildfire potential is high because of increases in stand density, fire suppression, and age of the forests. Because the area is relatively remote and road access is limited, active management will be more logistically challenging.

10.1.9 Tenmile Creek - Project Area 73 (River Mile 14.6 to 15.5)

10.1.9.1 Site Description

Project Area **73 (PA-73)** is located in the very upper Tenmile Creek between RM 14.6 to 15.5. The PA starts at the confluence with a tributary to Tenmile Creek (TM_06) at RM 14.6. The geomorphic, riparian, and floodplain function are high. The stream is confined in a narrow valley setting with steep, forested side hills. The primary limiting factors are limited geomorphic and hydraulic diversity, caused by a lack of structural elements. This PA has steelhead present.

Basic descriptors of Project Area 73.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership

14.6	15.5	0.9	Confined with Occasional Floodplain Pockets	High	Private

Primary limiting factors in Project Area 73.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 73.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 73.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and channel, and maintain access for recreation.
Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Invasive vegetation control along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.9.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-73 is mostly high and recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and a lack of LWD entering the channel.

10.1.9.3 Recommended Restoration Actions

Recommendations for PA-73 include conserving riparian areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.9.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.9.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

10.1.9.6 Potential Challenges

Wildfire potential is high because of increases in stand density, fire suppression, and age of the forests. Because the area is relatively remote and road access is limited, active management will be more logistically challenging.

10.1.10 Mill Creek - Project Area 74 (River Mile 0.0 to 4.7)

10.1.10.1 Site Description

Project Area **74 (PA-74)** is located along Mill Creek, which is a tributary to Tenmile Creek. The PA starts at the confluence with Tenmile Creek at RM 11.4. The upper section of Mill Creek flows through Anatone and its headwaters are on private forest land. The geomorphic, riparian, and floodplain function are high. Sections of Mill Creek upstream and downstream of Mill Creek road flow through meadows dominated by willow and other shrub species. These areas would be ideal beaver introduction areas. The primary limiting factors are limited geomorphic and hydraulic diversity, caused by a lack of structural elements. This PA has steelhead present.

Basic descriptors of Project Area 74.

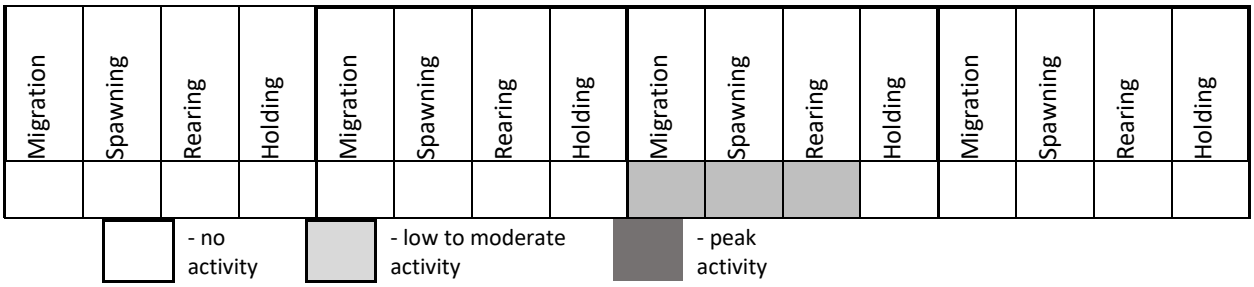
RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	4.7	4.7	Confined with Occasional Floodplain Pockets	High	Private

Primary limiting factors in Project Area 74.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 74.

Spring Chinook	Fall Chinook	Steelhead	Bull Trout



Restoration recommendations for Project Area 74.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and channel, and maintain access for recreation.
Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Invasive vegetation control along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.10.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-74 is mostly high and recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and a lack of LWD entering the channel.

10.1.10.3 Recommended Restoration Actions

Recommendations for PA-74 include conserving riparian areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.10.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.10.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

10.1.10.6 Potential Challenges

The Mill Creek road crossing could limit restoration actions, and the town of Anatone should be considered during restoration design.

10.1.11 Tenmile Creek Tributary - Project Area 75 (River Mile 0.0 to 1.7)

10.1.11.1 Site Description

Project Area **75 (PA-75)** is located along a tributary (TM_05) to Tenmile Creek. The PA starts at the confluence with Tenmile Creek at RM 14.0. The valley is confined and the hillslopes are steep and heavily forested. The geomorphic, riparian, and floodplain function are high. These areas would be ideal beaver introduction areas. The primary limiting factors are limited geomorphic and hydraulic diversity, caused by a lack of structural elements. This PA has steelhead present.

Basic descriptors of Project Area 75.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	1.7	1.7	Confined with Occasional Floodplain Pockets	High	Private

Primary limiting factors in Project Area 75.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 75.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 75.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and channel, and maintain access for recreation.

Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Invasive vegetation control along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.11.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-75 is mostly high and recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and lack of LWD entering the channel.

10.1.11.3 Recommended Restoration Actions

Recommendations for PA-75 include conserving riparian areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.11.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.11.5 Biological Benefits

Restoration actions will increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

10.1.11.6 Potential Challenges

There are limited challenges in this PA.

COUSE CREEK - TIER 4 CONCEPTUAL RESTORATION PROJECT AREA DESCRIPTIONS

10.1.12 Couse Creek - Project Area 80 (River Mile 3.5 to 8.2)

10.1.12.1 Site Description

Project Area **80 (PA-80)** is located along Couse Creek between RM 3.5 to 8.2 starting at the bridge crossing over Couse Creek road. The valley is confined and the hillslopes are steep with few trees. The geomorphic, riparian, and floodplain function are high. These areas would be ideal beaver introduction areas. The primary limiting factors are limited geomorphic and hydraulic diversity, caused by a lack of structural elements. This PA has steelhead present.

Basic descriptors of Project Area 80.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership

3.5	8.2	4.7	Confined with Occasional Floodplain Pockets	High	Private

Primary limiting factors in Project Area 80.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
					X	

Fish species presence and use by life history stage in Project Area 80.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 80.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Protect full functioning riparian vegetation throughout. Maintain, decommission, or relocate roads & trails out of floodplain to limit impacts to riparian habitat and channel, and maintain access for recreation.
Remove Barriers and Reconnect Disconnected Habitats	NA
Long-term Processes	Invasive vegetation control along roads & trails.
Short-term Processes	NA
Alternative Strategies	Combine reduction in forest fire fuels with addition of LWD by using thinned trees to increase wood loading. Assess area for potential beaver introduction as site appears to have high potential to support dam building beavers.

10.1.12.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-80 is mostly high and recovering. However, geomorphic diversity, floodplain, and riparian function is still likely impaired from past disturbances due to incision and a lack of LWD entering the channel.

10.1.12.3 Recommended Restoration Actions

Recommendations for PA-80 include conserving riparian areas and potentially using alternative methods to speed recovery, which would include coordinating forest fuel reductions with wood loading and relocating nuisance beaver colonies to the PA.

10.1.12.4 Geomorphic Implications

Addition of wood will improve geomorphic, floodplain, and riparian function locally and provide a source of LWD for reaches downstream. Beaver introduction will potentially improve floodplain and riparian function, increase habitat diversity for fish, recharge groundwater, and reduce peak flows.

10.1.12.5 Biological Benefits

Restoration actions could increase habitat diversity, flow refugia, temperature refugia, temperature diversity, increase growth of ESA listed fish, and provide habitat for many other species of management concern.

10.1.12.6 Potential Challenges

There are limited challenges in this PA except for the road crossing at the bottom of the PA.

Basic descriptors of Project Area 79.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
1.4	3.5	2.1	Fan Controlled with Discontinuous Floodplain	Limited	Private

Primary limiting factors in Project Area 79.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
	X	X	X	X	X	

Fish species presence and use by life history stage in Project Area 79.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 79.

Restoration Strategy	Recommended Restoration Actions

Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect flood channels and promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

10.1.12.7 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-79 is moderate due to sediment load, low or no flow, lack of structural elements, and agricultural activities in the watershed. Floodplain and riparian function is moderate to high.

10.1.12.8 Recommended Restoration Actions

Recommendations for PA-79 include protecting and reconnecting flood channels, promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

10.1.12.9 Geomorphic Implications

Reconnecting flood channels and promoting overbank flow will increase off-channel habitat and adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

10.1.12.10 Biological Benefits

Reconnecting flood channels and adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of a large portion of Couse Creek may provide some benefits to downstream flow.

10.1.12.11 Potential Challenges

Response to restoration will be slower due to inconsistent flow.

10.1.13 Couse Creek - Project Area 81 (River Mile 0.0 to 3.7)

10.1.13.1 Site Description

Project Area **81 (PA-81)** is a tributary to Couse Creek entering at RM 3.5. Couse Creek road runs along the PA at the toe of the river right hillslope and does not confine the channel. The valley is confined and there is limited floodplain. Flow goes subsurface or puddles throughout this PA and riparian function is limited. The primary limiting factors are low or no flow, high stream temperatures, and limited geomorphic and hydraulic diversity due to a lack of structural elements. This section is dominated by coarse substrate and an undefined channel.

Basic descriptors of Project Area 81.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	3.7	3.7	Confined with Occasional Floodplain Pockets	Moderate	Private

Primary limiting factors in Project Area 81.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 81.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 81.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect flood channels and promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

10.1.13.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-81 is moderate due to low or no flow, lack of structural elements, and agricultural activities in the watershed. Floodplain and riparian function varies.

10.1.13.3 Recommended Restoration Actions

Recommendations for PA-81 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

10.1.13.4 Geomorphic Implications

Reconnecting flood channels and promoting overbank flow will increase off-channel habitat and adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

10.1.13.5 Biological Benefits

Reconnecting flood channels and adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of a large portion of Couse Creek may provide some benefits to downstream flow.

10.1.13.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow.

10.1.14 Couse Creek Tributary - Project Area 82 (River Mile 0.0 to 0.9)

10.1.14.1 Site Description

Project Area **82 (PA-82)** is a secondary tributary to Couse Creek. The valley is confined and there is limited floodplain. Flow goes subsurface or puddles throughout this PA and riparian function is limited. The primary limiting factors are low or no flow, high stream temperatures, and limited geomorphic and hydraulic diversity due to a lack of structural elements. This section is dominated by coarse substrate and an undefined channel.

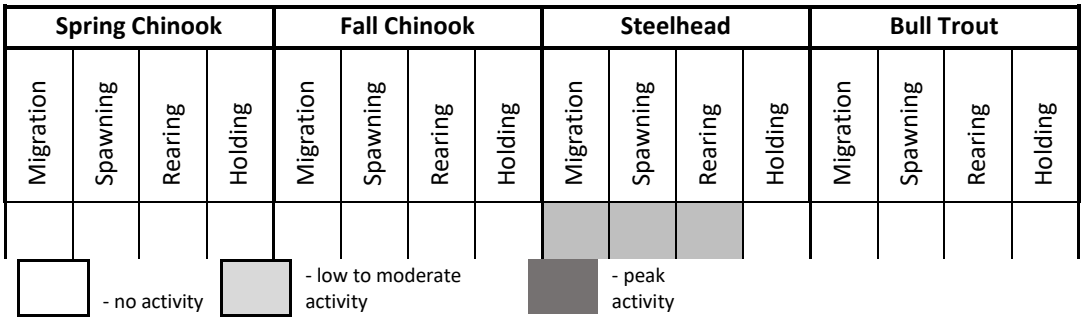
Basic descriptors of Project Area 82.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.0	0.9	0.9	Confined with Occasional Floodplain Pockets	Moderate	Private

Primary limiting factors in Project Area 82.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 82.



Restoration recommendations for Project Area 82.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect flood channels and promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.
Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

10.1.14.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-82 is moderate due to low or no flow, lack of structural elements, and agricultural activities in the watershed. Floodplain and riparian function varies.

10.1.14.3 Recommended Restoration Actions

Recommendations for PA-82 include promoting overbank flow, adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

10.1.14.4 Geomorphic Implications

Promoting overbank flow will increase off-channel habitat and adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

10.1.14.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of a large portion of Couse Creek may provide some benefits to downstream flow.

10.1.14.6 Potential Challenges

Response to restoration will be slower due to inconsistent flow.

