



PA18.1 Floodplain Connectivity May 2022

Tucannon Habitat Programmatic

Annual Summary Report

(January 2022– December 2022)

BPA Project #2010-077-00

#89977

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Regional Salmon Recovery Board

Dayton, WA 99328

Report Date: February, 2022



Project Area 8 implemented in 2017, new start of beavery dams and lodge 2-8-2022



Project Area 18.1 implemented in 2017, newly developing riparian wetland 4-26-2022

Acknowledgments:

A special thanks goes to the Tucannon Programmatic partners, it's through our collective hard work and dedication to our mission that measurable habitat improvement is achieved. We need to thank Tucannon landowners for having faith in our science based process and for committing to the goals and objectives of restoring habitat and preserving salmon and steelhead for future generations.

Implementers:

- Columbia Conservation District
- Confederated Tribes of the Umatilla Indian Reservation
- Nez Perce Tribe
- Snake River Salmon Recovery Board
- US National Forest
- Washington Department of Fish and Wildlife

Funders:

- Bonneville Power Administration:
- Confederated Tribes of the Umatilla Indian Reservation
- Nez Pierce Tribe
- Salmon Recovery Funding Board:
- Washington Conservation Commission:

Partners:



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Introduction:

The Tucannon River Programmatic Habitat Project #2010-077-00 (Program) is a restoration “Umbrella” project focusing on improving Snake River spring Chinook habitat in the Tucannon River, located near Dayton, WA (Figure 1). This annual implementation summary report encompasses the habitat restoration projects and associated restoration support funded, partially or entirely, through the Program’s support contract (#89977) and the Programs implementation partners, for the calendar year of 2022. The primary funding sources for the work reported in this report include; Bonneville Power Administration (BPA) and Washington State Salmon Recovery Funding Board (SRFB), with most projects including some level of cost share, both in-kind and cash. The Program is managed by the Snake River Salmon Recovery Board (SRSRB) and consists of the following partnerships: the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Columbia Conservation District (CCD), Pomeroy Conservation District (PCD), Nez Perce Tribe (NPT), Tri-State Steelheaders (TSS), U.S. National Forest (USNF) and the Washington Department of Fish and Wildlife (WDFW). The Program has worked as a group since 2010, starting with the completion of the Tucannon Conceptual Restoration Plan, Reaches 6 to 10 Phase II (Anchor QEA, 2011) (2011 Plan), and in 2021 the updated Tucannon Basin Habitat Restoration Geomorphic Assessment & Restoration Prioritization (Anchor QEA 2021) (2021 Plan). Collectively, the Program has implemented significant restoration actions in 24 project areas identified and prioritized in the 2011 & 2021 Plans (Figure 1). In 2022, the Program initiated restoration on PA13, completing Phase I and initiated/finalized designs for implementation in 2023 on four instream projects. The Program also supported the development of four conceptual/preliminary designs for implementation during the 2023-2025 construction windows.

The SRSRB serves as the southeastern Washington Regional Organization and Lead Entity for salmon recovery in the Washington State portions of the Snake River and Walla Walla River watersheds. The SRSRB supports the implementation of the Salmon Recovery Plan for SE Washington (SRSRB 2011), by guiding regional SRFB funding to high priority habitat restoration projects based on goals and objectives identified in the Recovery Plan (SRSRB 2011), as well as, providing scientific technical support as needed to program implementers. The SRSRB provides a regional perspective for salmon recovery, by participating in salmon recovery efforts and issues throughout the State of Washington. The SRSRB not only works to develop and maintain partnerships in restoration, but also provides the partners with technical support in the acquisition of funding, developing of design, permitting, providing a biologist for implementation and monitoring. Lastly, the SRSRB provides a sounding board (Table 1) for local public input and involvement in salmon recovery in southeastern Washington, both with respect to floodplain restoration projects and building the baseline support need for the large-scale restoration necessary to increase spring Chinook populations region wide.

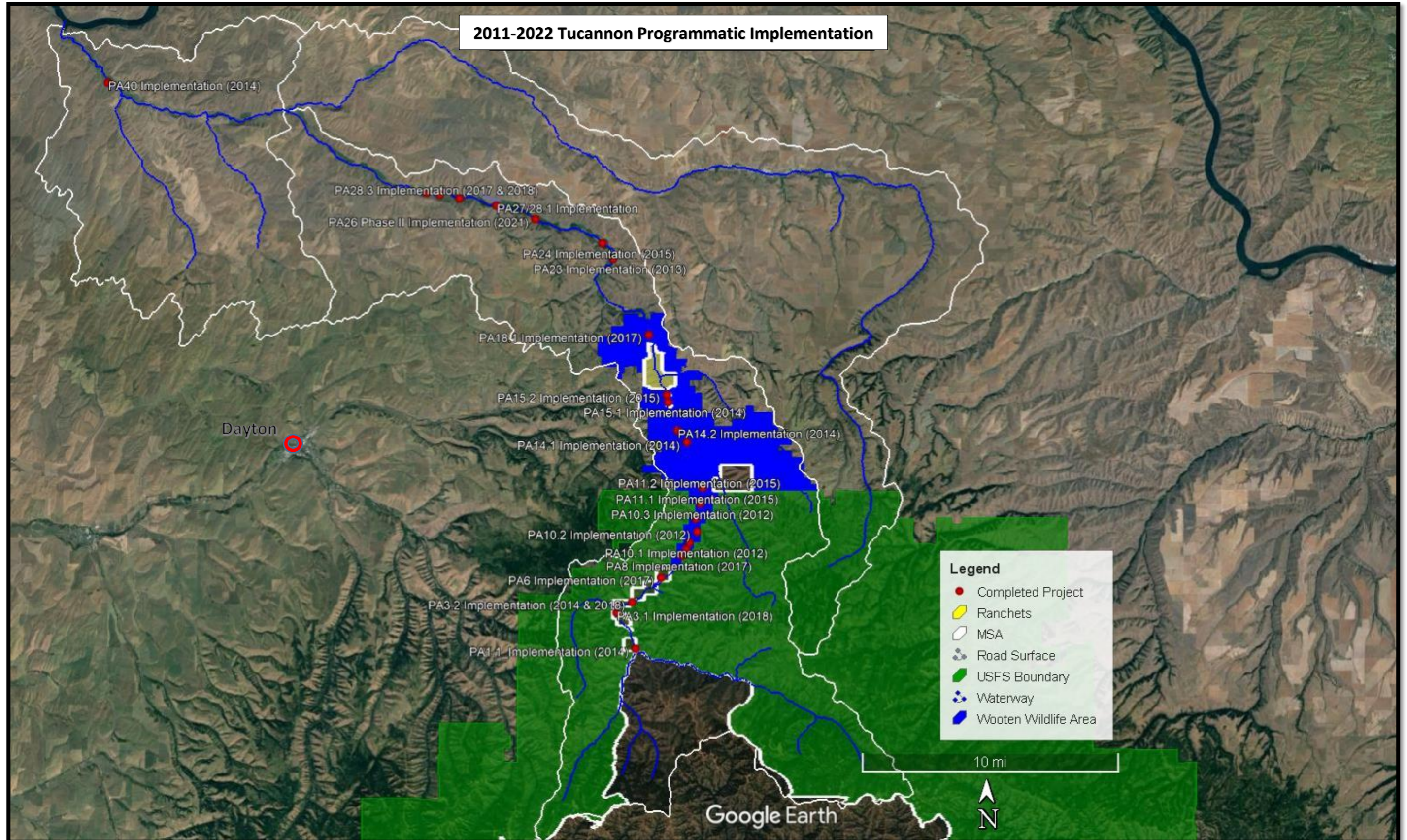


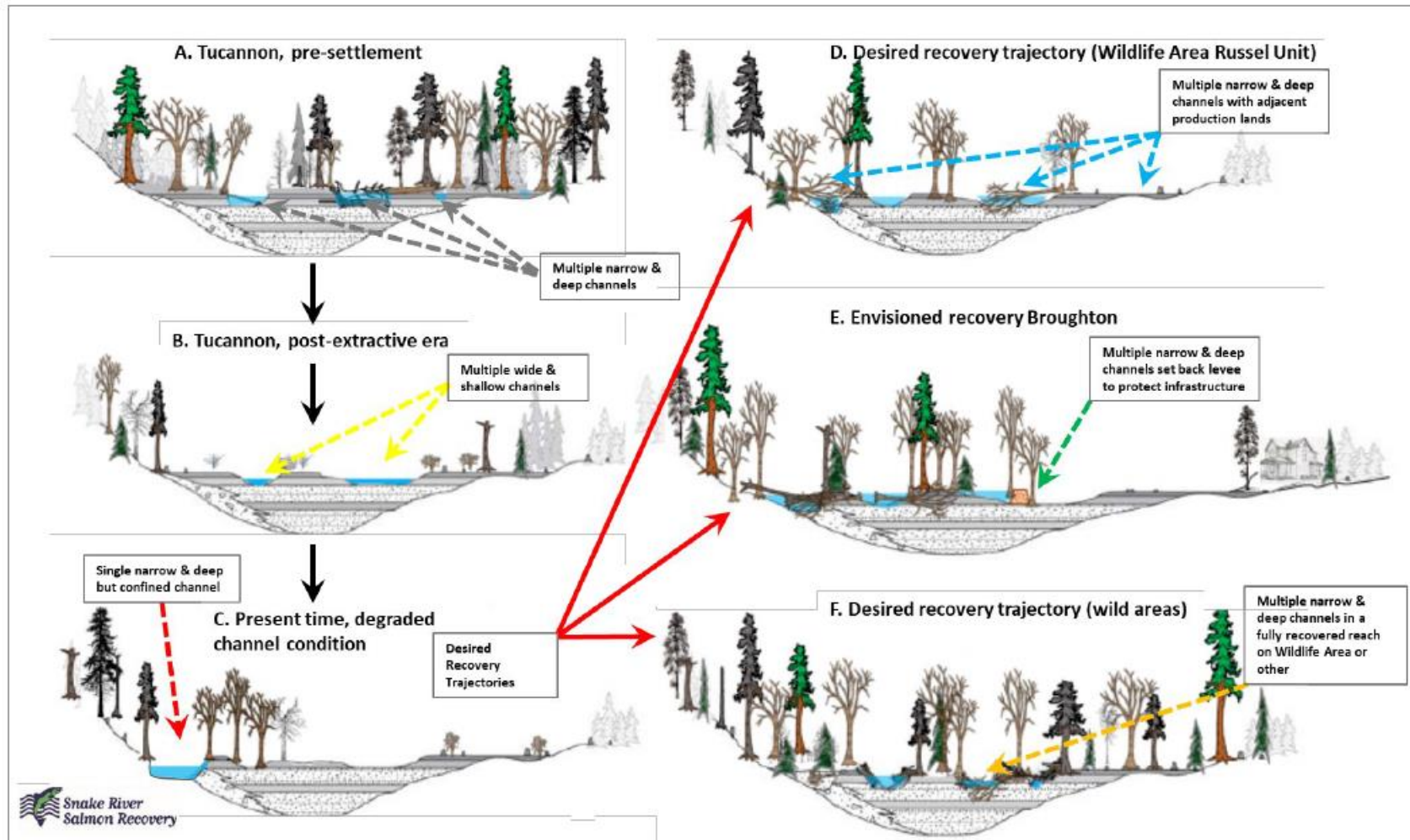
Figure 1: Distribution of habitat restoration project designed and implemented with support of the Tucannon Habitat Programmatic (2010-00-077) 2011-2022.