10.1.15 Couse Creek Tributary - Project Area 83 (River Mile 0.9 to 1.5)

10.1.15.1 Site Description

Project Area **83 (PA-83)** is located between is a secondary tributary to Couse Creek. The valley is confined and there is limited floodplain. Flow goes subsurface or puddles throughout this PA and riparian function is limited. The primary limiting factors are low or no flow, high stream temperatures, and limited geomorphic and hydraulic diversity due to a lack of structural elements. This section is dominated by coarse substrate and an undefined channel.

Basic descriptors of Project Area 83.

RM Start	RM End	RM Length	Reach Type	Geomorphic Function	Landownership
0.9	1.5	0.6	Confined with Occasional Floodplain Pockets	Limited	Private

Primary limiting factors in Project Area 83.

Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions
		X			X	

Fish species presence and use by life history stage in Project Area 83.

Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding

- no activity
- low to moderate activity
- peak activity

Restoration recommendations for Project Area 83.

Restoration Strategy	Recommended Restoration Actions
Protect and Maintain Natural Processes	Continue best management practices in the loess dominated farmlands to limit excess fine sediment.
Remove Barriers and Reconnect Disconnected Habitats	Reconnect flood channels and promote overbank flow. Add structural elements throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Long-term Processes	Riparian planting and invasive vegetation control when floodplain conditions improve.

Short-term Processes	Add LWD throughout to improve hydraulic and geomorphic complexity, increase fish cover and flow refuge, improve sediment sorting, and reduce sediment and LWD transport time.
Alternative Strategies	NA

10.1.15.2 Geomorphic, Floodplain, and Riparian Function

The geomorphic function in PA-83 is limited due to low or no flow, lack of structural elements, and agricultural activities in the watershed. Floodplain and riparian function varies.

10.1.15.3 Recommended Restoration Actions

Recommendations for PA-83 include adding structural elements to improve geomorphic function, riparian planting, and control of non-native vegetation.

10.1.15.4 Geomorphic Implications

Adding structural elements will increase geomorphic and hydraulic complexity, improve sediment sorting, and reduce sediment and LWD transport time.

10.1.15.5 Biological Benefits

Adding structural elements will increase high flow and predator refuge for fish and create more suitable rearing habitat. Restoration of a large portion of Couse Creek may provide some benefits to downstream flow.

10.1.15.6 Potential Challenges

The lack of consistent flows will limit the effects of restoration.

11 MAPPING NOTES AND DISCLAIMER

Note the river miles reported in this report do not match up directly with the river miles reported in the Geomorphic Assessment Report (Bennett et al. 2018). We used a digitized stream layer to develop the Conceptual Design maps, whereas the Geomorphic Assessment was conducted using the NHD stream layer. Both sets of river miles are only approximations of the stream location, but river miles in this report should be considered more accurate. Precise locations of restoration actions will be determined when conceptual designs are updated to full designs specifications.

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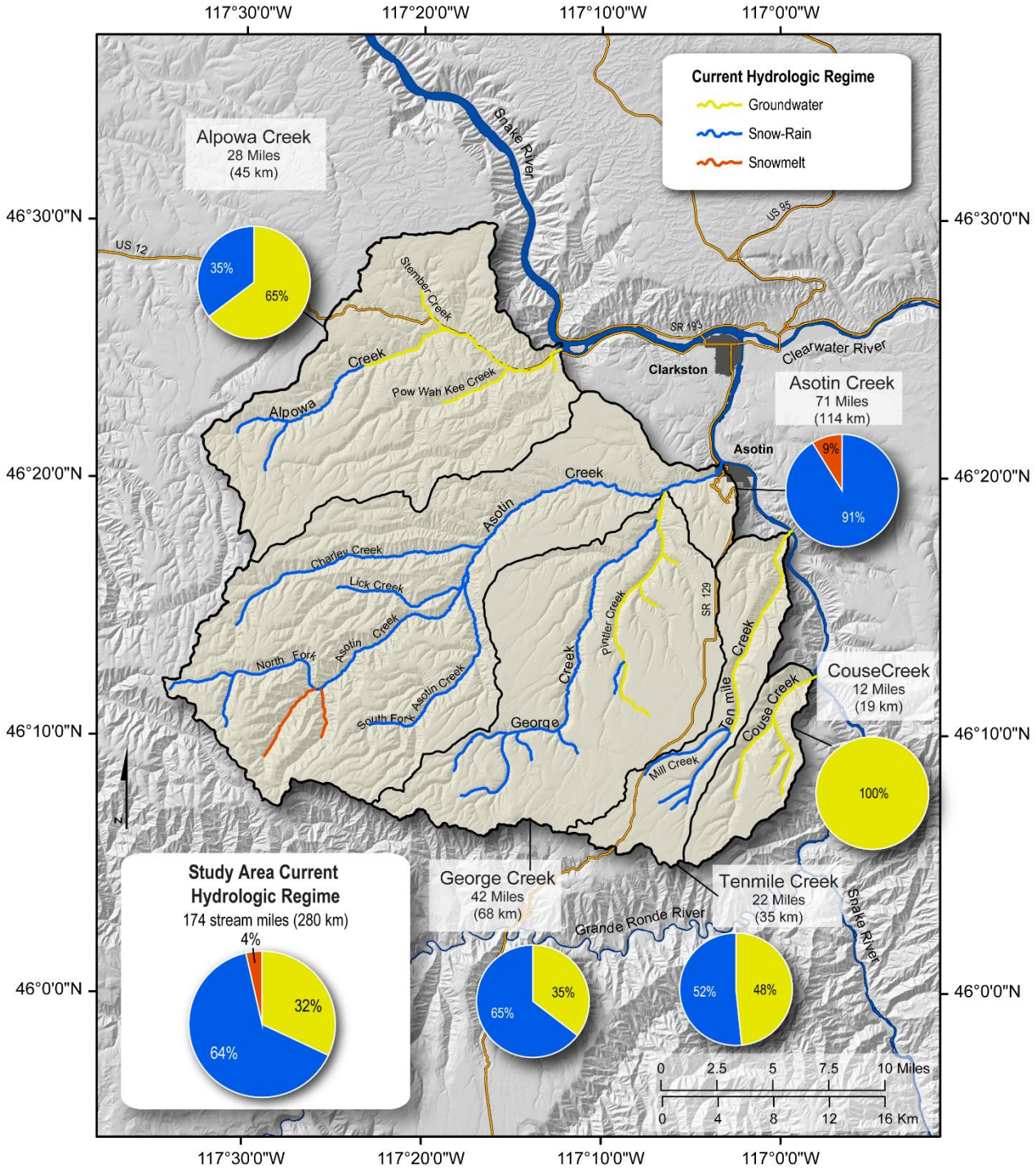
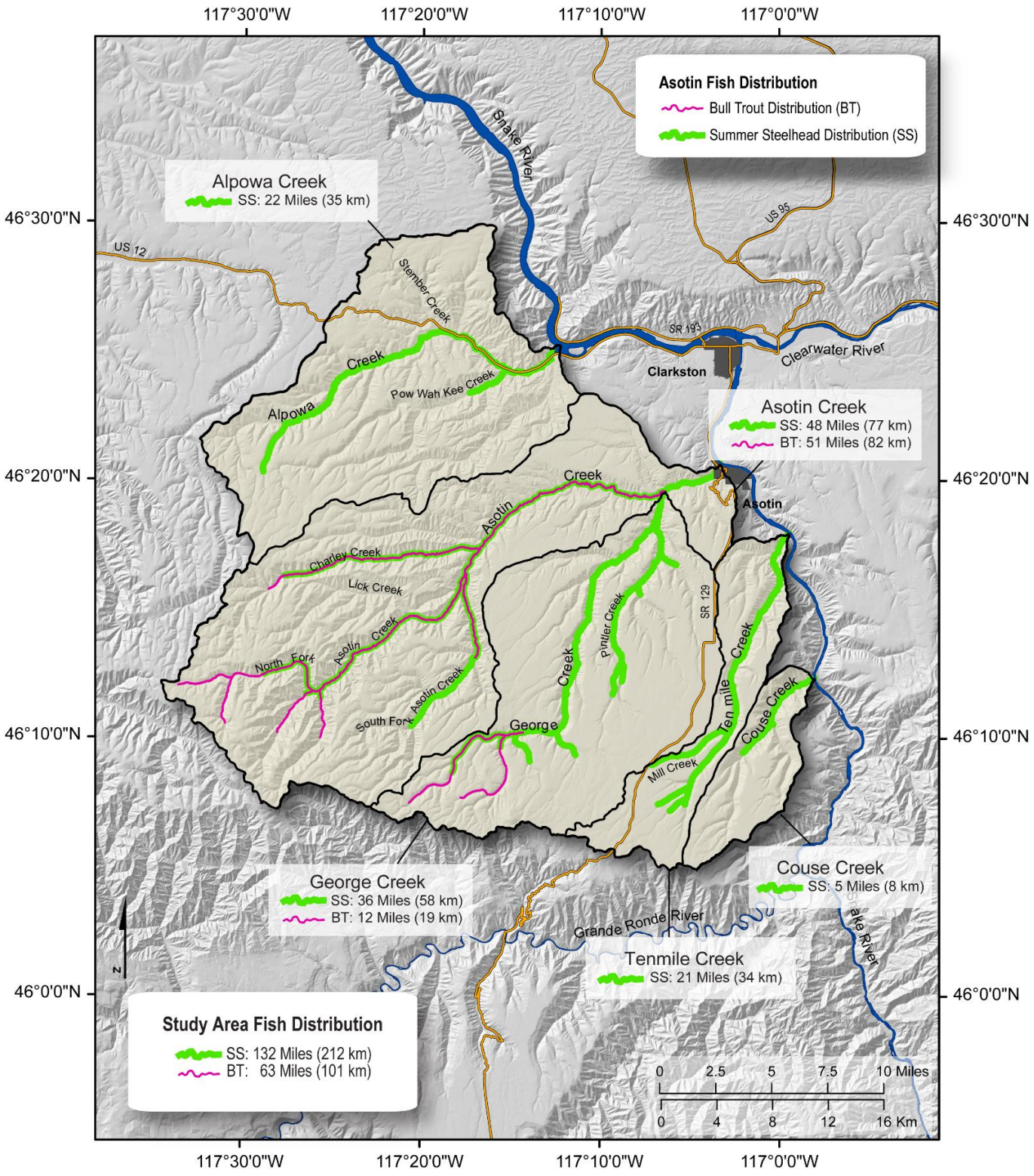
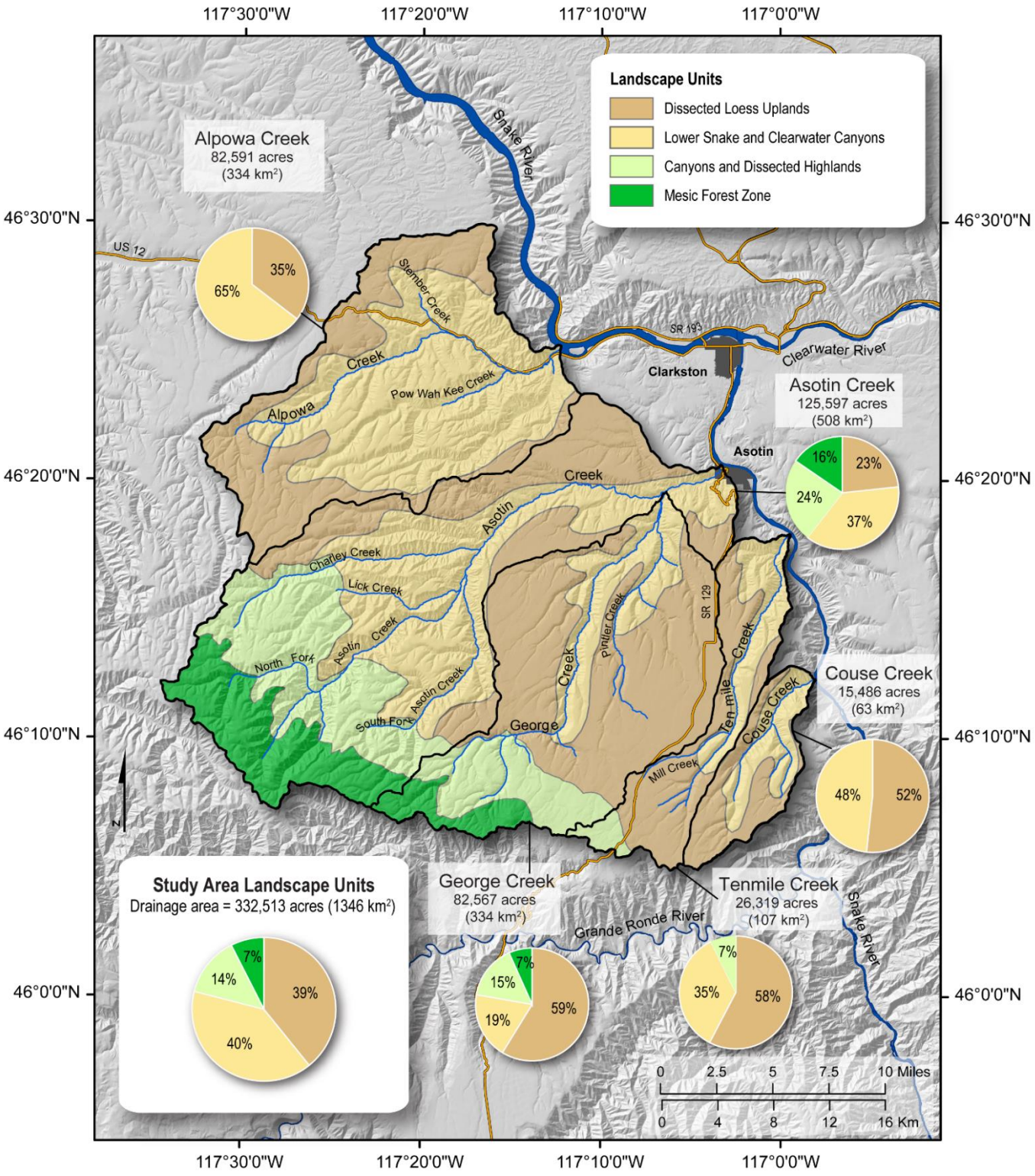
APPENDIX A. KEY GEOMORPHIC ASSESSMENT MAPS