Table 1. Active Members of the Snake River Salmon Recovery Board for the year of 2022.

Member	County	Affiliation
Michael Largent	Whitman	Commissioner
Jon Jones	Whitman	Citizen
Gary Ryan	Whitman	Citizen
Justin Dixon	Garfield	Commissioner
Bill Bowles, Chair	Garfield	Citizen
Todd Kimball	Walla Walla	Commissioner
Larry Hooker	Walla Walla	Citizen
Brian Shinn	Asotin	Commissioner
Brad Johnson	Asotin	Citizen
Jerry Hendrickson	Asotin	Citizen
Marty Hall	Columbia	Commissioner
Sean Thurston	Columbia	Citizen
Don Jackson	Columbia	Citizen
Gary James	Tribal	CTUIR
Kris Fischer	Tribal	CTUIR
John Foltz	Staff	SRSRB
Kris Buelow	Staff	SRSRB
Ali Fitzgerald	Staff	SRSRB

Tucannon River Habitat Characteristics and Limiting Factors:

Historically, the Tucannon River watershed was converted from an anabranching channel form (Figure 2) existing on a narrow-forested valley bottom (Hecht, 1982) to a single channel form by the development of commercial timber harvest, followed by further straightening to assist and expand agricultural and land management operations. Originally, the anabranching river planform would have had multiple channels separated by stable, forested islands that divide flows up at bankfull discharge, with floodwaters accessing the floodplain more frequently than today. During the 1960's, a number of significant flood events (Figure 3) led to a significant loss of property and infrastructure (Johnson 1995), the US Army Corps of Engineers (USACE) straightened and leveed significant reaches of river, increasing the conveyance capacity, confining the river to a single channel at the valley margins and significantly increasing stream-power. Between 1937 through 1978, the length of the main channel had been reduced between 7- 20% depending on the reach, and possibly as much as 50% of the Tucannon's total length was lost through channelization and further confinement (Hecht, 1982). In 1980, an investigation of the Tucannon River found 63% of river reaches surveyed to be comprised of turbulent riffle units, while only 4% to be slow water habitats (Kelley 1982). Today much of the Tucannon River is stuck in a state of arrested degradation (Figure 4) or what is referred to as Stage 3s in the Stream Evolution Model (Cluer and Thorne, 2013). Ultimately, rivers in this stage of channel evolution are as much as 60% less productive biologically than higher stages, because of lack of nutrient inputs from floodplain connectivity and increased stream velocities that require higher energy to forage in these channel types.



This model illustrates an idealized cross section of the Tucannon River floodplain and riparian forests over time since pre-settlement. Sections A and B illustrate changes that had occurred through the period of degradation with wide, shallow river channels, and Section C illustrates a modified condition with a single, narrow channel that has confinement and recovering riparian habitat. Sections D and E illustrate desired recovery trajectories for three different land types that all benefit salmon and steelhead. Section D illustrates working lands where occasional flooding is possible, Section E illustrates working lands with infrastructure protection setback levee, and Section F illustrates a full wild land restoration. Source: Kris Buelow, Snake River Salmon Recovery Board, via email communication.

Figure 2. Tucannon Conceptual Stream Model

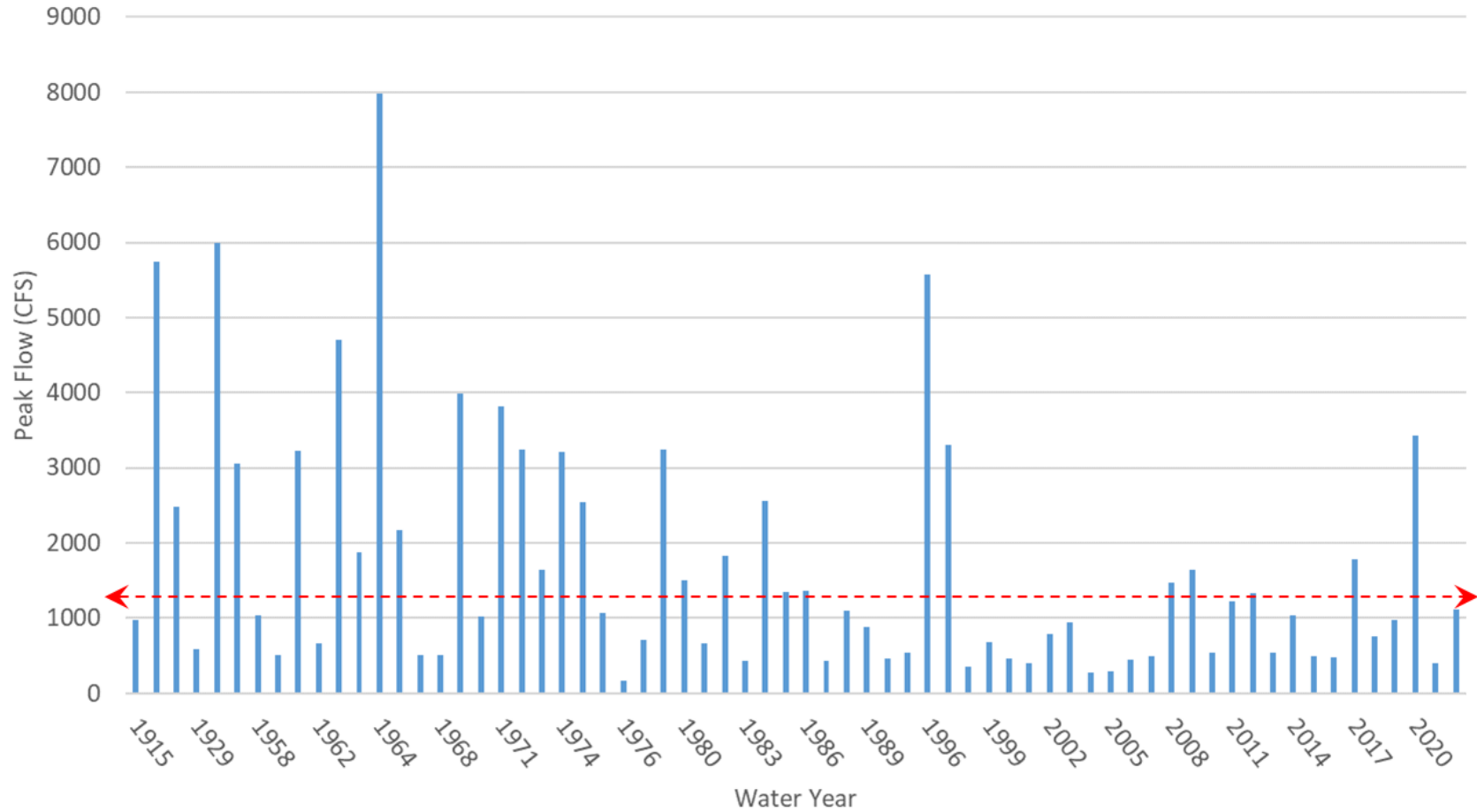


Figure 3: Peak stream flows recorded at the USGS Starbuck stream gage for the entire period of record 1914 to present. The dotted line indicated the approximate 2 yr flood return interval estimated for the basin at RM 8.8.

The degradation of physical and ecological processes in the Tucannon River caused three very common problems for salmonids typically associated with confined and incised channels: (1) diminished velocity refuge, (2) minimal food production and availability, and (3) redd scour (Cluer, 2019). Stage 3s rivers with a high conveyance capacity undergo a decrease in velocity refuge when discharge increases, limiting food production and requiring high energy expenditure for foraging salmonids (Facey and Grossman, 1990; Sommer et al., 2001a; Kemp et al., 2006; Jeffres et al., 2008; Katz et al, 2017).

The 2021 Plan (Anchor QEA 2021) evaluated habitat conditions basin wide and identified floodplain connectivity and channel complexity as the ecological limiting factors most impacting salmon and steelhead habitat. The plan refocuses restoration efforts on reconnecting floodplains through levee modification, and the reduction of incision as the primary actions in restoring habitat unit diversity and ecosystem resilience necessary for salmonid survival. These two limiting factors are identified in the Salmon Recovery Plan for SE WA (SRSRB 2011) and by the Program.

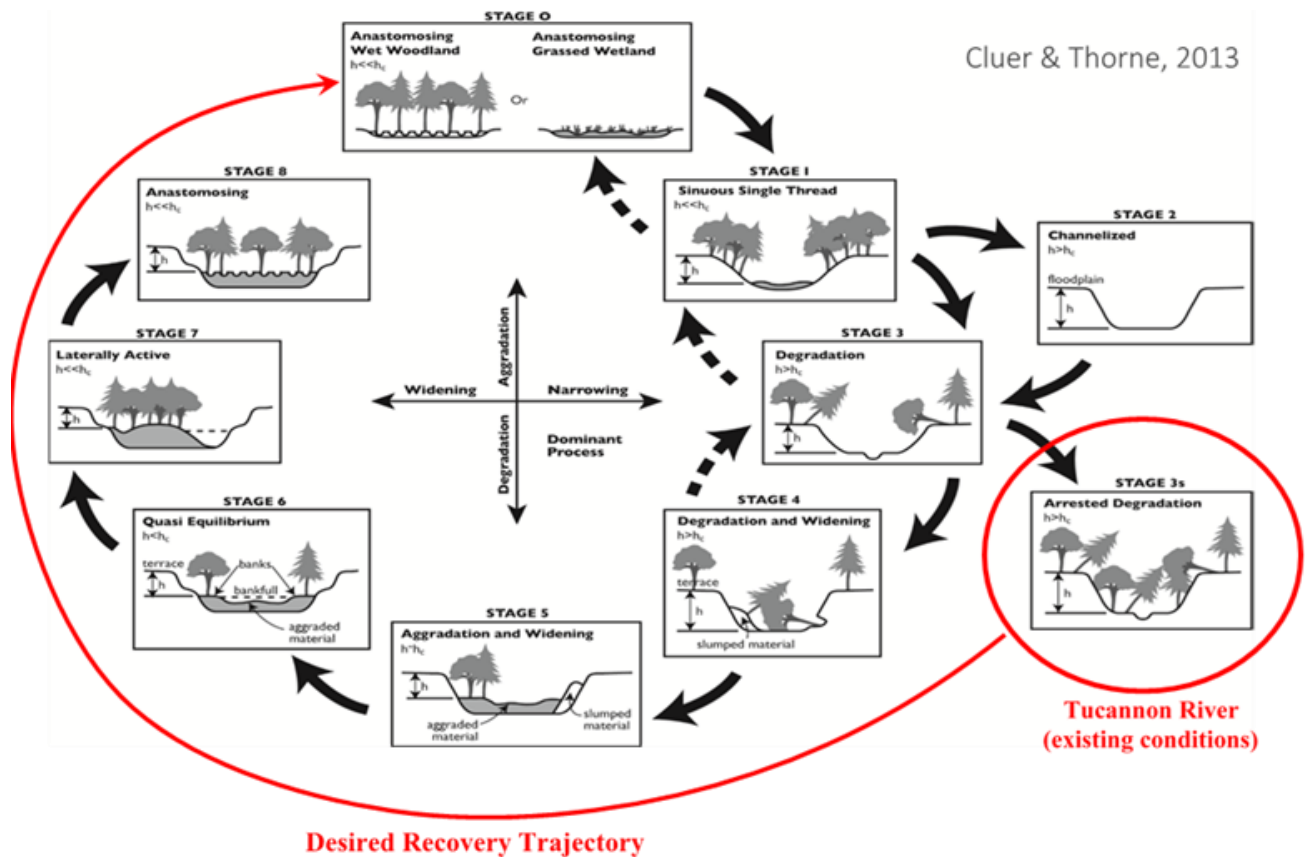


Figure 4: Stream Evolution Model (Clure & Thorn, 2013) illustrating the current channel shape for the most severely impacted reach of the Tucannon in red and the desired trajectory for recovery.