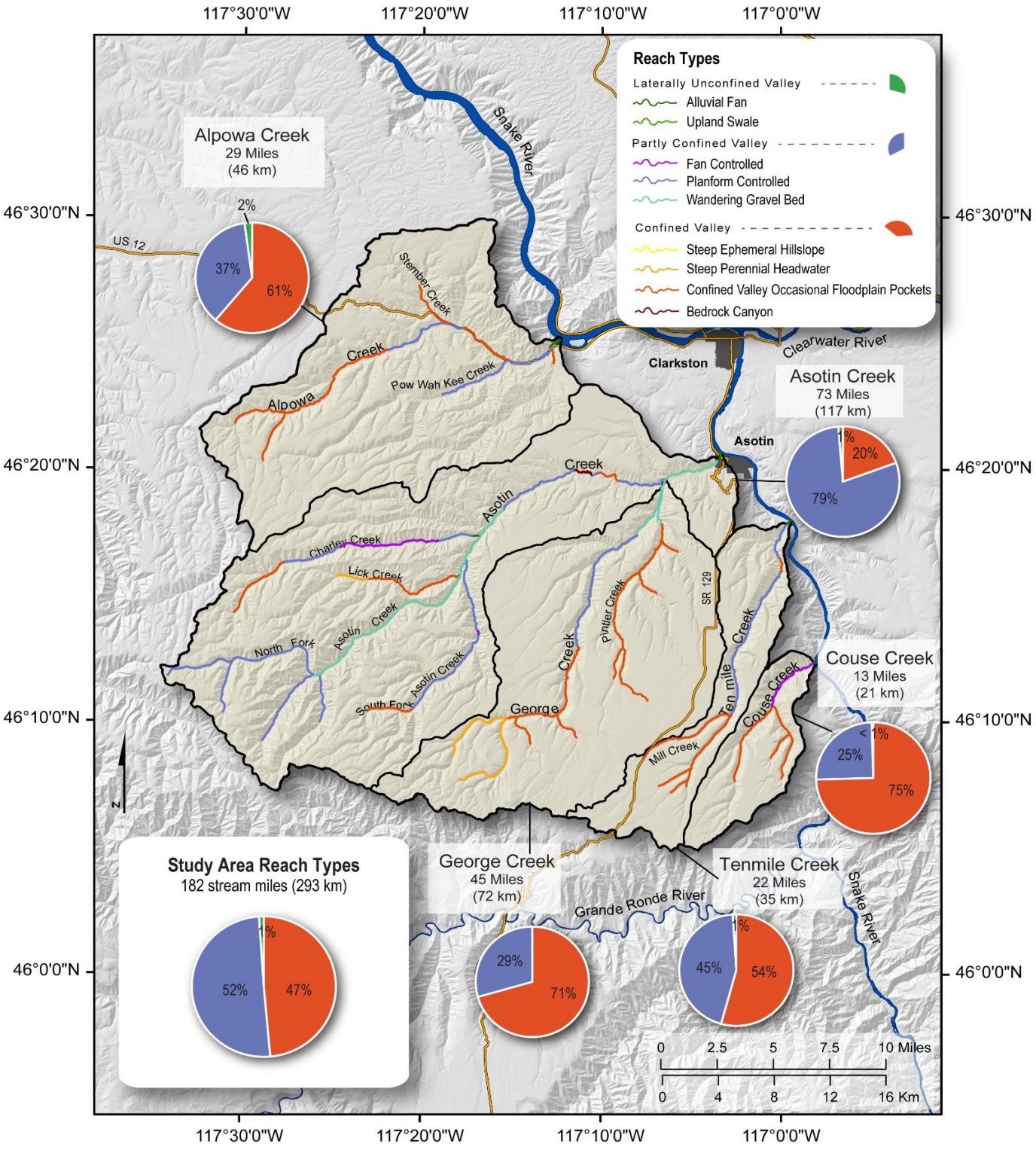
Appendix A. 1. Current hydrologic regime based on Liermann et al. (2012).



Appendix A. 2. Fish distribution along the perennial network based on Streamnet.org data downloaded in October 2017.



Appendix A. 3. Landscape units within the study area based on geology, soils, and ecoregions.

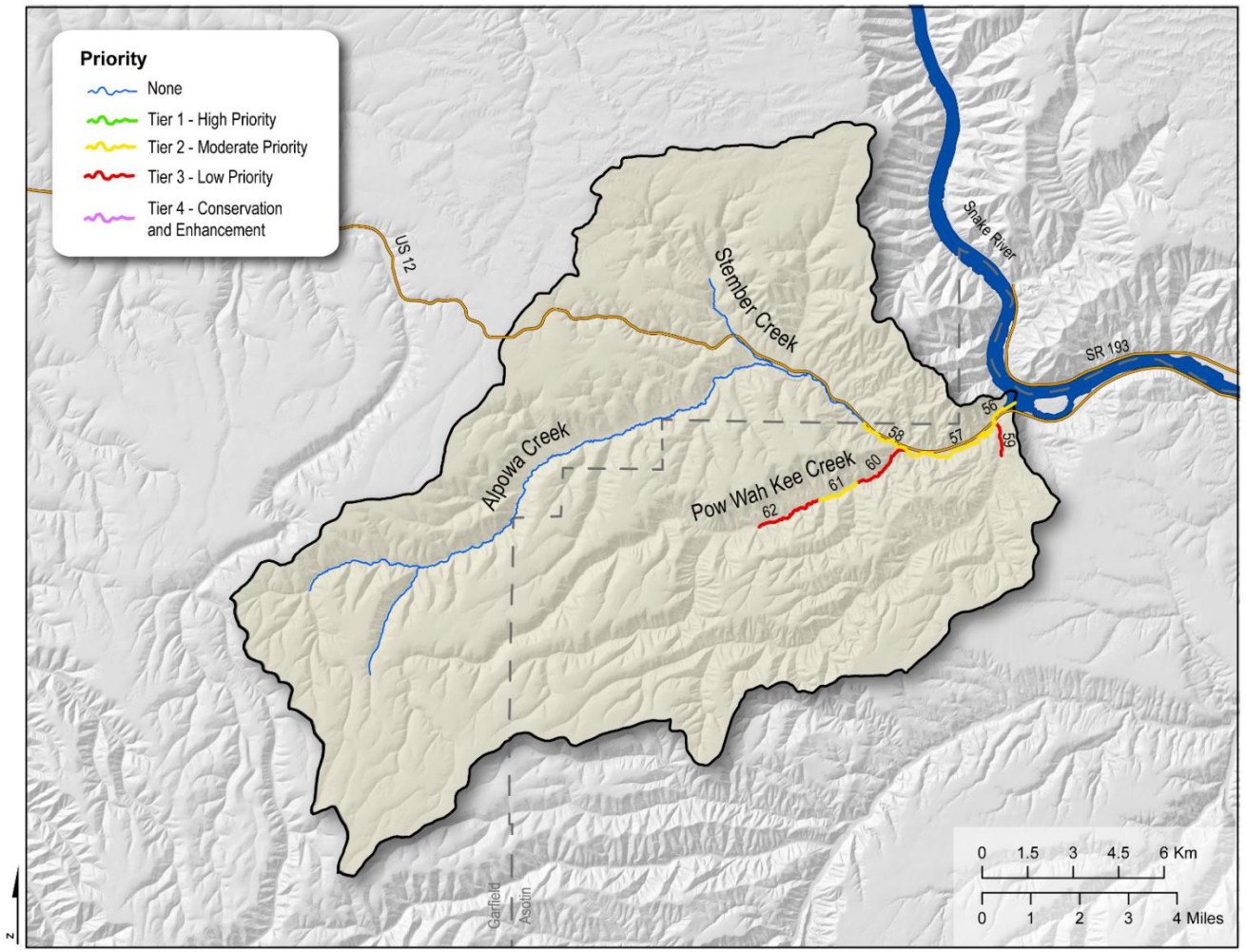


Appendix A. 4. Reach types based on valley setting, gradient, and geomorphic unit assemblage.

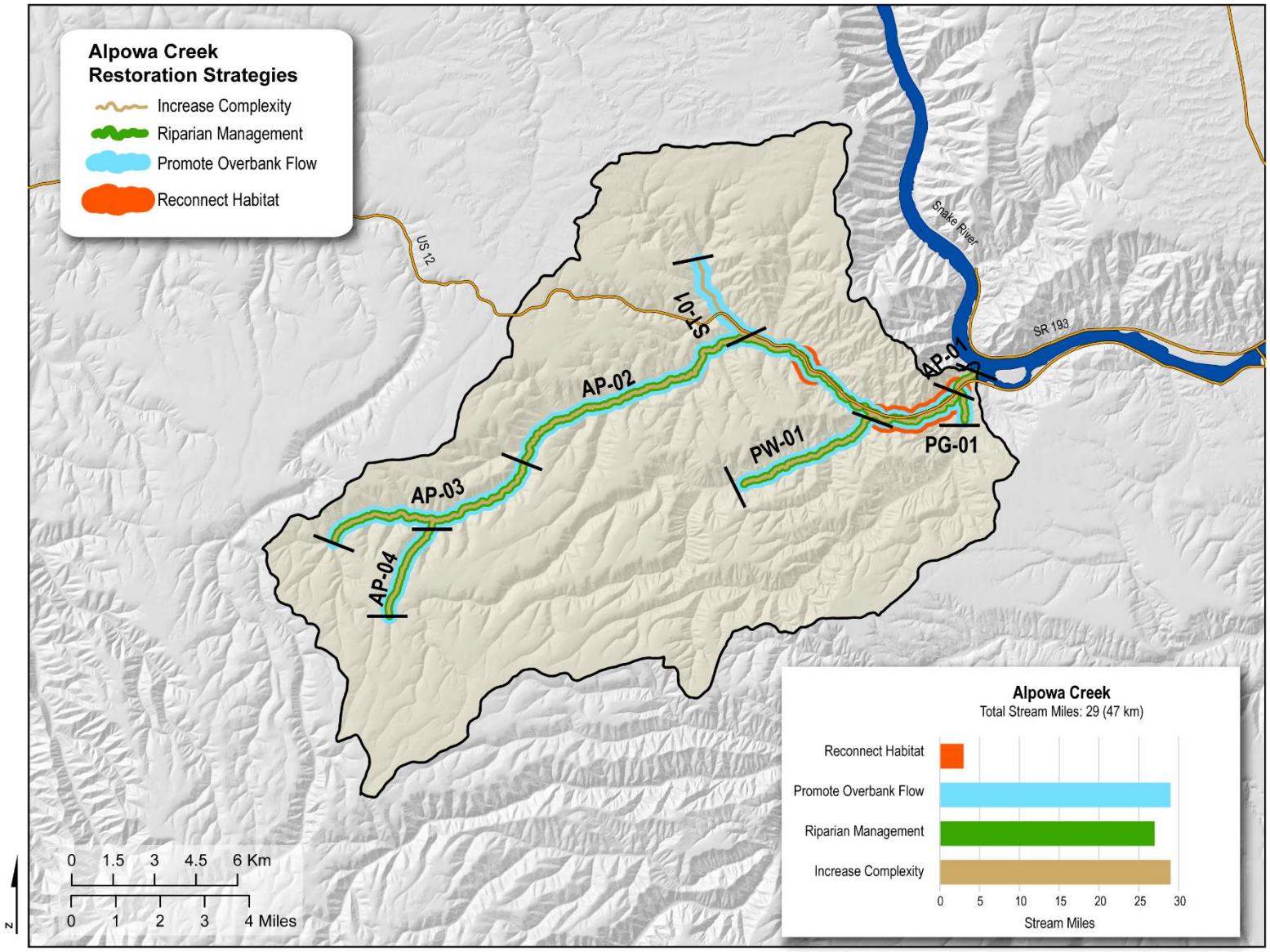
APPENDIX B. LOCATION OF PROJECT AREAS AND RESTORATION PRIORITY BY WATERSHED

Appendix B. 1. Location of Alpowa Creek Project Areas, Restoration Priority (a), and Restoration Reaches (b). See Table 10 and Appendix G for project summaries. Numbers refer to approximate location of Project Areas.

a)

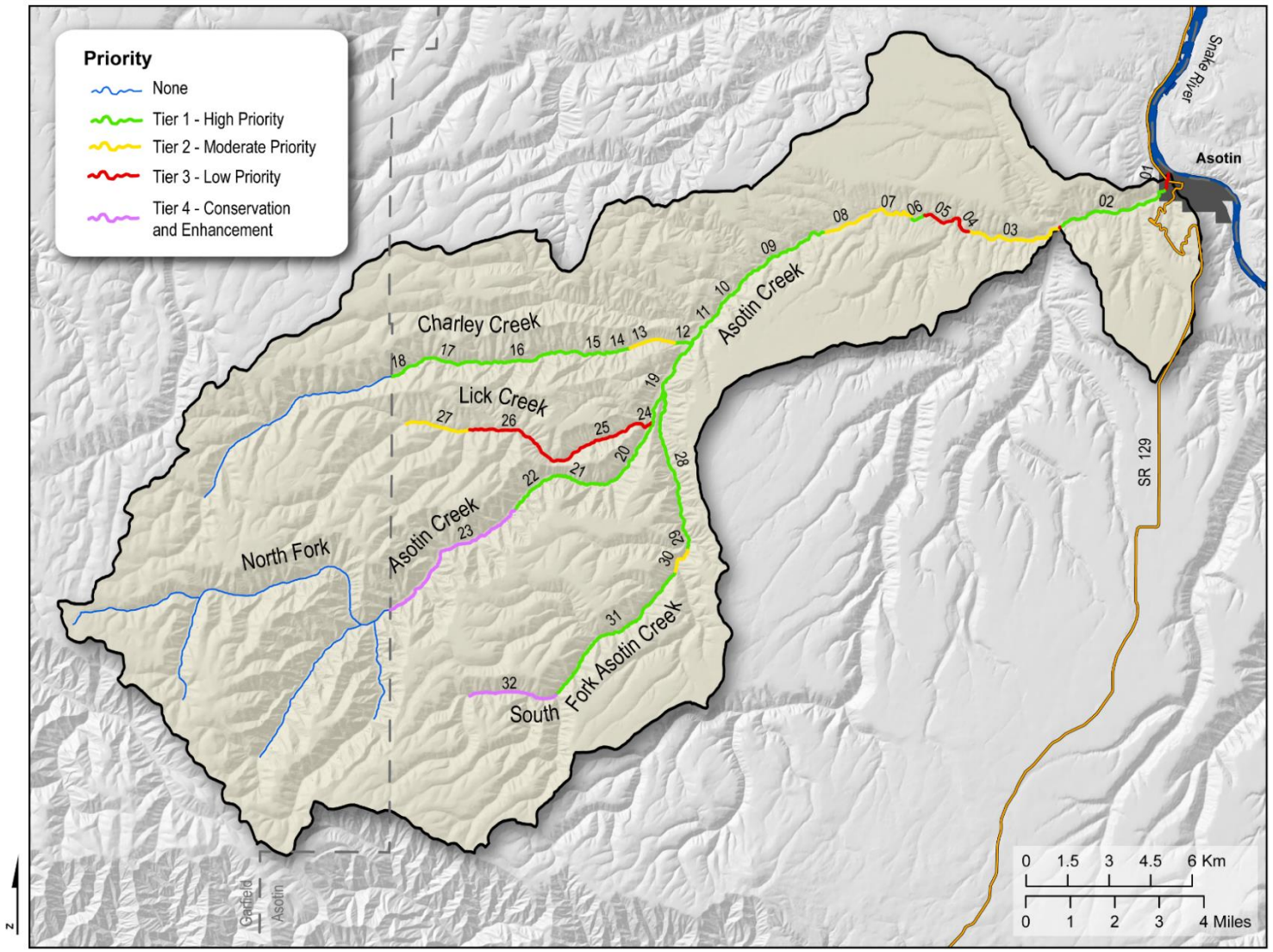


b)

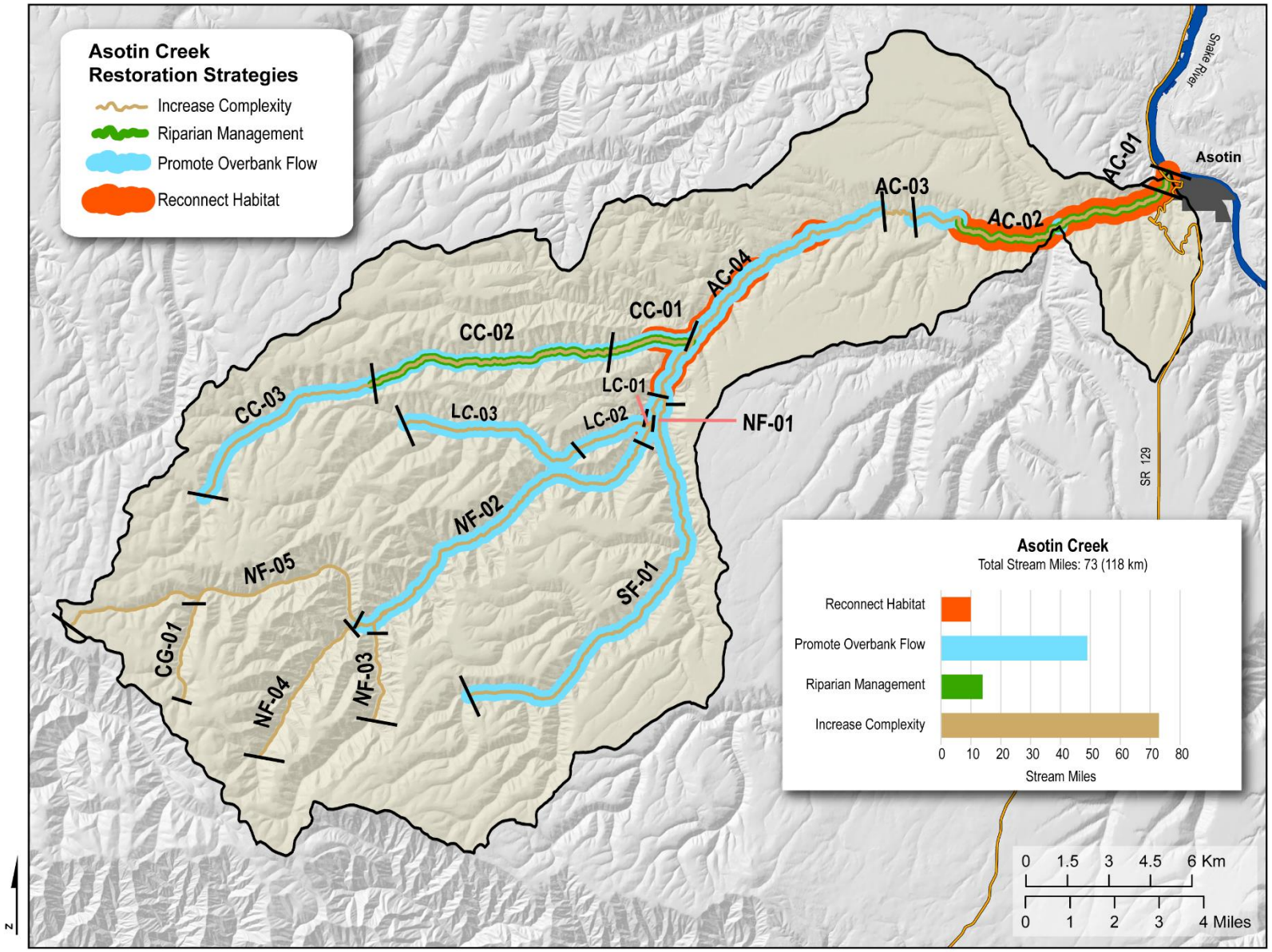

Alpowa Creek
Restoration Strategies
Increase Complexity
Riparian Management
Promote Overbank Flow
Reconnect Habitat
US 12
Snake River
SR 193
ST-01
AP-01
AP-02
AP-03
AP-04
PW-01
PG-01
0 1.5 3 4.5 6 Km
0 1 2 3 4 Miles
N
Alpowa Creek
Total Stream Miles: 29 (47 km)
Reconnect Habitat
Promote Overbank Flow
Riparian Management
Increase Complexity
0 5 10 15 20 25 30
Stream Miles

Appendix B. 2. Location of Asotin Creek Project Areas, Restoration Priority (a), and Restoration Reaches (b). See Table 10 and Appendix G for project summaries. Numbers refer to approximate location of Project Areas.

a)