Limiting Factors

An anabranching Tucannon River (Figure 2) existing on a narrow-forested valley bottom would have supported greater floodplain and channel complexity, along with greater flora and faunal diversity, and would have provided system resiliency to natural flood and draught cycles. The conversion to a single planner channel, followed by further straightening to protect infrastructure has precipitated habitat limiting factors associated with degraded modern-day rivers of the inter mountain west, including reduced summer flow, elevated summer temperatures, depressed winter temperatures and elevated stream power. The conversion in channel type, in its self would have had profound impacts to spring Chinook and other native salmonids populations, but the Tucannon was also undergoing change in spatial connectivity with barriers being constructed and water being diverted.

In the early 90's some of the habitat factors impacting salmonids were very recognizable, and efforts to plant riparian and upland areas began to reduced soil loss and sedimentation to the point that today fines are not considered a significant factor limiting habitat above Pataha Creek. At the drafting of the Snake River Salmon Recovery Plan for SE WA (SRSRB 2005), the Ecosystem Diagnose and Treatment (EDT) model was used to identify and prioritize basin wide habitat limiting factors. The factors were separated into those that were physical (eminent threats to mortality) like fish passage barriers, dewatered stream reaches, irrigation diversions, acute high-water temperature and screens; then the environmental factors (indirect caused to mortality) like chronic high-water temperature, excessive fine sediments, and conditions which limited natural process like disconnected floodplain and low channel complexity. By 2010, irrigation efficiencies projects eliminated dewatering and riparian plantings combined with water saving contribute to declining summer water temperature, extending the summer fish extent from above RM 32 (Kelley 1982) downstream closer to RM 15, above the confluence with Pataha Creek. All major fish passage barriers have been addressed with the remaining partial barriers well underway to being mitigated. An account of identified limiting factors and the restoration goals/objectives for each priority species was completed in 2021 Plan (Anchor QEA 2021) and can be viewed in this document (Table 2).

By the drafting of the 2021 Plan (Anchor QEA 2011), a good number of the limiting factors within the basin were in the process or had previously been mitigated including; barriers, irrigation screens, dewatering, significant riparian planting, and implementation of agricultural best management practices (Figure 5). The result was a shift in project scope and scale focusing on (indirect causes of mortality) forcing ecosystem and geomorphic response, looking to restore river system function. This approach enabled the Program to directly prioritize projects which aim to increase floodplain connectivity and function, including those which increase channel complexity.

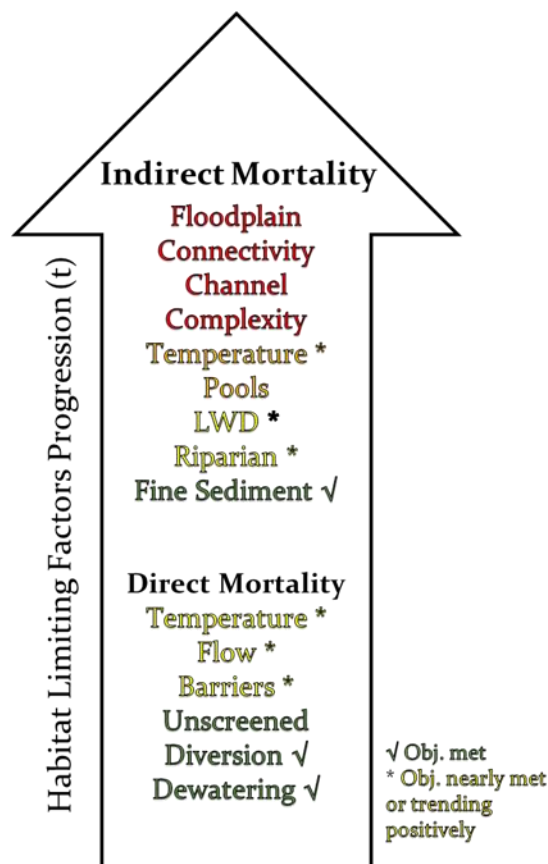


Figure 5: Tucannon priority limiting factor progression through time beginning in the mid-1990s with the direct mortality to adult and juvenile salmonids to more indirect form of mortality caused by loss of ecosystem function. The change on indirect limiting factors also has undergone a change in approaches in addressing them, from a more direct approach of planting trees to shade the river and log jams to form pools to changing the way the river can perform by increase floodplain and increasing channel connectivity.

Previous Planning Efforts

Efforts to stem the loss of salmonid population in the Tucannon got an early start (Figure 6) with Tucannon Model Watershed (TMW) in 1996, led to analysis of Limiting Factors (Kuttle 2002), the development of the Tucannon Sub-basin Plan (TSP) (2004) and the following year the Recovery Plan (2005). The Snake River Salmon Recovery Board (SRSRB) developed the Recovery Plan (SRSRB 2005) and updated it in 2011, with biotic and physical habitat goals and objectives closely align with or exceeding those of the 2004 TSP and the 2008 FCRPS BiOp. During the initial development of the Program the SRFB funded the CCD to conduct a basin wide Tucannon Geomorphic Assessment & Habitat Restoration Study (2011 Assessment) (Anchor QEA 2011a) to identify habitat stressors and review current limiting factors. Until this point limiting factors had their origins in the TSP (2004) and the Recovery Plan (2005), but the and resulting 2011 Plan (Anchor QEA 2011b) took a close look at the LF and prioritized them for restoration actions and deprioritized several which had experienced significant improvement. The goals and objectives identified in the 2011 plans supported the goals and objectives identified in the Columbia River Basin Fish & Wildlife Program (2014) by mirroring the habitat strategy in protecting the best habitats and enhancing and restoring channel complexity and floodplain connectivity to restore ecosystems for broad base recovery and resilience. In 2021,

the programmatic partners completed an evaluation and update to the 2011 Plan (Anchor QEA 2011) in the 2021 Plan (Anchor QEA 2021).

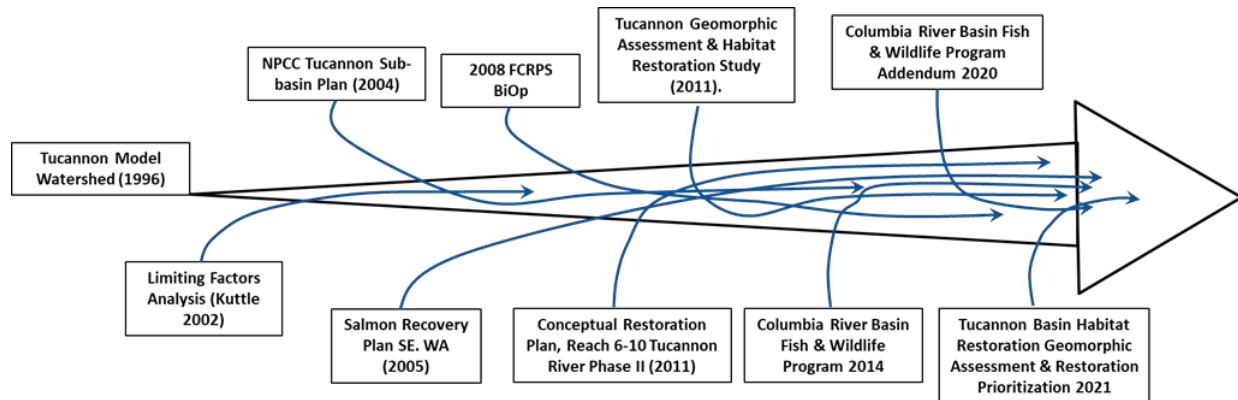


Figure 6: The projects and plans that have contributed toward the building of a scientific knowledge base in the Tucannon basin. Overtime as new information and analysis is identified and gained some outdated plans have dropped off or been reformed, but the contribution is carried forward.

Project Implementation Monitoring & Adaptive Management

Beginning in 2012, the SRSRB began collecting physical monitoring data on instream restoration projects implemented in the Tucannon using a Rapid Habitat Survey (RHS) protocol, for the purpose of project implementation and effectiveness monitoring. This effort was initiated for the purpose of providing habitat metric data to inform our goals and objectives in our various contract and program reporting requirements. The Tucannon Columbia Habitat Monitoring Protocol (CHaMP) and Asotin Intensively Monitored Watershed (IMW) programs operating in the SRSRB Region, lead to the adoption of modified methods and protocols developed and field tested by these programs. In 2020, the methods were formalized in the Tucannon Habitat Monitoring Plan (Monitoring Plan) (Camp 2021). The goals of RHS are to significantly limit the number of metrics collected during an individual survey so that an entire project could be surveyed (~1-2km) over a relatively short period of time. The RHS approach was developed to limit the number of hours (< 1 field day with 1-2 people) necessary to collect meaningful information on the primary key metrics (Table 3) driving limiting factors in the basin. This approach allowed the SRSRB to continually survey a relatively large number of project areas over a longer duration of time from 2012 to the present (Table 4). In 2020, the Program began to formalize habitat monitoring protocols in the absence of an outside large-scale monitoring effort (i.e. CHaMP). The Monitoring Plan (Camp 2021) uses RHS field measurements integrated with remote sensing (LiDAR) data collected in support of Program planning in 2010, 2017 and 2020.

Table 2: Table 6-1 from the 2021 Plan (pg 48) Summary of Life History Stages & Limiting Factors (Anchor QEA 2021).

Salmon Life History Stage	EDT Limiting Factors ¹	Key Limiting Factor ²	Cause of Problem	2011 Salmon Recovery Plan Obj. ³	2011 Programmatic Objectives ⁴	2020 Prioritization Goals ⁵	2020 Prioritization Objectives ⁵	Expected Ecological Response ⁵	Assessment Method ⁸
Spring Chinook Egg-Fry	Sediment Load ^{A,a} Temperature ^b Channel Stability ^c Habitat Diversity ^d	Large Wood Log Jams Confinement ^f Riparian Function Key Habitat (pools) Temperature	Channelization, loss of floodplain and riparian, loss of channel complexity and function	Riparian: > 40-70% max LWM: > 1 key piece/channel width Confinement: < 20-50% of Length Temperature < 4 day > 72°F Embeddedness: < 20% ^g	OBJ-1 OBJ-2 OBJ-3 OBJ-4 OBJ-6 ^h	Increase complexity at low-winter flows, during spring and winter peaks Reconnect abandoned floodplains	Flow Complexity to levels of current 90th percentile of basin for low-winter and mean spring/winter peaks 75% of the available floodplain is connected at the 2-year event > 15% pool area	Improved habitat conditions for summer and fall juvenile rearing and winter refugia Improved extreme event refugia, riparian growth, wood material availability, bedload material availability juvenile rearing	Channel complexity at low-winter, mean-winter, and 1-year flow Channel aggradation floodplain potential, encroachment removal, and total floodplain potential
Spring Chinook Fry-Smolt	Temperature ^B Channel Stability ^c Habitat Diversity ^d Key Habitat ^f	Large Wood Log Jams Confinement Riparian Function Key Habitat (pools) Temperature	Channelization, loss of floodplain and riparian, loss of channel complexity and function		OBJ-1 OBJ-2 OBJ-3 OBJ-4 OBJ-5	Increase retention and storage of bed load gravel		Improved adult holding and cover	Excess transport capacity, connectivity, and complexity analysis
Spring Chinook Adult	Temperature ^B Habitat Diversity ^d Key Habitat ^f	Large Wood Log Jams Riparian Function Key Habitat (pools) Temperature	Loss of channel process and complexity		OBJ-1, OBJ-3, OBJ-4, OBJ-5	Improve quantity and quality of pools	> 15% pool area	Improved adult holding and cover	Pool frequency analysis and excess transport capacity analysis
Steelhead Egg-Fry	Sediment Load ^{A,a} Temperature ^b Channel Stability ^c Habitat Diversity ^d Key Habitat ^f	Large Wood Log Jams Confinement Riparian Function Key Habitat (pools) Temperature Sediment ^A	Channelization, loss of floodplain and riparian, loss of channel complexity and function	Riparian: > 40-70% max LWM: > 1 key piece/channel width Confinement: < 20-50% of Length Temperature < 4 day > 72°F Embeddedness: < 20% ^g	OBJ-1 OBJ-2 OBJ-3 OBJ-4 OBJ-6 ^h	Increase complexity at low-winter flows, during spring and winter peaks Reconnect abandoned floodplains	Flow Complexity to levels of current 90th percentile of basin for low-winter and mean spring/winter peaks 75% of the available floodplain is connected at the 2-year event > 15% pool area	Improved habitat conditions for summer and fall juvenile rearing and winter refugia Improved extreme event refugia, riparian growth, wood material availability, bedload material availability juvenile rearing	Channel complexity at low-winter, mean-winter, and 1-year flow Channel aggradation floodplain potential, encroachment removal, and total floodplain potential
Steelhead Fry-Smolt	Temperature ^B Channel Stability ^c Habitat Diversity ^d Key Habitat ^f	Large Wood Log Jams Confinement Riparian Function Key Habitat (pools) Temperature	Channelization, loss of floodplain and riparian, loss of channel complexity and function		OBJ-1 OBJ-2 OBJ-3 OBJ-4 OBJ-5	Increase retention and storage of bed load gravel		Improved adult holding and cover	Excess transport capacity, connectivity, and complexity analysis
Steelhead Adult	Habitat Diversity ^d Key Habitat ^f	Large Wood Log Jams Riparian Function Key Habitat (pools) Temperature	Loss of channel process and complexity		OBJ-1, OBJ-3, OBJ-4, OBJ-5	Improve quantity and quality of pools	> 15% pool area	Improved adult holding and cover	Pool frequency analysis and excess transport capacity analysis
Fall Chinook Egg-Fry	Sediment Load ^A Temperature ^B Habitat Diversity ^d Key Habitat ^f	Large Wood Log Jams Confinement Riparian Function Key Habitat (pools) Temperature Sediment ^A	Channelization, loss of floodplain and riparian, loss of channel complexity and function	Riparian: > 40-70% max LWM: > 1 key piece/channel width Confinement: < 20-50% of Length Temperature < 4 day > 72°F Embeddedness: < 20% ^g	OBJ-1 OBJ-2 OBJ-3 OBJ-4 OBJ-6	Increase complexity at low-winter flows, during spring and winter peaks Reconnect abandoned floodplains	Flow Complexity to levels of current 90th percentile of basin for low-winter and mean spring/winter peaks 75% of the available floodplain is connected at the 2-year event > 15% pool area	Improved habitat conditions for summer and fall juvenile rearing and winter refugia Improved extreme event refugia, riparian growth, wood material availability, bedload material availability juvenile rearing	Channel complexity at low-winter, mean-winter, and 1-year flow Channel aggradation floodplain potential, encroachment removal, and total floodplain potential
Fall Chinook Fry-Smolt	Temperature ^B Habitat Diversity ^d Key Habitat ^f	Large Wood Log Jams Confinement Riparian Function Key Habitat (pools) Temperature	Channelization, loss of floodplain and riparian, loss of channel complexity and function		OBJ-1 OBJ-2 OBJ-3 OBJ-4 OBJ-5	Increase retention and storage of bed load gravel		Improved adult holding and cover	Excess transport capacity, connectivity, and complexity analysis
Fall Chinook Adult	Temperature ^B Habitat Diversity ^d Key Habitat ^f	Large Wood Log Jams Riparian Function Key Habitat (pools, spawning riffles)	Loss of channel process and complexity		OBJ-1, OBJ-2, OBJ-3, OBJ-4, OBJ-5, OBJ-6	Improve quantity and quality of pools	> 15% pool area	Improved adult holding and cover	Pool frequency analysis and excess transport capacity analysis

Table 3: Rapid Habitat Survey Metric collected in pre and post project surveys for the entire project reach where implement is occurring.

Class	Attribute	Description
LWD	Structure	# of key pieces, structure type, structure position, pool forming & effectiveness
Pool	Area	Location surface dimensions and max depth
	Quality	Forcing mechanism, % cover, % slow water, dominant sub straight
	Tail out	Max Depth, sorting ratio & embeddedness ration
Channel Units	Area & Quality	Unit type, surface area
Channel Delineation	Main Channel	Length delineation, wetted width & photo points
	Perennial Side Channel	Length delineation, average width, flow estimate, size ratio, velocity ratio and channel age estimate
	Ephemeral Side Channel	Length delineation, estimated bank width, channel type, flow frequency, cfs estimate, & age estimate

Rapid-habitat surveys (RHS) are conducted at base flow (~130 cfs – 60 cfs) as measured at Marengo (WDOE stream gage <https://fortress.wa.gov/ecy/eap/flows/station.asp?sta=35b150>), during the day of the survey. Each project funded or implemented under the Program has a survey for the entire project reach conducted pre-implementation, with an as-built survey completed in the late summer following construction (Table 4). Pre-project surveys are used in prioritization and the development of project concepts/designs, and are used to provide the majority of background information toward project development and permitting. The pre-project surveys in combination with hydraulic models (HEC-RAS) developed during previous topo-bathymetric LiDAR data acquisition (2020) are used in the development of project area specific goals and objectives. As-built surveys are used locally by the Program to complete contract reporting on deliverables to the BPA Pisces database at CBfish.org, SRFB Prism and CTUIR CDMS project reporting data bases. Follow up surveys are planned on a two year recurring cycle, meaning a minimum of two winter flow periods after the as-built survey is completed. This informs project funders and helps project implementer’s track project longevity (meeting contractual requirements) and project effectiveness for the purpose of informing the Program’s adaptive management approach. Follow up surveys are also conducted following major high flow events, (flow events exceeding the 5 yr return flow), or when visual observation warrants a follow up survey to capture unusual or interesting conditions that might provide opportunities or require maintenance actions.

In addition to the RHS, the program is using basin scale GIS techniques such as geomorphic change detection (GCD) to inform adaptive management in the Tucannon River (Wheaton et al., 2010a; Wheaton et al. 2010b; Wheaton, 2008). GCD was first used in the Tucannon by CHaMP and AEM programs, to support adaptive management actions over the last decade. To offset

the absence of CHaMP and AEM programs, the Program is using topo bathymetric LiDAR data (QSI, 2017 and QSI, 2020) collected as part of the Programs basin wide assessment and planning process. A full description of how the Program is using topo-bathymetric LiDAR to track channel complexity, floodplain connectivity and excess stream power can be viewed in the 2021 Plan (Anchor QEA, 2021) at <https://snakeriverboard.org/reports/tucannon-river-documents/>.

The Monitoring Plan (Camp 2021) and the Adaptive Management (Anchor QEA 2021) approach build off the availability of data collected by the Planning process with data collection events being trigger on an 8-year cycle or following high water event >5 yr return for the purpose of learning and adaptive management. Collecting topo-bathymetric LiDAR data following significant flow events allows continued assessment of geomorphic change in the Tucannon River. Using LiDAR instead of CHaMP and AEM, allows the Program to cover the entire valley bottom, a much larger spatial scale and a fraction of the cost (in time and money). In 2020, the Program partnered with CTUIR in the collection of a post flood data set in the fall of 2020 following the February 2020 flooding (Figure 3). Currently, CTUIR is working to conduct analysis of this change detection data set to better understand the distribution and abundance of habitat units and in 2022 developed a habitat suitability index for spring Chinook at low winter, mean winter and 1 yr flows for spring Chinook, steelhead and bull trout in the lower 50 miles of river. This information in combination with the RHS metrics described above help to improve the Program's understanding about how the different reaches of the Tucannon respond to different treatment techniques over various time scales and flow events.

Topographic datasets collected for the Tucannon River in 2017, combined with rapid habitat survey data, inform the analyses that were conducted in 2022. Results of the updated analyses indicate that portions of the Tucannon River remain below the desired targets for floodplain connectivity although channel complexity is improving. The data also indicate minimal geomorphic change and minimal increases in habitat complexity in areas where restoration treatments were not aggressive enough in approach. Data and analyses continue to support the need for more aggressive restoration treatments that increase floodplain connectivity and channel complexity over shorter timeframes. A more aggressive approach will hopefully create more durable restoration outcomes on the Tucannon River moving forward. The 2022 Tucannon River Project 5-15.2 Assess/Design will focus on developing project concepts which aggressively reset channel grade and floodplain elevation supporting the need for more deliberate floodplain connectivity.

As part of the 2021 Plan, methods to automate floodplain connectivity and channel complexity metric were developed for the spatial data sets completed in the 2021 Plan (Anchor QEA 2021) and are now available in an online web map hosted at: <https://ctuirgis.maps.arcgis.com/apps/MapSeries/index.html?appid=7961a9f233684f0daf87970b37d8dc1c>. It is the intention of the Program to use this approach to track habitat change, towards basin goals and objectives.

Table 4: Habitat and biological monitoring data collected at project area implemented between 2011 and 2022.