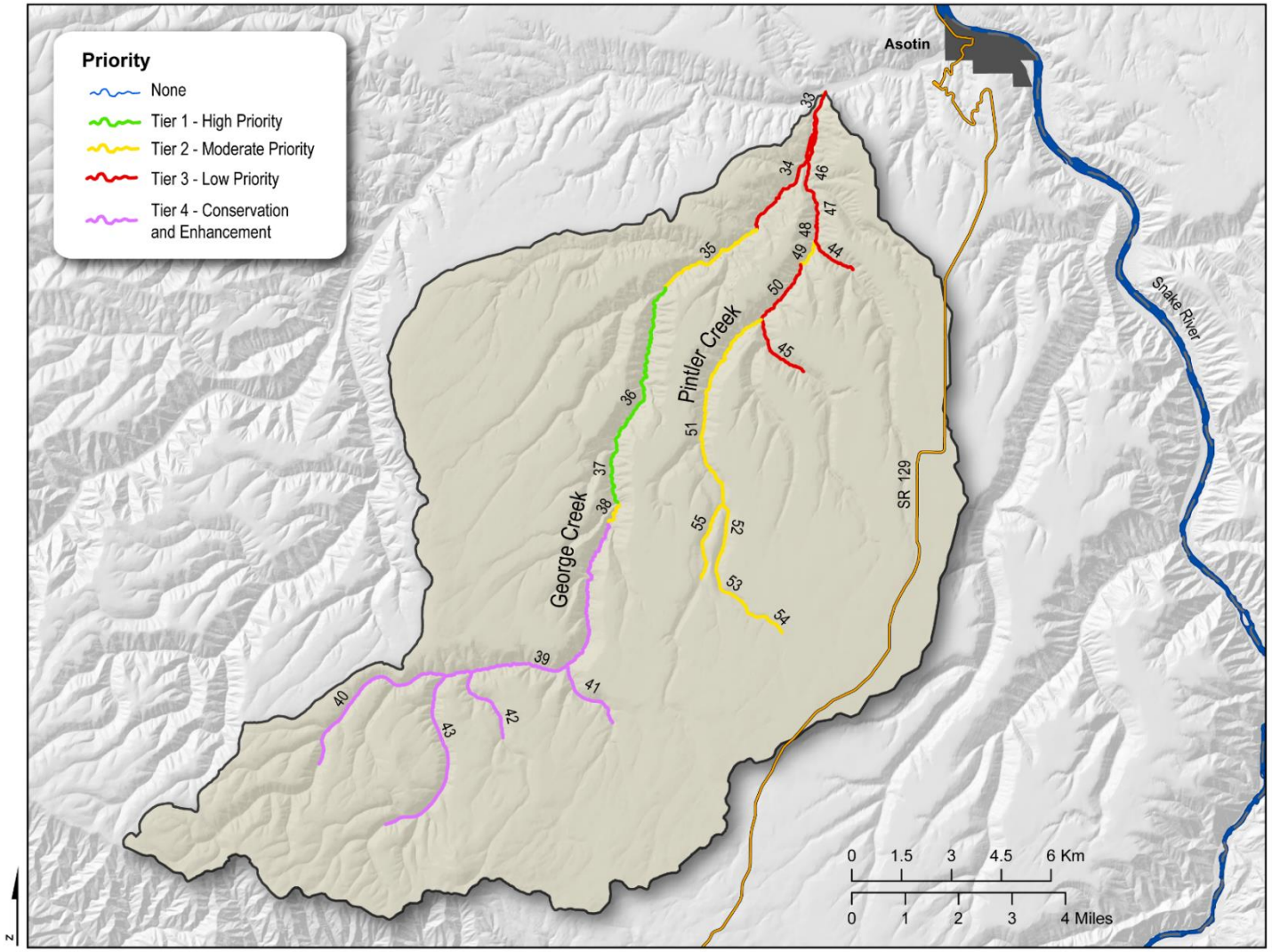


b)

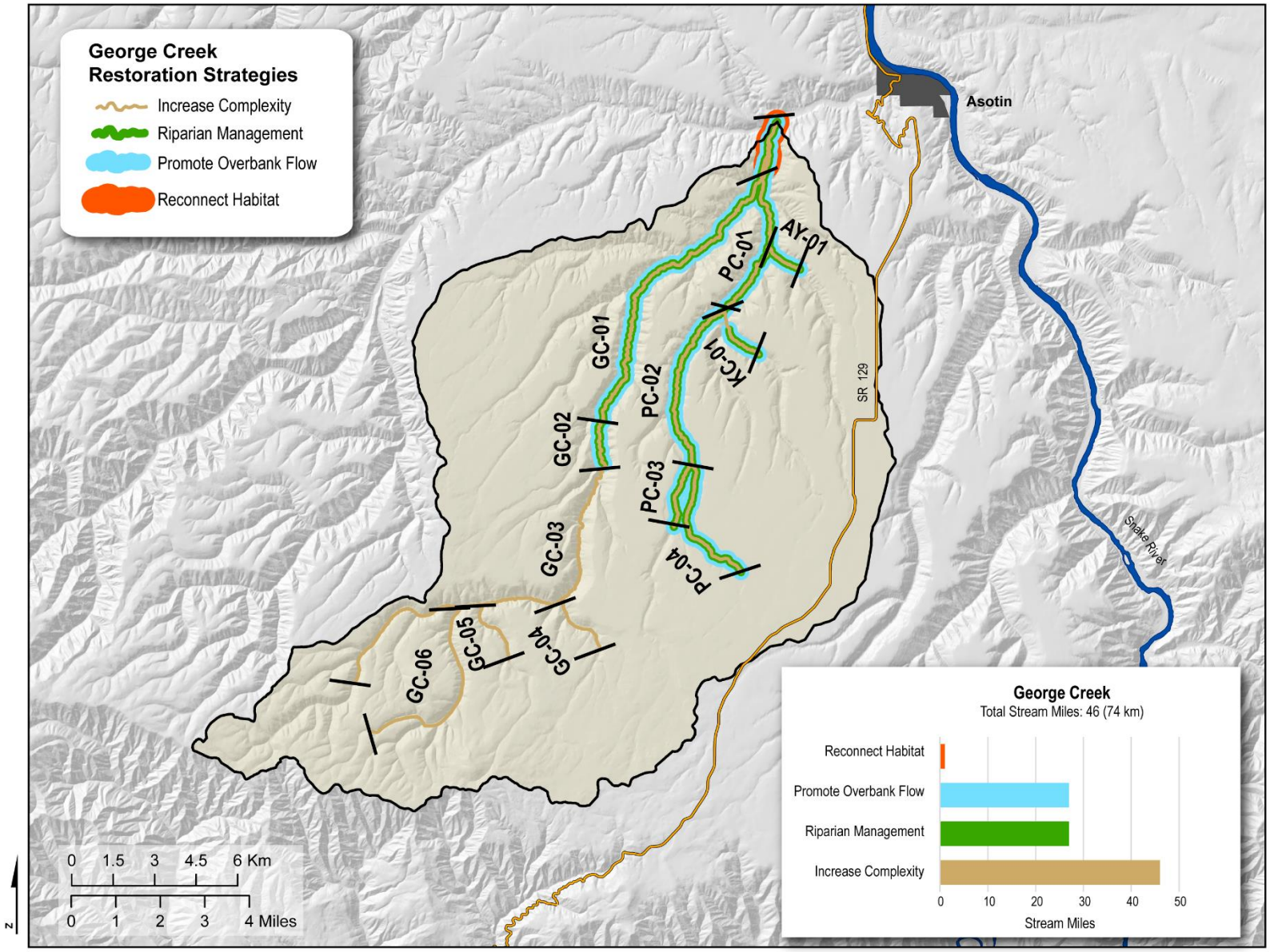

Asotin Creek
Restoration Strategies
Increase Complexity
Riparian Management
Promote Overbank Flow
Reconnect Habitat
Snake River
Asotin
AC-01
AC-02
AC-03
AC-04
CC-01
CC-02
CC-03
LC-01
LC-02
LC-03
NF-01
NF-02
NF-03
NF-04
NF-05
SF-01
CG-01
SR 129
Asotin Creek
Total Stream Miles: 73 (118 km)
Reconnect Habitat
Promote Overbank Flow
Riparian Management
Increase Complexity
0 10 20 30 40 50 60 70 80
Stream Miles
0 1.5 3 4.5 6 Km
0 1 2 3 4 Miles
N

Appendix B. 3. Location of George Creek Project Areas, Restoration Priority (a), and Restoration Reaches (b). See Table 10 and Appendix G for project summaries. Numbers refer to approximate location of Project Areas.

a)

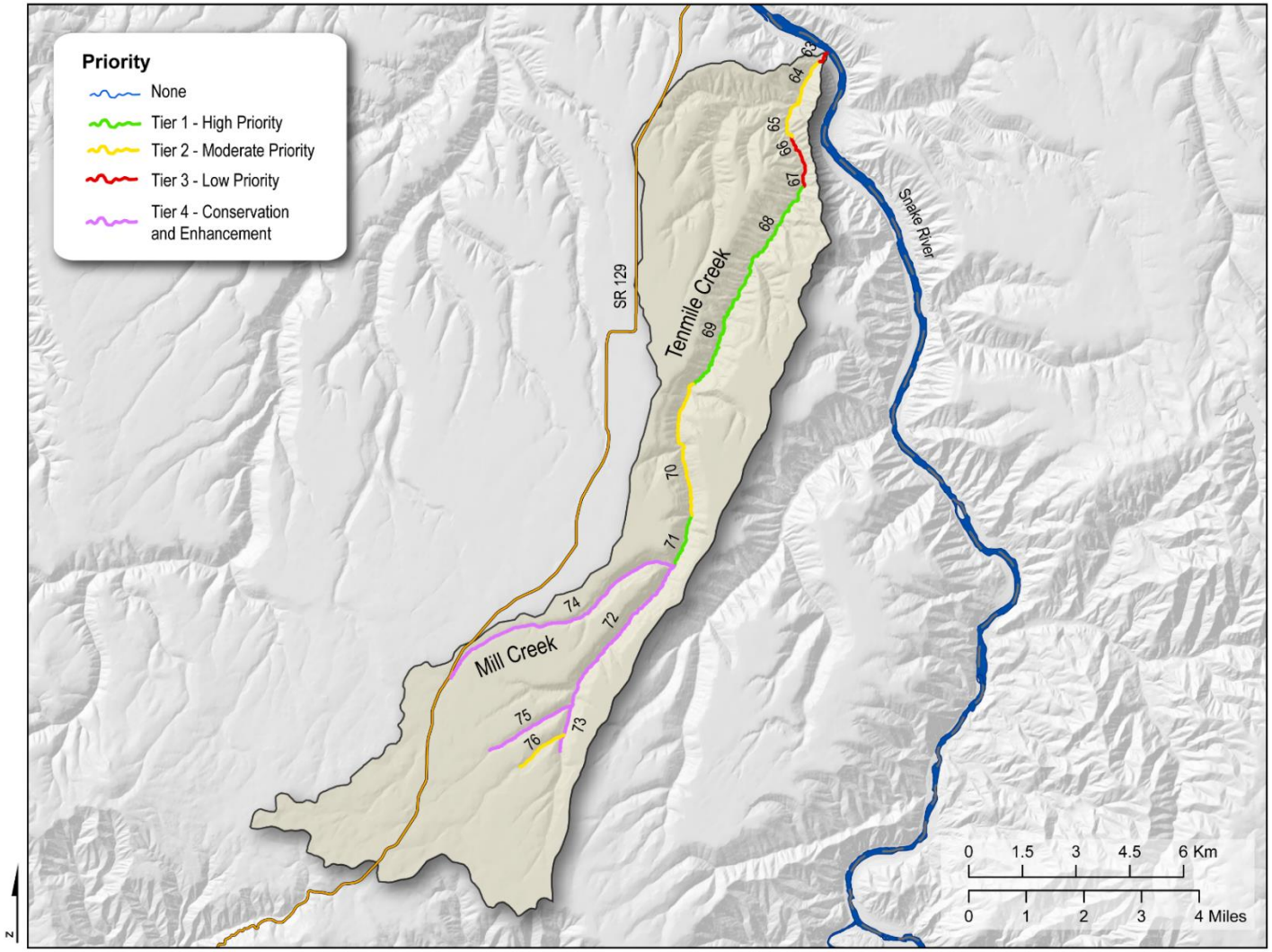


b)