Implementation			Biological M&E		AEM/ Biomonitoring	Mussel Presence Survey	Lamprey Presence Survey	Stream Temp	Stream Flow	Rapid Habitat Surveys			LiDAR		
Project Name	Project Sponsor	Construction Year	Fish in Fish out	Salmonid Redd Surveys						Pre-project (yrs.)	Post Project (yr)	2 yr Interval (yrs.)	Terrestrial	Bathymetric	Areal Images yrs.
PA1.1	CTUIR	2014	yes	yes				Logger		2014	2014	2017 & 2021	2010	2017 & 2020	11 & 18 & 21
PA2.1	N/A	not	yes	yes						2022			2010	2017 & 2020	11 & 18 & 21
PA3.1	CTUIR	2018	yes	yes						2010, 2017 & 2018	2018	2019 & 2020	2010	2017 & 2020	11 & 18 & 21
PA3.2	CTUIR	2018	yes	yes				Logger		2017 & 2018	2018	2019 & 2020	2010	2017 & 2020	11 & 18 & 21
PA6	WDFW	2017	yes	yes						2017	2017	2019 & 2021	2010	2017 & 2020	11 & 18 & 21
PA7	N/A	not	yes	yes						2017 & 2019 & 2021			2010	2017 & 2020	11 & 18 & 21
PA8	WDFW	2017	yes	yes						2017	2017	2019 & 2022	2010	2017 & 2020	11 & 18 & 21
PA9	WDFW	2017	yes	yes						2017	2017	2019 & 2022	2010	2017 & 2020	11 & 18 & 21
PA10.1	WDFW	2012	yes	yes						2012	2015	2019 & 2022	2010	2017 & 2020	11 & 18 & 21
PA10.2	WDFW	2012	yes	yes						2012	2015	2019 & 2021	2010	2017 & 2020	11 & 18 & 21
PA10.3	WDFW	2012	yes	yes						2012	2015	2019 & 2021	2010	2017 & 2020	11 & 18 & 21
PA11.1	N/A	not	yes	yes						2010, 2015 & 2019 & 2020			2010	2017 & 2020	11 & 18 & 21
PA11.2	WDFW	2015	yes	yes			yes	Logger		2015	2015	2017 & 2019 & 2020	2010	2017 & 2020	11 & 18 & 21
PA12	N/A	not	yes	yes						2022	2023	2025	2010	2017 & 2020	11 & 18 & 21
PA13	WDFW	2022-23	yes	yes		yes	yes	Logger		2020-2022			2010	2017 & 2020	11 & 18 & 21
PA14.1	WDFW	2014	yes	yes						2014	2014	2017 & 2019 & 2020	2010	2017 & 2020	11 & 18 & 21
PA14.2	WDFW	2014	yes	yes				Logger		2014	2014	2017 & 2019 & 2020	2010	2017 & 2020	11 & 18 & 21
PA14.3	N/A	not	yes	yes	yes					2010, 2020			2010	2017 & 2020	11 & 18 & 21
PA15.1	CCD	2014	yes	yes		yes				2014	2014	2015 & 2017 & 2020	2010	2017 & 2020	11 & 18 & 21
PA15.2	CCD	2015	yes	yes						2014 & 2015	2015	2017 & 2020	2010	2017 & 2020	11 & 18 & 21
PA18.1	CTUIR	2017	yes	yes	yes	yes		Logger		2010, 2017	2017	2019 & 2020	2010	2017 & 2020	11 & 18 & 21
PA23	CCD	2015	yes	yes						2015	2017	2019	2010	2017 & 2020	11 & 18 & 21
PA24	CCD	2015	yes	yes	yes	yes				2015	2015	2019 & 2021	2010	2017 & 2020	11 & 18 & 21
PA26	CCD	2021	yes	yes		yes		DOE Gage	DOE Gage	2010, 2015 & 2019 & 2021	2021	2022	2010	2017 & 2020	11 & 18 & 21
PA27	CTUIR	2021	yes	yes		yes	yes			2020 & 2021	2021		2010	2017 & 2020	11 & 18 & 21
PA28.1	CTUIR	2020-21	yes	yes		yes	yes	Logger		2020 & 2021	2021		2010	2017 & 2020	11 & 18 & 21
PA28.2	CCD	2016	yes	yes		yes				2016	2016	2018 & 2021	2010	2017 & 2020	11 & 18 & 21
PA28.3	CCD	2018	yes	yes		yes				2016 & 2018	2018	2018 & 2021	2010	2017 & 2020	11 & 18 & 21
PA32.1	CCD	2020	yes	yes		yes	yes	Logger		2019 & 2020	2020	2022	2010	2017 & 2020	11 & 18 & 21

Implementation Observations: 2010-2022

The Program is focusing efforts and leveraging resources to complete the highest priority projects identified first in the 2011 Plan (Anchor QEA Nov. 2011) and now the 2021 Plan (Anchor QEA 2021). To date the Program implemented restoration actions on all or part of 25 (Figure 1) of the initial 60 project areas identified in the 2011 & 2021 Plan. Key habitat metrics collected during pre-project RHA survey (Table 5) are contrasted against surveys conducted post 2020 flood in an analysis to better understand the impacts of higher than average flows (Figure 3) on project integrity and goals and objectives. In general, projects exhibit a positive trend for key metrics from pre-project to present (Figure 8) when considering log jams/LWD however there has been decreases in channel log structures following the large (~25 yr) flood event (Figure 3). This is largely attributed to the redistribution of mobile LWD as well as the formation of large channel spanning jams (Figure 7) as well as the slow decomposition of LWD materials at some of the earliest projects implemented in 2012. Looking at the mean number of LWD key pieces (Figure 8), the number doesn't decline overtime flowing construction, indicating that LWD is not being lost as might be indicated by the decreased number of structures, but is being redistributed. It has also been observed that following construction, the proportion of natural LWD recruited into the channel increases and is more likely to remain in the system becoming functional pieces. The Program objective is to maintain > 2 LWD key pieces (>6m long and 0.3m dia.) per bank full width in order to maintain the minimum volume needed to force channel change and increased channel complexity including perennial length, pool frequency (area & depth) and floodplain connectivity.

Table 5: Rapid Habitat Survey key metric summary across 24 project areas totaling 26 river km or 22.5 valley km for projects implemented for the time period of 2012-2021.

Key Metric	Pre-project	Post-Project	Post-flood (2020-21)
Key LWD Pieces (#)	908	7449	6538
Log Jams (#)	334	1284	998
Perennial Side Channel (km)	5.94	13.4	30.0
Ephemeral Side Channel (km)	5.9	8.96	24.16
Pool (#)	362	639	714

LWD placement/recruitment within the project areas accompanied by the removal of confining features has led to a significant increase in the number and length of side channels both ephemeral and perennial across all the projects with only a few exceptions (Figure 9). For both channels types the mean number of km per valley km show an increasing trend from pre-project out to the oldest project at 8 + years post project. This trend ranges from a 0.25 km



Figure 7: Example of large post 2020 flood log jam complex created by mobile LWD transported downstream from PA11.1 to form the large jam complex in PA11.2.

pre-project means to > 1 km mean for the older projects, indicating that in most project areas, a positive trend is being observed. The gains have taken time to be achieved as observed in the figure 9, this is due to the passive approach taken by implementers in the basin, allowing the river to define these channels over successive high-water cycles (Figure 9).

The development of pools across the projects also show an improving trend over pre-project conditions (Figure 10), however there are some indications that pool frequency declines from the post project peak, the farther out from implementation the project gets. This has been observed in several of the older projects following the 2020 flood, particularly in projects where the number of log jams declined. Although pool frequency declined pool area and the number of deep pools remain closer to the post -project high (Figure 10), indicating positive changes in the system are persisting. Pools are one of the key threshold triggers in the adaptive management plan, the Program will consider in upcoming assessments and actions.

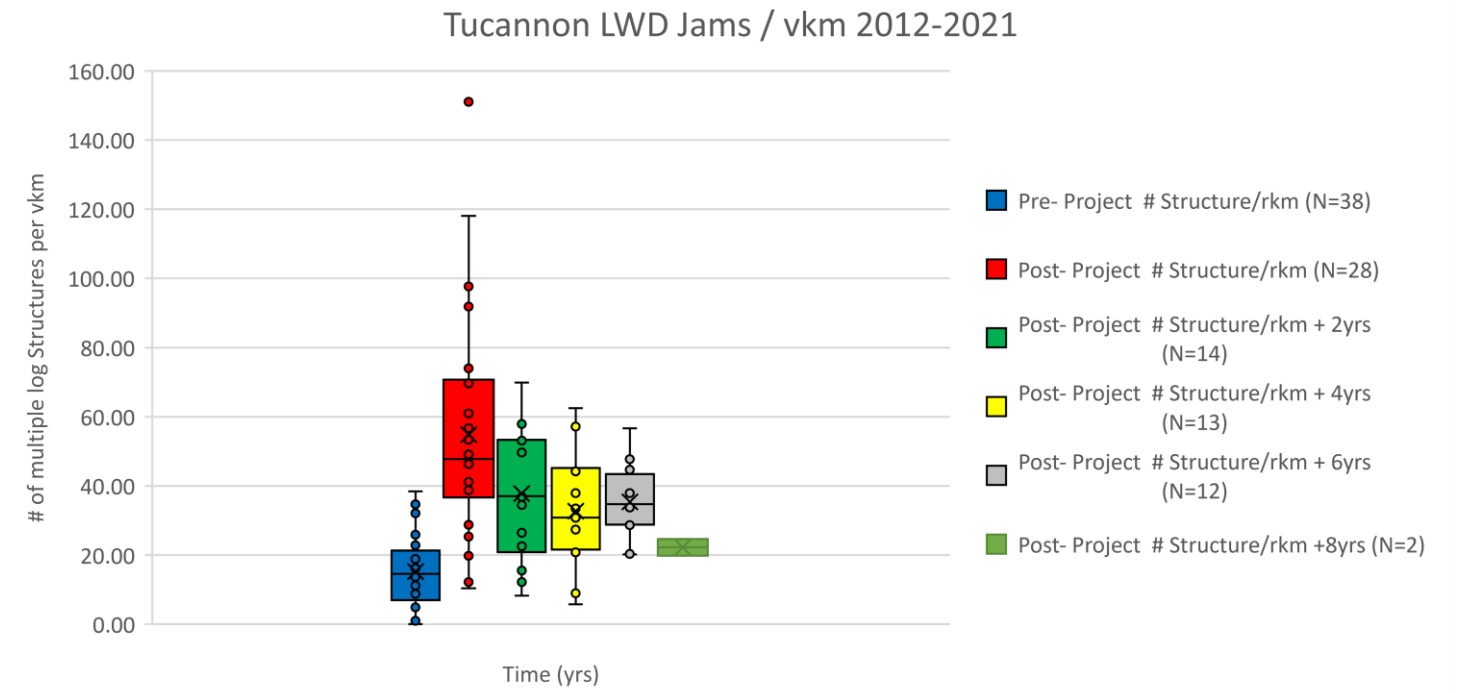
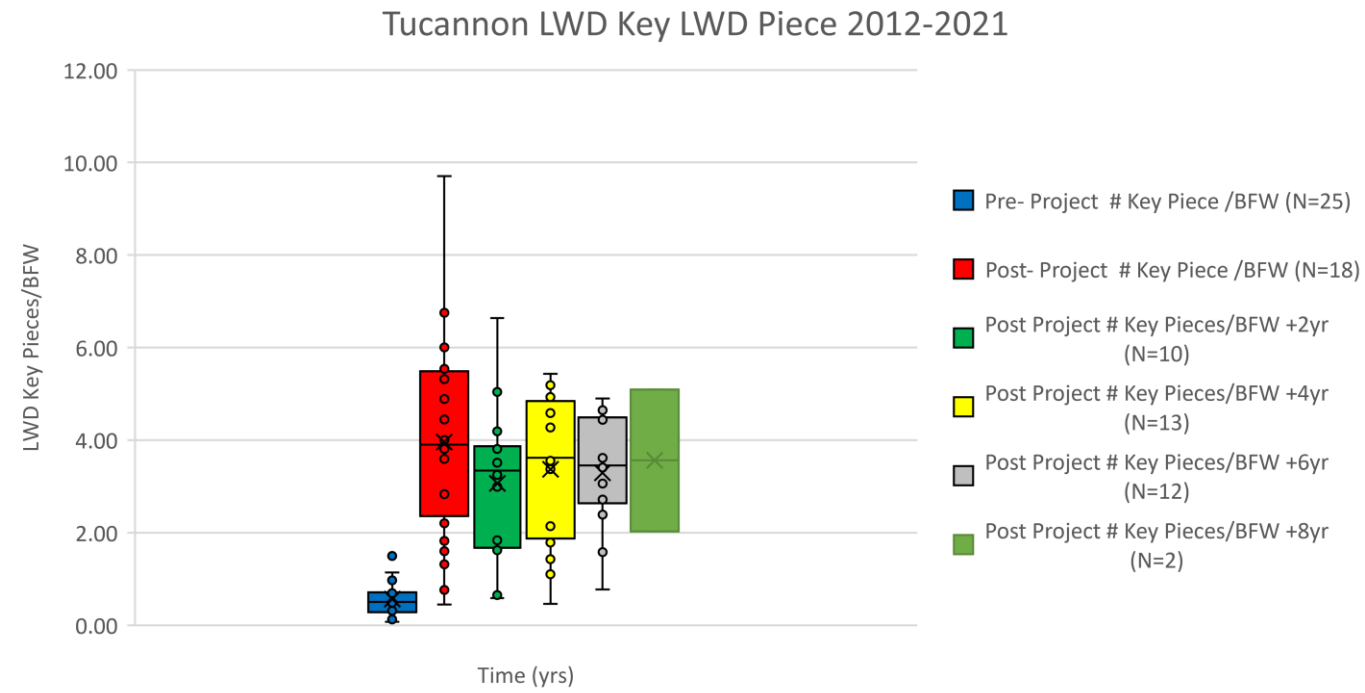


Figure 8: Mean number of large woody debris key pieces (>6 m long & 0.3 m dia.) per bank full width during pre-implementation immediately following implementation (post project) and then every 2 yrs. recurring up to 8 yrs. for the oldest project implemented in 2012 (Upper left). (Upper right) The mean number of log jams per valley km where a jam is a log structure containing 2 or more LWD key pieces.