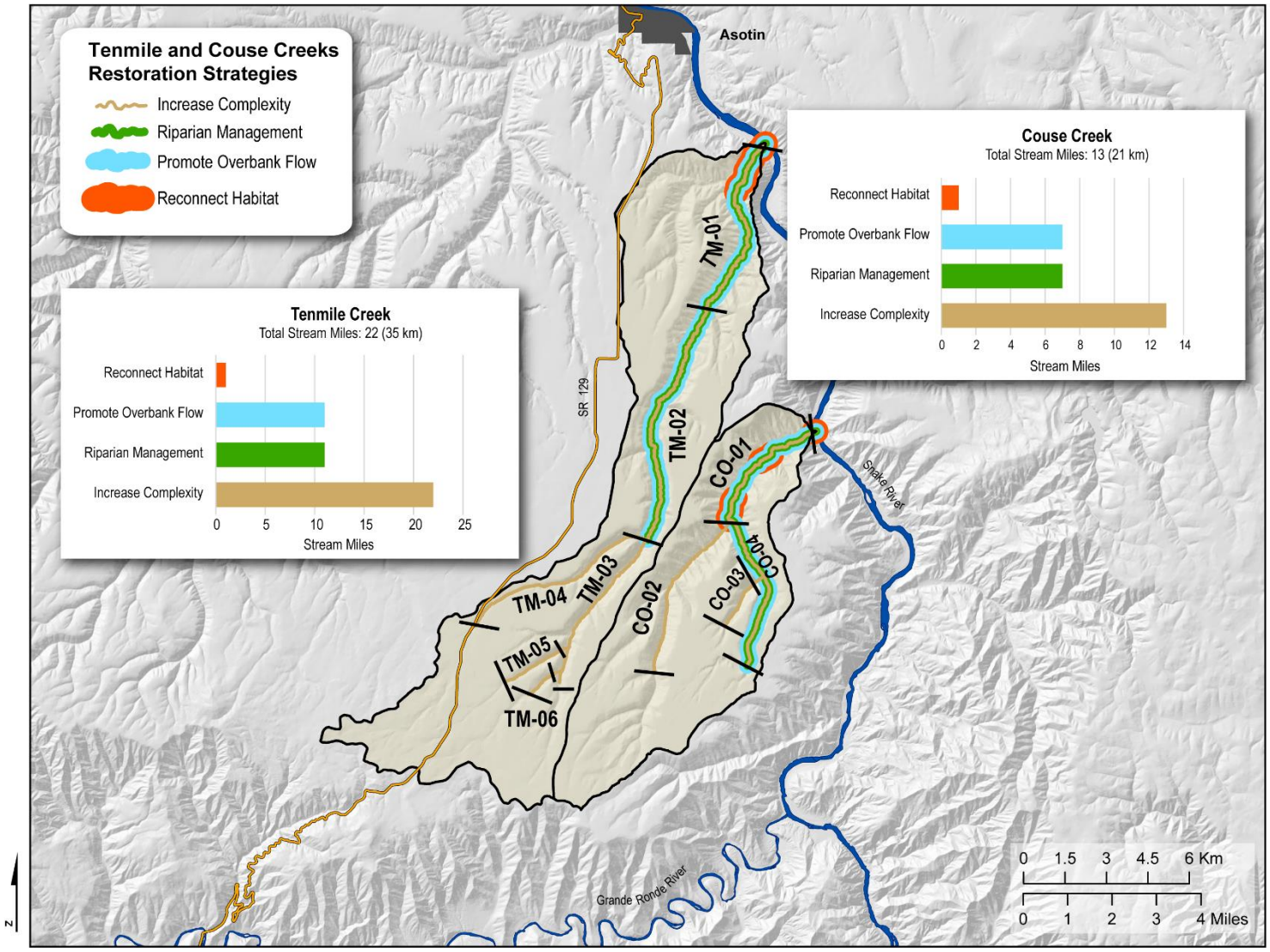

George Creek
Restoration Strategies
Increase Complexity
Riparian Management
Promote Overbank Flow
Reconnect Habitat
Asotin
SR 129
Snake River
AY-01
PC-01
KC-01
GC-01
PC-02
GC-02
PC-03
GC-03
PC-04
GC-04
GC-05
GC-06
0 1.5 3 4.5 6 Km
0 1 2 3 4 Miles
N
George Creek
Total Stream Miles: 46 (74 km)
Reconnect Habitat
Promote Overbank Flow
Riparian Management
Increase Complexity
0 10 20 30 40 50
Stream Miles

Appendix B. 4. Location of Tenmile Creek Project Areas, Restoration Priority (a), and Restoration Reaches (b). See Table 10 and Appendix G for project summaries. Numbers refer to approximate location of Project Areas.

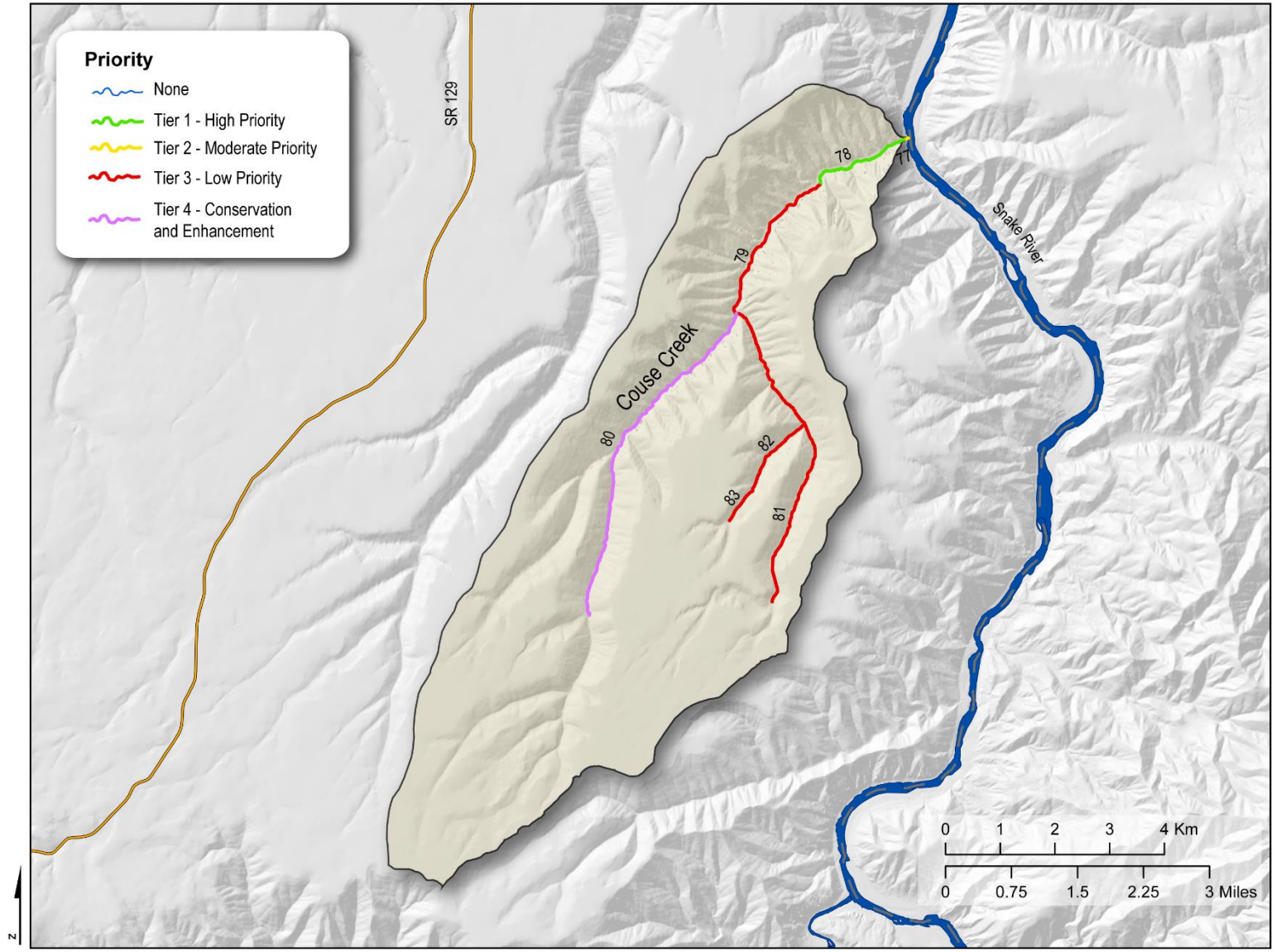
a)



b)


Tenmile and Couse Creeks
Restoration Strategies
Increase Complexity
Riparian Management
Promote Overbank Flow
Reconnect Habitat
Tenmile Creek
Total Stream Miles: 22 (35 km)
Reconnect Habitat
Promote Overbank Flow
Riparian Management
Increase Complexity
0 5 10 15 20 25
Stream Miles
Couse Creek
Total Stream Miles: 13 (21 km)
Reconnect Habitat
Promote Overbank Flow
Riparian Management
Increase Complexity
0 2 4 6 8 10 12 14
Stream Miles
Asotin
SR 129
TM-01
TM-02
TM-03
TM-04
TM-05
TM-06
CO-01
CO-02
CO-03
CO-04
Snake River
Grande Ronde River
N
0 1.5 3 4.5 6 Km
0 1 2 3 4 Miles

Appendix B. 5. Location of Couse Creek Project Areas, Restoration Priority, and Restoration Reaches. See Table 10, Appendix G for project summaries, and Appendix B. 5. b) for restoration reach locations. Numbers refer to approximate location of Project Areas.



APPENDIX C. CONCEPTUAL DESIGN MAPS FOR TIER 1 PROJECT AREAS

Appendix C. 1. Conceptual design maps for Tier 1 Project Areas (Separate attachment).

APPENDIX D. CONCEPTUAL DESIGN MAPS FOR TIER 2 PROJECT AREAS

Appendix D. 1. Conceptual design maps for Tier 2 Project Areas (Separate attachment).

APPENDIX E. CONCEPTUAL DESIGN MAPS FOR TIER 3 PROJECT AREAS

Appendix E. 1. Conceptual design maps for Tier 3 Project Areas (Separate attachment).

APPENDIX F. CONCEPTUAL DESIGN MAPS FOR TIER 4 PROJECT AREAS

Appendix F. 1. Conceptual design maps for Tier 4 Project Areas (Separate attachment).

APPENDIX G. TIER 2-4 PROJECT AREA SUMMARIES

Appendix G. 1. Tier 2 Project Areas and summary of location, geomorphic function, limiting factors, and fish distribution and use.

Location							Project Area Info				Limiting Factors							Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Project Area	Restoration Reach	RM Start	RM End	Length (mi)	Stream	Landownership	Reach Type	Geomorphic Function	Recovery Potential	Restoraiton Strategies	Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding
02	AC_02	0.4	3.2	2.8	Asotin	Private	WGB_DF	Limited	Low	REC, RIP, INS			X		X	X																	
06	AC_02	7.0	7.4	0.4	Asotin	Private	PC_DF	Moderate	Moderate	OVB, INS			X	X	X	X																	
09	AC_04	9.9	12.6	2.7	Asotin	Private	PC_DF	Moderate	Moderate	REC, OVB, INS			X			X																	
10	AC_04	12.6	13.0	0.4	Asotin	State/Private	WGB_DF	High	High	OVB, INS						X																	
11	AC_04	13.0	15.7	2.7	Asotin	State/Private	WGB_DF	Moderate	High	REC, OVB, INS			X			X																	
12	CC_01	0.0	0.6	0.6	Charley	Private	AF	Moderate	High	REC, OVB, RIP, INS			X			X																	
14	CC_01	1.9	2.4	0.5	Charley	State	PC_DF	Moderate	High	OVB, RIP, INS			X			X																	
15	CC_02	2.4	3.1	0.7	Charley	State	FC_DF	Moderate	High	OVB, RIP, INS			X			X																	
16	CC_02	3.1	5.5	2.4	Charley	State	FC_DF	Limited	High	OVB, RIP, INS	X		X			X																	
17	CC_02	5.5	7.7	2.2	Charley	State	FC_DF	Moderate	High	OVB, RIP, INS			X			X																	
18	CC_02	7.7	8.4	0.7	Charley	State/Federal	PC_DF	Moderate	High	OVB, RIP, INS			X			X																	
19	NF_01	0.0	0.9	0.9	North Fork	State	WGB_DF	Moderate	High	OVB, INS			X			X																	
20	NF_02	0.9	3.3	2.4	North Fork	State	WGB_DF	Moderate	High	OVB, INS			X			X																	
21	NF_02	3.3	4.7	1.4	North Fork	State	WGB_DF	High	High	OVB, INS						X																	
22	NF_02	4.7	5.8	1.1	North Fork	State/Federal	WGB_DF	Moderate	High	OVB, INS			X			X																	
28	SF_01	0.0	3.9	3.9	South Fork	State	PC_DF	Moderate	High	OVB, INS			X		X	X																	
29	SF_01	3.9	4.3	0.4	South Fork	State	FC_DF	Moderate	High	OVB, INS			X		X	X																	
31	SF_01	4.9	9.2	4.3	South Fork	State/Federal	PC_DF	Moderate	High	OVB, INS			X			X																	
36	GC_01	6.0	9.7	3.7	George	State/Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																	
37	GC_02	9.7	10.9	1.2	George	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																	
68	TM_01	3.1	4.8	1.7	Tenmile	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X	X	X	X																	
69	TM_02	4.8	7.6	2.8	Tenmile	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																	
71	TM_02	10.3	11.4	1.1	Tenmile	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																	
78	CO_01	0.1	1.4	1.3	Couse	Private	FC_DF	Moderate	Moderate	REC, OVB, RIP, INS		X	X	X	X	X																	

Appendix G. 2. Tier 3 Project Areas and summary of location, geomorphic function, limiting factors, and fish distribution and use.

Location							Project Area Info				Limiting Factors							Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Project Area	Restoration Reach	RM Start	RM End	Length (mi)	Watershed	Landownership	Reach Type	Geomorphic Function	Recovery PotentiaLow	Restoraiton Strategies	Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding
01	AC_01	0.0	0.4	0.4	Asotin	Private	AF	Limited	Low	REC, RIP, INS			X		X	X																	
04	AC_02	5.6	6.0	0.4	Asotin	Private	COFP	Limited	Moderate	REC, RIP, INS			X		X	X																	
05	AC_02	6.0	7.0	1.0	Asotin	Private	COFP	Moderate	Moderate	OVB, INS			X		X	X																	
24	LC_01	0.0	0.2	0.2	Lick	State	AF	Limited	High	REC, OVB, INS		X	X		X	X																	
25	LC_02	0.2	2.0	1.8	Lick	State	COFP	Limited	High	OVB, INS	X	X	X		X	X																	
26	LC_03	2.0	4.8	2.8	Lick	State	COFP	Limited	High	OVB, INS	X	X	X		X	X																	
33	GC_01	0.0	0.5	0.5	George	Private	WGB_DF	Limited	Low	REC, OVB, RIP, INS		X	X	X	X	X																	
34	GC_01	0.5	3.5	3.0	George	State/Private	WGB_DF	Limited	Low	REC, OVB, RIP, INS		X	X	X	X	X																	
44	AY_01	0.0	0.9	0.9	Ayers	State	COFP	Moderate	High	OVB, RIP, INS		X	X			X																	
45	KC_01	0.0	1.4	1.4	Kelly	State	COFP	Moderate	High	OVB, RIP, INS		X	X			X																	
46	PC_01	0.0	0.8	0.8	Pintler	State/Private	WGB_DF	Limited	Low	OVB, RIP, INS		X	X	X	X	X																	
47	PC_01	0.8	1.4	0.6	Pintler	State	COFP	Moderate	Low	OVB, RIP, INS		X	X	X	X	X																	
48	PC_01	1.4	1.7	0.3	Pintler	State	COFP	Moderate	Moderate	OVB, RIP, INS		X	X	X	X	X																	
50	PC_01	2.3	3.6	1.3	Pintler	State	COFP	Limited	High	OVB, RIP, INS		X	X	X	X	X																	
59	PG_01	0.0	0.7	0.7	Page	Private	COFP	Limited	Moderate	OVB, RIP, INS		X	X		X	X																	
60	PW_01	0.0	1.4	1.4	PowWahKee	Private	PC_DF	Limited	Moderate	OVB, RIP, INS		X	X		X	X																	
62	PW_01	2.3	3.9	1.6	Pow Wah Kee	Private	PC_DF	Limited	Moderate	OVB, RIP, INS		X	X		X	X																	
63	TM_01	0.0	0.3	0.3	Tenmile	Private	AF	Limited	Low	REC, OVB, RIP, INS		X	X	X	X	X	X																
66	TM_01	1.9	2.3	0.4	Tenmile	Private	PC_DF	Limited	Moderate	OVB, RIP, INS		X	X	X	X	X																	
67	TM_01	2.3	3.1	0.8	Tenmile	Private	COFP	Moderate	Moderate	OVB, RIP, INS		X	X	X	X	X																	
79	CO_01	1.4	3.5	2.1	Couse	Private	FC_DF	Limited	Moderate	REC, OVB, RIP, INS		X	X	X	X	X																	
81	CO_04	0.0	3.7	3.7	Couse Trib	Private	COFP	Moderate	Moderate	OVB, RIP, INS			X			X																	
82	CO_03	0.0	0.9	0.9	Couse Trib	Private	COFP	Moderate	High	INS			X			X																	
83	CO_03	0.9	1.5	0.6	Couse Trib	Private	COFP	Limited	High	INS			X			X																	

Appendix G. 3.Tier 4 Project Areas and summary of location, geomorphic function, limiting factors, and fish distribution and use.

Location							Project Area Info				Limiting Factors							Spring Chinook				Fall Chinook				Steelhead				Bull Trout			
Project Area	Restoration Reach	RM Start	RM End	Length (mi)	Watershed	Landownership	Reach Type	Geomorphic Function	Recovery Potential	Restoraiton Strategies	Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding
23	NF_02	5.8	10.2	4.4	North Fork	Federal	WGB_DF	High	High	OVB, INS						X																
32	SF_01	9.2	11.3	2.1	South Fork	Federal	COFP	High	High	OVB, INS						X																
39	GC_03	11.4	16.0	4.6	George	Private	COFP	High	High	INS						X																
40	GC_03	16.0	20.1	4.1	George	Private/Federal	CSH	High	High	INS						X																
41	GC_04	0.0	1.6	1.6	George Trib	Private	COFP	High	High	INS						X																
42	GC_05	0.0	1.6	1.6	George Trib	Private	COFP	High	High	INS						X																
43	GC_06	0.0	4.7	4.7	George Trib	Private/Federal	CSH	High	High	INS						X																
72	TM_03	11.4	14.6	3.2	Tenmile	Private	COFP	High	High	INS						X																
73	TM_03	14.6	15.5	0.9	Tenmile	Private	COFP	High	High	INS						X																
74	TM_04	0.0	4.7	4.7	Mill Creek	Private	COFP	High	High	INS						X																
75	TM_05	0.0	1.7	1.7	Tenmile Trib	Private	COFP	High	High	INS						X																
80	CO_02	3.5	8.2	4.7	Couse	Private	COFP	High	High	INS						X																

Appendix G. 4. Summary of all Project Areas (in order): location, geomorphic function, limiting factors, and fish distribution and use.

Location							Project Area Info				Limiting Factors						Spring Chinook				Fall Chinook				Steelhead				Bull Trout				
Project Area	Restoration Reach	RM Start	RM End	Length (mi)	Stream	Landownership	Reach Type	Geomorphic Function	Recovery Potential	Restoraiton Strategies	Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Restoration Priority
01	AC_01	0.0	0.4	0.4	Asotin	Private	AF	Limited	Low	REC, RIP, INS			X		X	X																	3
02	AC_02	0.4	3.2	2.8	Asotin	Private	WGB_DF	Limited	Low	REC, RIP, INS			X		X	X																	1
03	AC_02	3.2	5.6	2.4	Asotin	Private	PC_DF	Limited	Moderate	REC, RIP, INS			X		X	X																	2
04	AC_02	5.6	6.0	0.4	Asotin	Private	COFP	Limited	Moderate	REC, RIP, INS			X		X	X																	3
05	AC_02	6.0	7.0	1.0	Asotin	Private	COFP	Moderate	Moderate	OVB, INS			X		X	X																	3
06	AC_02	7.0	7.4	0.4	Asotin	Private	PC_DF	Moderate	Moderate	OVB, INS			X	X	X	X																	1
07	AC_03	7.4	8.4	1.0	Asotin	Private	BC	Moderate	Moderate	INS			X			X																	2
08	AC_04	8.4	9.9	1.5	Asotin	Private	PC_DF	Limited	Moderate	OVB, INS			X			X																	2
09	AC_04	9.9	12.6	2.7	Asotin	Private	PC_DF	Moderate	Moderate	REC, OVB, INS			X			X																	1
10	AC_04	12.6	13.0	0.4	Asotin	State/Privat	WGB_DF	High	High	OVB, INS						X																	1
11	AC_04	13.0	15.7	2.7	Asotin	State/Privat	WGB_DF	Moderate	High	REC, OVB, INS			X			X																	1
12	CC_01	0.0	0.6	0.6	Charley	Private	AF	Moderate	High	REC, OVB, RIP, INS			X			X																	1
13	CC_01	0.6	1.9	1.3	Charley	State	PC_DF	Limited	High	REC, OVB, RIP, INS			X			X																	2
14	CC_01	1.9	2.4	0.5	Charley	State	PC_DF	Moderate	High	OVB, RIP, INS			X			X																	1
15	CC_02	2.4	3.1	0.7	Charley	State	FC_DF	Moderate	High	OVB, RIP, INS			X			X																	1
16	CC_02	3.1	5.5	2.4	Charley	State	FC_DF	Limited	High	OVB, RIP, INS	X		X			X																	1
17	CC_02	5.5	7.7	2.2	Charley	State	FC_DF	Moderate	High	OVB, RIP, INS			X			X																	1
18	CC_02	7.7	8.4	0.7	Charley	State/Federa	PC_DF	Moderate	High	OVB, RIP, INS			X			X																	1
19	NF_01	0.0	0.9	0.9	North Fork	State	WGB_DF	Moderate	High	OVB, INS			X			X																	1
20	NF_02	0.9	3.3	2.4	North Fork	State	WGB_DF	Moderate	High	OVB, INS			X			X																	1
21	NF_02	3.3	4.7	1.4	North Fork	State	WGB_DF	High	High	OVB, INS						X																	1
22	NF_02	4.7	5.8	1.1	North Fork	State/Federa	WGB_DF	Moderate	High	OVB, INS			X			X																	1
23	NF_02	5.8	10.2	4.4	North Fork	Federal	WGB_DF	High	High	OVB, INS						X																	4

Location							Project Area Info				Limiting Factors						Spring Chinook				Fall Chinook				Steelhead				Bull Trout				
Project Area	Restoration Reach	RM Start	RM End	Length (mi)	Stream	Landownership	Reach Type	Geomorphic Function	Recovery Potential	Restoraiton Strategies	Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Restoration Priority
24	LC_01	0.0	0.2	0.2	Lick	State	AF	Limited	High	REC, OVB, INS		X	X		X	X																		3
25	LC_02	0.2	2.0	1.8	Lick	State	COFP	Limited	High	OVB, INS	X	X	X		X	X																			3
26	LC_03	2.0	4.8	2.8	Lick	State	COFP	Limited	High	OVB, INS	X	X	X		X	X																			3
27	LC_03	4.8	6.4	1.6	Lick	State/Federa	CSH	Moderate	High	OVB, INS		X	X		X	X																			2
28	SF_01	0.0	3.9	3.9	South Fork	State	PC_DF	Moderate	High	OVB, INS			X		X	X																			1
29	SF_01	3.9	4.3	0.4	South Fork	State	FC_DF	Moderate	High	OVB, INS			X		X	X																			1
30	SF_01	4.3	4.9	0.6	South Fork	State	PC_DF	Limited	High	OVB, INS			X			X																			2
31	SF_01	4.9	9.2	4.3	South Fork	State/Federa	PC_DF	Moderate	High	OVB, INS			X			X																			1
32	SF_01	9.2	11.3	2.1	South Fork	Federal	COFP	High	High	OVB, INS						X																			4
33	GC_01	0.0	0.5	0.5	George	Private	WGB_DF	Limited	Low	REC, OVB, RIP, INS		X	X	X	X	X																			3
34	GC_01	0.5	3.5	3.0	George	State/Privat	WGB_DF	Limited	Low	REC, OVB, RIP, INS		X	X	X	X	X																			3
35	GC_01	3.5	6.0	2.5	George	State	PC_DF	Moderate	Moderate	OVB, RIP, INS		X	X	X	X	X																			2
36	GC_01	6.0	9.7	3.7	George	State/Privat	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																			1
37	GC_02	9.7	10.9	1.2	George	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																			1
38	GC_03	10.9	11.4	0.5	George	Private	COFP	Moderate	High	INS		X	X			X																			2
39	GC_03	11.4	16.0	4.6	George	Private	COFP	High	High	INS						X																			4
40	GC_03	16.0	20.1	4.1	George	Private/Fede	CSH	High	High	INS						X																			4
41	GC_04	0.0	1.6	1.6	George Trib	Private	COFP	High	High	INS						X																			4
42	GC_05	0.0	1.6	1.6	George Trib	Private	COFP	High	High	INS						X																			4
43	GC_06	0.0	4.7	4.7	George Trib	Private/Fede	CSH	High	High	INS						X																			4