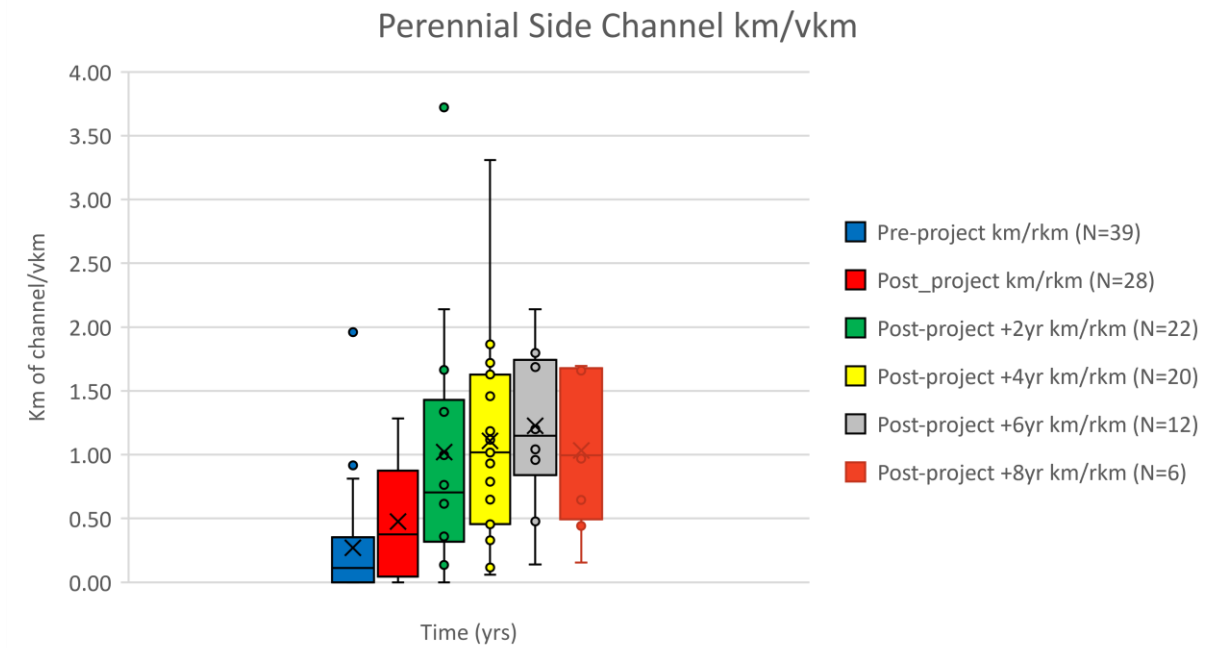
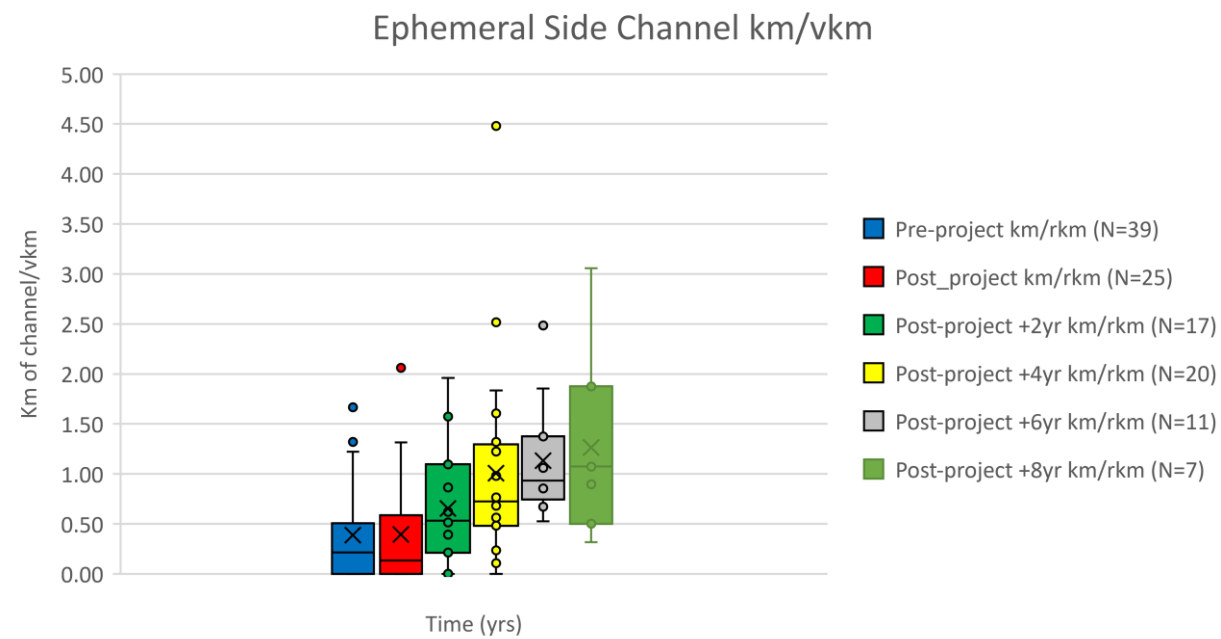


Figure 9: Mean length of ephemeral flow paths and perennial side channels standardized by valley km across all project implemented by the Program between 2010 & 2021.

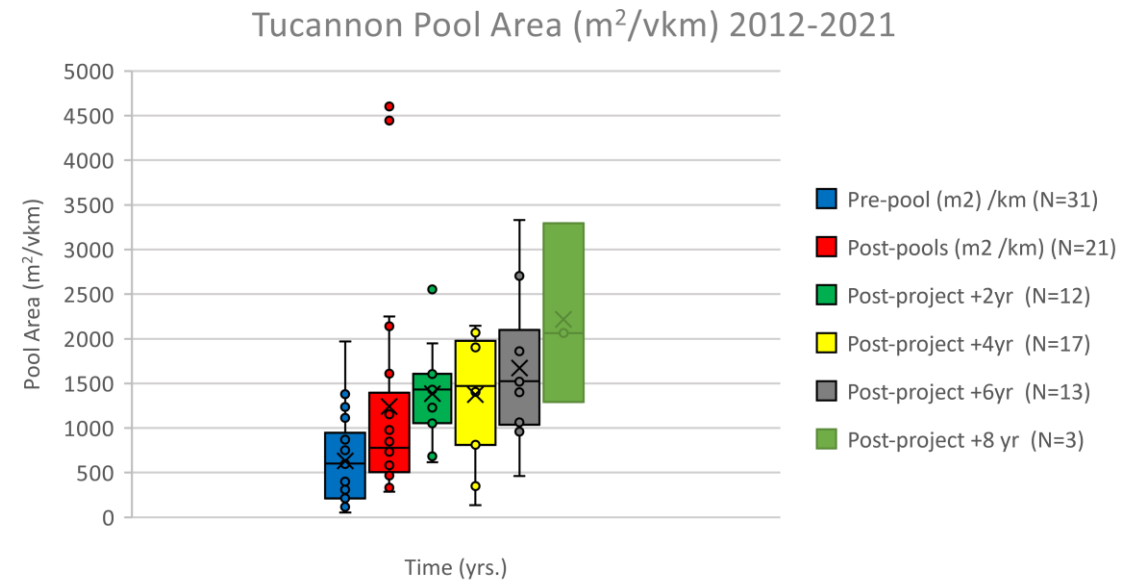
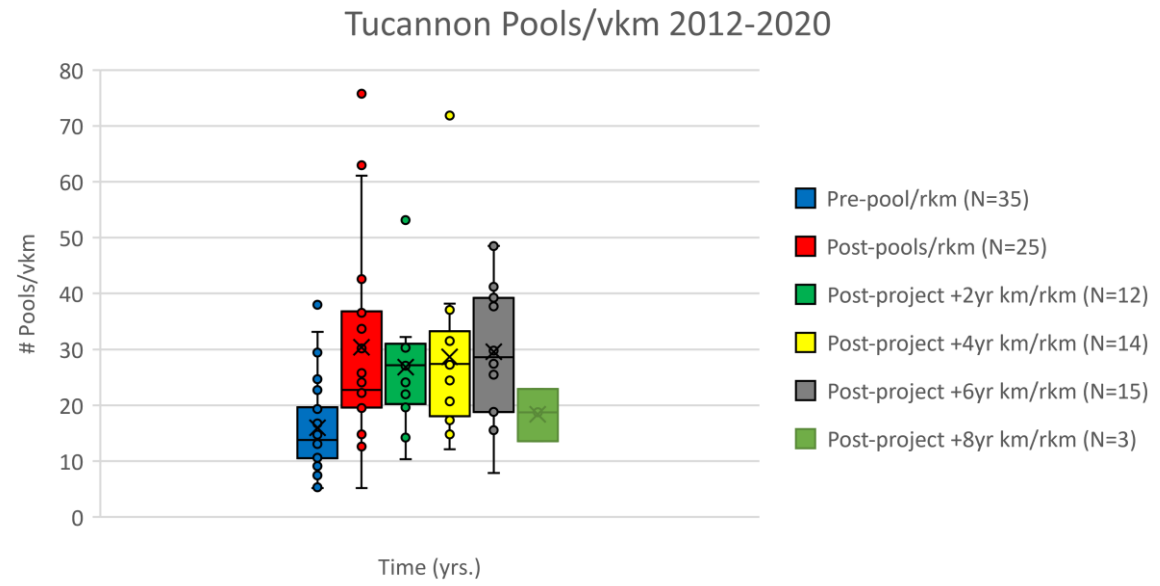
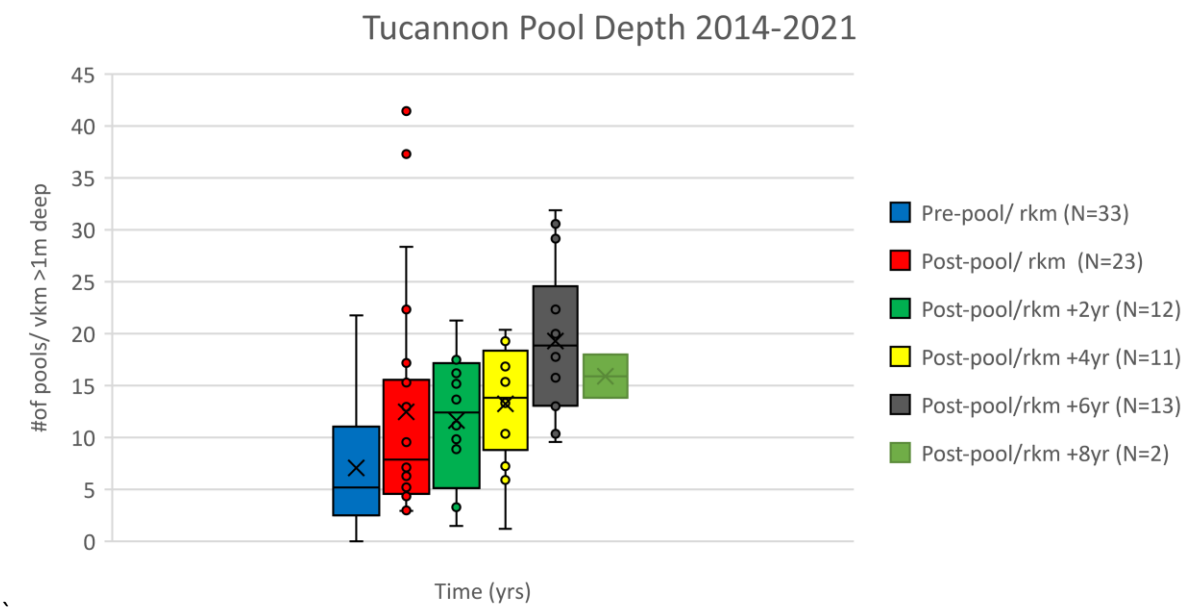


Figure 10: The mean pool frequency (above), area (upper right) and frequency deep pools (lower right) by sample period standardized by valley km, across all project implemented between 2012 and 2021. The dip in pool frequency for following 8yr post surveys was reflected by the deterioration of and mobilization of LWD jams indicated in Figure 8. It is important to note that pool area and depth did not significantly decline.