Appendix G.4 Continued

Location							Project Area Info				Limiting Factors							Spring Chinook				Fall Chinook				Steelhead				Bull Trout				
Project Area	Restoration Reach	RM Start	RM End	Length (mi)	Stream	Landownership	Reach Type	Geomorphic Function	Recovery Potential	Restoraiton Strategies	Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Restoration Priority
44	AY_01	0.0	0.9	0.9	Ayers	State	COFP	Moderate	High	OVB, RIP, INS		X	X			X																		3
45	KC_01	0.0	1.4	1.4	Kelly	State	COFP	Moderate	High	OVB, RIP, INS		X	X			X																				3
46	PC_01	0.0	0.8	0.8	Pintler	State/Privat	WGB_DF	Limited	Low	OVB, RIP, INS		X	X	X	X	X																				3
47	PC_01	0.8	1.4	0.6	Pintler	State	COFP	Moderate	Low	OVB, RIP, INS		X	X	X	X	X																				3
48	PC_01	1.4	1.7	0.3	Pintler	State	COFP	Moderate	Moderate	OVB, RIP, INS		X	X	X	X	X																				3
49	PC_01	1.7	2.3	0.6	Pintler	State	COFP	Moderate	High	OVB, RIP, INS		X	X	X	X	X																				2
50	PC_01	2.3	3.6	1.3	Pintler	State	COFP	Limited	High	OVB, RIP, INS		X	X	X	X	X																				3
51	PC_02	3.6	7.9	4.3	Pintler	State	COFP	Moderate	High	OVB, RIP, INS		X	X	X	X	X																				2
52	PC_04	0.0	0.8	0.8	Pintler Trib	Private	COFP	Moderate	High	OVB, RIP, INS		X	X			X																				2
53	PC_04	0.8	2.2	1.4	Pintler Trib	Private	COFP	Moderate	High	OVB, RIP, INS		X	X			X																				2
54	PC_04	2.2	3.2	1.0	Pintler Trib	Private	COFP	Limited	High	OVB, RIP, INS		X	X			X																				2
55	PC_03	7.9	9.5	1.6	Pintler	Private	COFP	Moderate	High	OVB, RIP, INS			X			X																				2
56	AP_01	0.0	0.7	0.7	Alpowa	Private	AF	Moderate	High	RIP, INS			X	X		X																				2
57	AP_02	0.7	3.0	2.3	Alpowa	Private	PC_DF	Limited	Moderate	REC, OVB, RIP, INS			X	X		X																				2
58	AP_02	3.0	4.1	1.1	Alpowa	Private	COFP	Limited	Moderate	REC, OVB, RIP, INS			X			X																				2
59	PG_01	0.0	0.7	0.7	Page	Private	COFP	Limited	Moderate	OVB, RIP, INS		X	X		X	X																				3
60	PW_01	0.0	1.4	1.4	PowWahKee	Private	PC_DF	Limited	Moderate	OVB, RIP, INS		X	X		X	X																				3
61	PW_01	1.4	2.3	0.9	PowWahKee	Private	PC_DF	Moderate	Moderate	OVB, RIP, INS		X	X		X	X																				2
62	PW_01	2.3	3.9	1.6	Pow Wah Kee	Private	PC_DF	Limited	Moderate	OVB, RIP, INS		X	X		X	X																				3

Appendix G.4 Continued

Location							Project Area Info				Limiting Factors							Spring Chinook				Fall Chinook				Steelhead				Bull Trout				
Project Area	Restoration Reach	RM Start	RM End	Length (mi)	Stream	Landownership	Reach Type	Geomorphic Function	Recovery Potential	Restoraiton Strategies	Channel Stability	Flow	Habitat Diversity	Sediment Load	Temperature	Key Habitat Quantity	Obstructions	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Migration	Spawning	Rearing	Holding	Restoration Priority
63	TM_01	0.0	0.3	0.3	Tenmile	Private	AF	Limited	Low	REC, OVB, RIP, INS		X	X	X	X	X	X																3
64	TM_01	0.3	1.1	0.8	Tenmile	Private	PC_DF	Limited	Moderate	REC, OVB, RIP, INS		X	X	X	X	X																			2
65	TM_01	1.1	1.9	0.8	Tenmile	Private	PC_DF	Moderate	Moderate	REC, OVB, RIP, INS		X	X	X	X	X																			2
66	TM_01	1.9	2.3	0.4	Tenmile	Private	PC_DF	Limited	Moderate	OVB, RIP, INS		X	X	X	X	X																			3
67	TM_01	2.3	3.1	0.8	Tenmile	Private	COFP	Moderate	Moderate	OVB, RIP, INS		X	X	X	X	X																			3
68	TM_01	3.1	4.8	1.7	Tenmile	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X	X	X	X																			1
69	TM_02	4.8	7.6	2.8	Tenmile	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																			1
70	TM_02	7.6	10.3	2.7	Tenmile	Private	PC_DF	Limited	High	OVB, RIP, INS		X	X			X																			2
71	TM_02	10.3	11.4	1.1	Tenmile	Private	PC_DF	Moderate	High	OVB, RIP, INS		X	X		X	X																			1
72	TM_03	11.4	14.6	3.2	Tenmile	Private	COFP	High	High	INS						X																			4
73	TM_03	14.6	15.5	0.9	Tenmile	Private	COFP	High	High	INS						X																			4
74	TM_04	0.0	4.7	4.7	Mill Creek	Private	COFP	High	High	INS						X																			4
75	TM_05	0.0	1.7	1.7	Tenmile Trib	Private	COFP	High	High	INS						X																			4
76	TM_06	0.0	1.0	1.0	Tenmile	Private	COFP	Moderate	High	INS			X			X																			2
77	CO_01	0.0	0.1	0.1	Couse	Private	AF	Moderate	Moderate	REC, OVB, RIP, INS			X	X	X	X	X																			2
78	CO_01	0.1	1.4	1.3	Couse	Private	FC_DF	Moderate	Moderate	REC, OVB, RIP, INS		X	X	X	X	X																			1
79	CO_01	1.4	3.5	2.1	Couse	Private	FC_DF	Limited	Moderate	REC, OVB, RIP, INS		X	X	X	X	X																			3
80	CO_02	3.5	8.2	4.7	Couse	Private	COFP	High	High	INS						X																			4
81	CO_04	0.0	3.7	3.7	Couse Trib	Private	COFP	Moderate	Moderate	OVB, RIP, INS			X			X																			3
82	CO_03	0.0	0.9	0.9	Couse Trib	Private	COFP	Moderate	High	INS			X			X																			3
83	CO_03	0.9	1.5	0.6	Couse Trib	Private	COFP	Limited	High	INS			X			X																			3

Appendix G. LEGEND

Reach Types	
WGB_DF	Wandering Gravel Bed with Discontinuous Floodplain
PC_DF	Planform Controlled with Discontinuous Floodplain
FC_DF	Fan Controlled with Discontinuous Floodplain
AF	Alluvial Fan
COFP	Confined with Occasional Floodplain Pockets
CSH	Confined Steep Headwater

Restoration Strategies	
REC	Reconnect Isolated or Disconnected Habitats
OVB	Promote Over-bank Flow
RIP	Riparian Management
INS	Instream Complexity

APPENDIX H. POTENTIAL PHYSICAL AND HABITAT CHANGES BASED ON CONCEPTUAL DESIGNS: TIER 2 AND 3 PROJECT AREAS

Appendix H. 1. Summary of the potential quantity of physical and habitat attributes expected from restoration actions in Tier 2 Project Area (See Table 11 for definitions and methods for calculating quantities).

						Project Actions (feet)								
						Instream Complexity	**Reconnect Habitats**		**Promote Overbank Flow**		**Roads**	**Potential Areas Affected**		**Conserve/ Enhance**
Watershed	Restoration Reach	Project Area	RM Start	RM End	Length	LWD Addition	Levee Removal or Setback	Dam Removal	Flood Channel Connection	Side Channel Connection	Decommision	Floodplain (acres)	Riparian Enhancement (acres)	Protection Area (river mile)
Asotin	AC_02	3	3.2	5.6	2.4	12,672	1,013		573	4,180		20	12	3.5-4.0, 5.2-5.5
Asotin	AC_02	5	6	7	1	5,280			1,950	252		1	2	
Asotin	AC_03	7	7.4	8.4	1	5,280							1	
Asotin	AC_04	8	8.4	9.9	1.5	7,920	3,900		3,479	1,385		33	25	
Asotin	CC_01	13	0.6	1.9	1.3	6,864						1	4	
Asotin	LC_03	27	4.8	6.4	1.6	8,448							1	
Asotin	SF_01	30	4.3	4.9	0.6	3,168						1	1	
George	GC_01	35	3.5	6	2.5	13,200						3	6	
George	GC_03	38	10.9	11.4	0.5	2,640					2,390	3	1	
George	AY_01	44	0	0.9	0.9	4,752			334		3,900	1	1	
George	KC_01	45	0	1.4	1.4	7,392							2	
George	PC_01	49	1.7	2.3	0.6	3,168			455			2	4	1.7-1.9
George	PC_02	51	3.6	7.9	4.3	22,704			729			1	5	
George	PC_04	52	0	0.8	0.8	4,224							1	
George	PC_04	53	0.8	2.2	1.4	7,392							14	
George	PC_04	54	2.2	3.2	1	5,808							1	
George	PC_03	55	7.9	9.5	1.6	8,448							2	
Alpowa	AP_01	56	0	0.6	0.6	3,168				1,077		1	3	
Alpowa	AP_01	57	0.6	3	2.4	12,672	4,115		2,041	2,119		30	17	
Alpowa	AP_01	58	3	4.1	1.1	5,808			725			1	3	
Alpowa	PW_01	61	1.4	2.3	0.9	4,752							4	
Tenmile	TM_01	64	0.3	1.1	0.8	4,224			495			1	1	
Tenmile	TM_01	65	1.1	1.9	0.8	4,224			1,118	516		2	1	1.3-1.8
Tenmile	TM_02	70	7.6	10.3	2.7	14,256			2,404	692		2	6	
Tenmile	TM_06	76	0	1	1	5,280								
Couse	CO_01	77	0	0.1	0.1	528								
			Average		**1.3**	**7,087**	**3,009**	**-**	**1,300**	**1,460**	**3,145**	**6**	**5**	

Appendix H. 2. Summary of the potential quantity of physical and habitat attributes expected from restoration actions in Tier 2 Project Area (See Table 11 for definitions and methods for calculating quantities).

						Project Actions (feet)								
						Instream Complexity	Reconnect Habitats		Promote Overbank Flow		Roads	Potential Areas Affected		Conserve/ Enhance
Watershed	Restoration Reach	Project Area	RM Start	RM End	Length	LWD Addition	Levee Removal or Setback	Dam Removal	Flood Channel Connection	Side Channel Connection	Decommision	Floodplain (acres)	Riparian Enhancement (acres)	Protection Area (river mile)
Asotin	AC_01	1	0	0.4	0.4	2,112	1,240		719	-		2	5	
Asotin	AC_02	4	5.6	6	0.4	2,112	275		715			1	1	
Asotin	LC_01	24	0	0.2	0.2	1,056						1	2	
Asotin	LC_02	25	0.2	2	1.8	9,504								
Asotin	LC_03	26	2	4.8	2.8	14,784			1,778			5	16	
George	GC_01	33	0	0.5	0.5	2,640	677					5	7	
George	GC_01	34	0.5	3.5	3	15,840	2,790					61	73	
George	PC_01	46	0	0.8	0.8	4,224	170		3,934	386		9	20	
George	PC_01	47	0.8	1.4	0.6	3,168			602			2	4	
George	PC_01	48	1.4	1.7	0.3	1,584				394		1	1	
George	PC_01	50	2.3	3.6	1.3	6,864			1,398	282		6	11	
Alpowa	PG_01	59	0	0.7	0.7	3,696							7	
Alpowa	PW_01	60	0	1.4	1.4	7,392			1,189			3	18	
Alpowa	PW_01	62	2.3	3.9	1.6	8,448							10	2.7 and 3.3
Tenmile	TM_01	63	0	0.3	0.3	1,584	908					3		
Tenmile	TM_01	66	1.9	2.3	0.4	2,112			422			1	5	
Tenmile	TM_01	67	2.3	3.1	0.8	4,224								2.8-3.1
Couse	CO_01	79	1.4	3.5	2.1	11,088								
Couse	CO_04	81	0	3.7	3.7	19,536			496	158		1	3	
Couse	CO_03	82	0	0.9	0.9	4,752							1	
Couse	CO_03	83	0.9	1.5	0.6	3,168							2	
			Average		**1.2**	**6,185**	**1,010**	**-**	**1,250**	**244**	**-**	**7**	**11**	