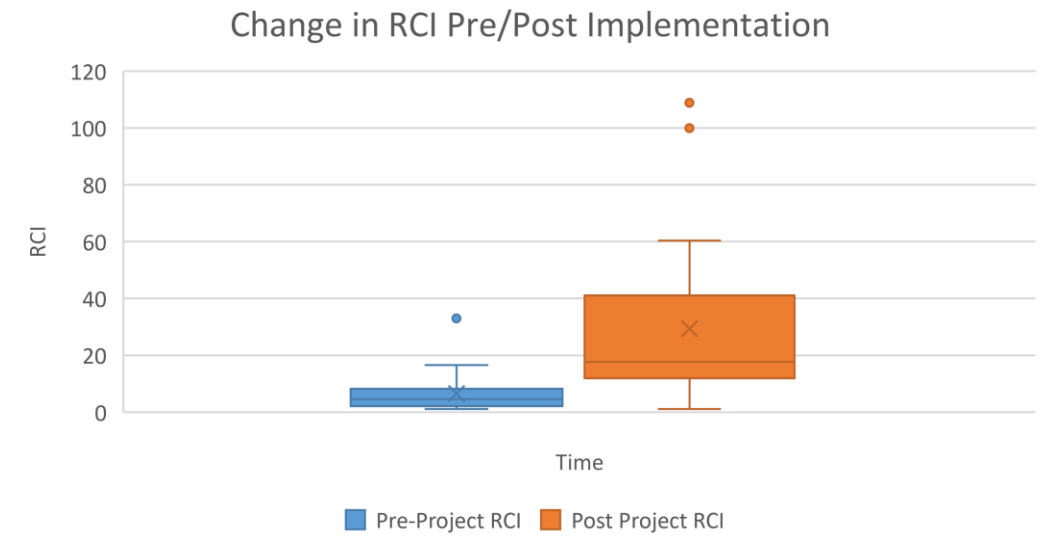
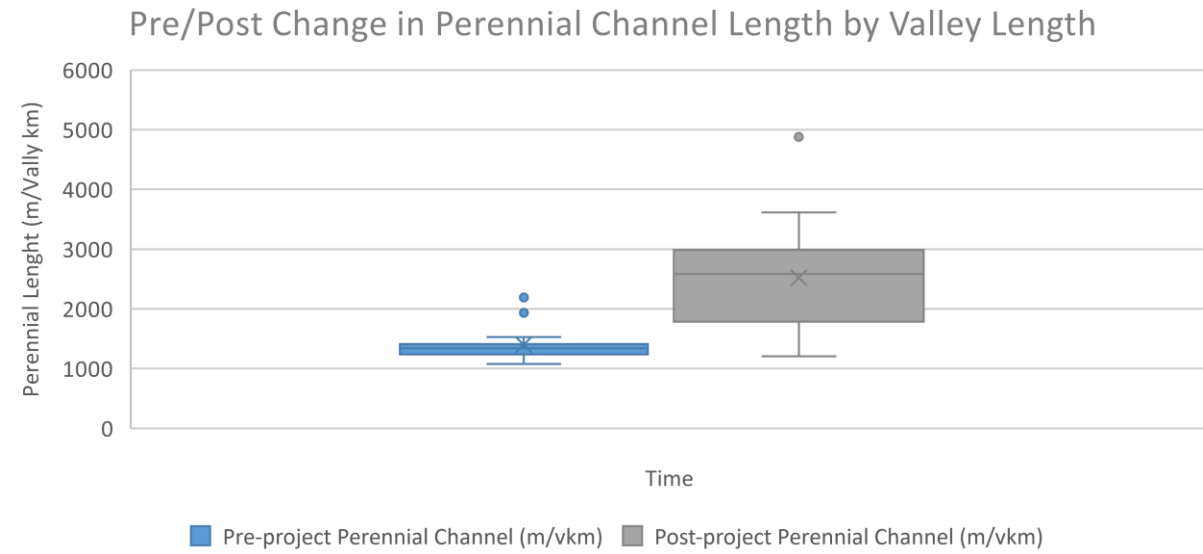
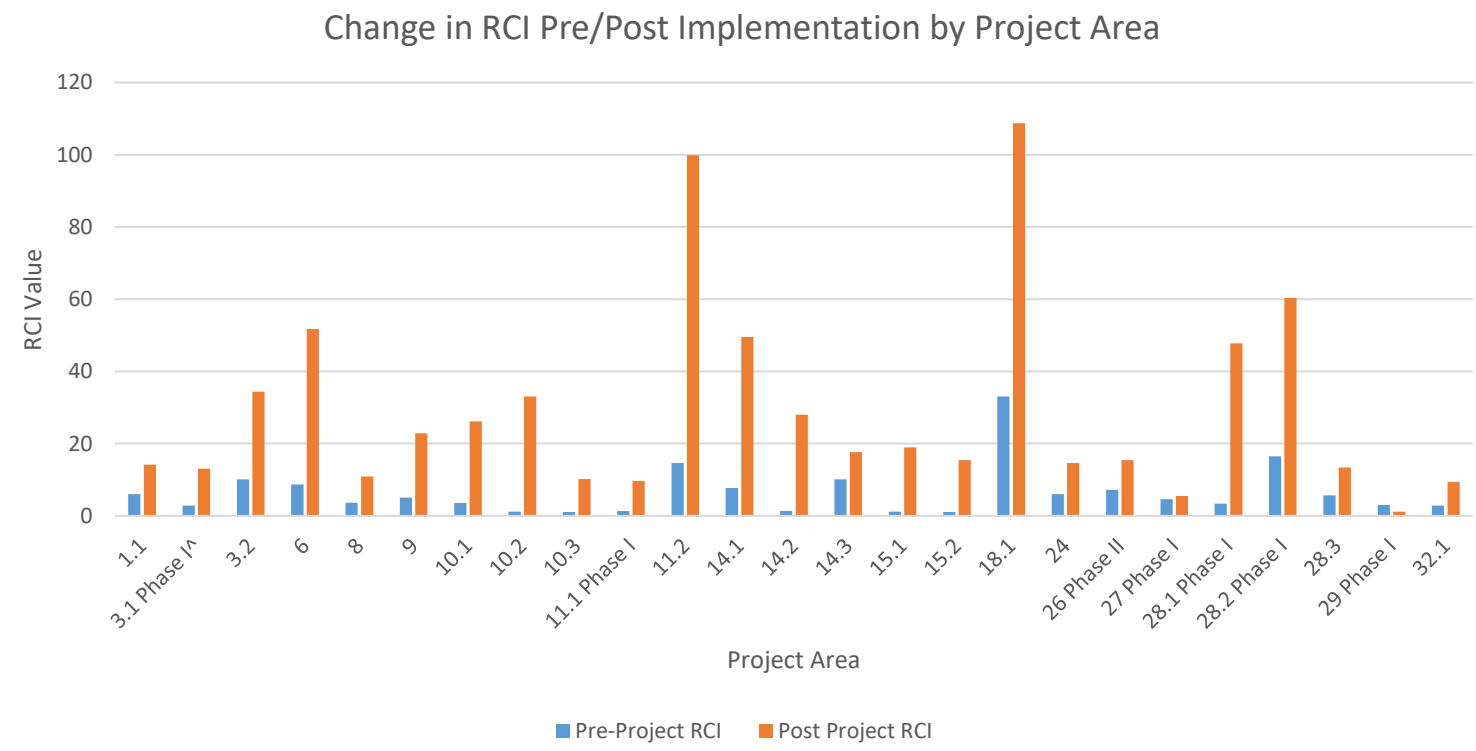


Figure 11: Changes in channel complexity for the Tucannon River project areas is captured using the changes in perennial channel length and reflected in change in River Complexity Index (Brown 2002). Data for project areas is collected in the RHS conducted by the SRSRB and supported by remote sensing data. Changes in perennial channel length standardized by valley km across all projects 2012-2022 prioritized for implementation (above left). Perennial length is shown for pre-project condition and post project condition as the summed total length delineated during RHS for main channels and side channels. The River Complexity Index is calculated for all project pre and post project (upper right) indicating an increase in the mean RCI from pre-project to post project conditions. Individual project changes are provided (right) indicating some project with significant increases in RCI value.



The Program tracks channel complexity through measuring perennial channel length and River Complexity Index (RCI) (Brown 2002). Channel length and connections(nodes) are mapped during RHS to tract habitat change from pre-project through as-built and 2 yr recurring intervals. Looking at all projects surveyed between 2012 and the present (Figure 11) main channel length was summed with perennial side channel length and standardized by valley km for all pre-project surveys and post project survey completed (Table 4) after the 2020 flood. The change illustrates a 50% increase in the mean perennial channel length per project area (Figure 11). The increase is driven largely by increasing side channel length, and is represented by > 24 km of new perennial side channel habitat (Table 5). Side channels for this analysis are channels separated from the main river by island which support terrestrial wood-stemmed plant species indicating at most seasonal inundations. The increase in perennial length has driven an increase in RCI, the measure we are using to track change in channel complexity across project implemented 2012-2022 (Figure 11). An assessment of projects implemented show an increase in RCI following implementation to pre-project to post 2020 flood, to have a pre-project mean RCI value of 8, to a mean of 33 (Figure 11). The goal for restoration is set based on available space and assessment of observed paleo-channels identified in imagery and LiDAR data models (REM), but a target of 25-60 will produce excellent results for most reaches of the Tucannon. The most aggressive restoration at some of the more responsive sites have shown RCI values >90 (Figure 11).

As described previously, the Program supported of the collection and analysis of remote sensing data in the form of terrestrial LiDAR in 2010, topo-bathymetric LiDAR in 2017 and again in 2020. The Program has used the products generated from the point cloud data sets to better understand and classify changes occurring in the channel and on the floodplain. The 2010 data set was the foundation for the development of the 2011 Plan (Anchor QEA Nov 2011) and was used to conduct change detection analysis following the collection of the 2017 dataset during the Program's adaptive management loop and the development of the 2021 Plan (Anchor QEA 2021). The significant flood event (Figure 3) in February 2020 triggered a new adaptive management loop and supported the collection a 2020 topo-bathymetric LiDAR dataset in November of 2020 for the purpose of bracketing the flood event for learning. The collection and analysis of that data set is being conducted by CTUIR an effort summarized in the following section.

Project Title: 2020 Tucannon River LiDAR Data Collection and Analysis

Implementer: Confederated Tribes of the Umatilla Reservation

BPA Programmatic Funding (2010-077-00): In 2020 \$182,785 (86153)' Terrestrial NIR LiDAR, Topo-bathymetric LiDAR, 4-Band Orthophotography Acquisition, Post-processing and Data Analysis.

Matching Funds: Matching funding toward this project comes from the FY20 SRSRB Regional funds, at a sum of \$73,000 (IAA 20-2013).

Location: Tucannon Basin floodplain and major tributaries.

Project Time Line: LiDAR acquisition in November 2020 and 4-Band Orthophotography acquisition in May 2021. In 2021, the Program, QSI and Anchor QEA will work together to analyze the 2011, 2017, and 2021 LiDAR datasets. A final draft document is planned for completion in the spring of 2022.

Priority Populations: The 2020 LiDAR data acquisition and analysis will support natural habitats and native flora and fauna of the Tucannon basin through improving natural river process. Although these efforts are targeting Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened), Snake River Fall Chinook (Threatened), Columbia Basin Bull trout (Threatened) analysis of this data is intended to help restore natural process that will provide habitat for all species present including pacific lamprey and bivalves.

Priority Life Stages: All life stages.

Project Goal & Objectives: The overall goal of the 2020 LiDAR data acquisition and analysis is to provide a topographic layer to compare geomorphic changes (floodplain connectivity and channel complexity) since the 2017 LiDAR data collection. The fall of 2020, was chosen for the next LiDAR data collection, because of the 30-year flow event that occurred in early February of 2020, which is the highest flow event since Program restoration started and dating back to 1997.

Objectives:

LIDAR DATA ACQUISITION

- Acquire Topo-bathymetric Lidar Point cloud in November 2020 (Figure 13) Nov 2020
- Develop Surface Models March – April 2021
- Acquire Intensity Images, March April 2021
- Develop Vectors April-May 2021
- Develop Geodatabase to deliver surface models, vectors and raster's for 2010, 2017 and 2021 data sets. June-August 2021
- Reporting including methods, results accuracy assessment and metadata. August – November
- Presentation Ready Graphics June 2021

DATA ANALYSIS

The data analysis products are becoming available on the Tucannon River GIS Web-map at: <https://ctuirgis.maps.arcgis.com/apps/MapSeries/index.html?appid=7961a9f233684f0daf87970b37d8dc1c>. The following datasets are being made available on this site in 2023.

- Geomorphic Change Analysis
 - Geomorphic Change GIS Data: channel traces, lidar differencing, change locations shapefile (Figure 14)
 - Geomorphic Change Summary Memorandum
 - Run the GUT to model channel units (added in 2021)
- HEC-RAS Update
 - HEC-RAS file packages for both the 1D and 2D models
- Floodplain Connectivity Analysis
 - Model Result Layers in GIS Meeting CTUIR Data Standards:
 - Inundation shapefiles and depth raster at low-winter, mean-winter, 1-year, 2-year, 5-year, 10- year, and 25-year flow events
 - Connected, disconnected, and unavailable areas as part of the connectivity analysis
 - Detailed Data and Calculations for Connectivity Analyses
 - Connectivity Analysis Report
- Habitat Complexity Analysis
 - Model Result Layers in GIS Meeting CTUIR Data Standards:
 - Island, river thalweg, and valley line shapefiles used for the complexity analysis
 - Detailed Data and Calculations for Complexity Analyses
 - Complexity Analysis Report
 - Habitat Suitability Index (new in 2021)
- Presentation Ready Graphics
 - To be determined in collaboration with CTUIR and Anchor QEA throughout the post-processing period.

Summary: This work was initiated to capitalize on the learning opportunity presented by the effects of a 25-30 yr flood event on the extensive restoration action that had been implemented between 2012 and 2019. The data collection and analysis conducted in 2017-19 gave us a topo-bathymetric LiDAR data set prior to the flooding in February 2020 (Figure 3) which we bracketed with a follow up data acquisition in November 2020 prior to high water. The majority of the work conducted in 2022 was to process, calibrate and analyze that dataset and the models produced from it. We expect to be able to better understand geomorphic change including channel complexity, floodplain connectivity and stream power. Additionally, we are working to develop and calibrate a habitat suitability index model (HSI) (Maret et al 2006) now available on the Tucannon web-map, and the Geomorphic Unit Tool (GUT) for comparison of projects between pre and post flood impacts (Figure 14). Following the completion of the analysis all materials and GIS layers will be made available in the CTUIR CDMS geodatabase as well as on line in the Tucannon web map.

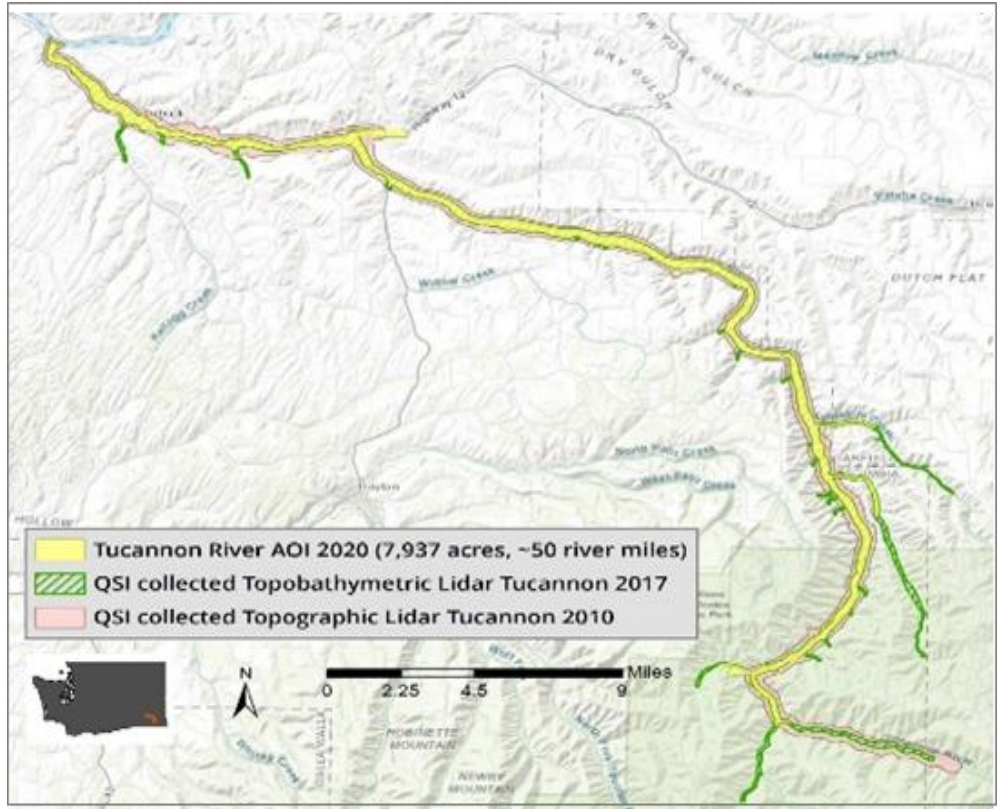


Figure 13: 2020 Tucannon River LiDAR coverage map.

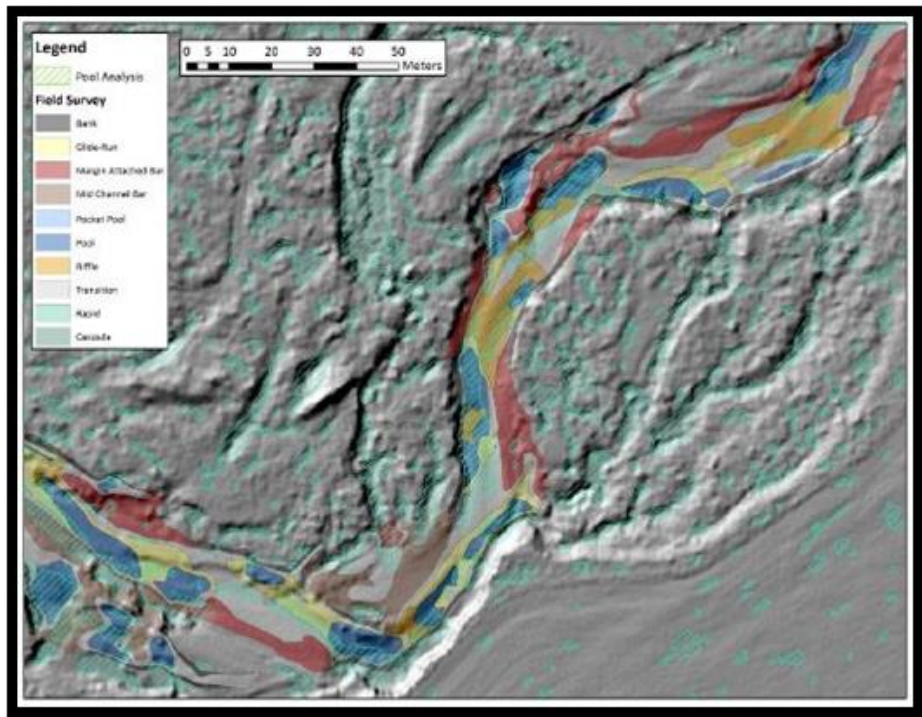


Figure 14: Example of the Tucannon LiDAR analysis classifying different habitat units using the bathymetric green LiDAR. The blue areas in the map are pools.

Partner – Projects

The following section on partner projects, is a summary of project areas designed and implemented in 2022, as well as an assessment of floodplain connectivity, completed as part of the Programs efforts to restore spring Chinook habitat and recover populations in the Tucannon River. The first project is PA 13, a project being implemented in two Phases, with Phase I completed in 2022 and Phase II planned for 2023. The second project area included in this section is PA26 a project area which has undergone a number of Phases including a Phase I levee set back in 2011. In 2022, the Program conducted a RHS following a single high water event at PA 26 Phase II, a wood loading and floodplain connectivity project implemented in 2021, to support the CCDs reporting request by the ISRP in 2021. Traditionally, the survey would have been postponed until the second winter flow following the as-built survey so an additional by the ISRP in 2021. Traditionally, the survey would have been postponed until the second winter flow following the as-built survey so an additional survey will be need in 2023. Following this section is a summary of the PA 26 Phase III-IV implementation planned for the summer 2023. In support of the ISRP request and to analyze the effectiveness of previous floodplain connectivity and channel complexity projects a summary of scheduled results from surveys of project area 28.2, 28.3 and 32.1 implemented by the CCD between 2016 and 2020 were completed but have not been included in this report.

The program has also been supporting CTUIR in the development of PA28.1 Phase II, an irrigation efficiency phase of the work be completed at PA 27/28.1 in 2020 and 2021. The design of Phase III, the final floodplain construction work at PA28.1 is planned in 2023. CTUIR has also been the lead on an assessment and conceptual design of ten miles of floodplain located on the Wooten T. Wildlife Area. The assessment and conceptual design, will consider the benefits to floodplain connectivity that could be gained through infrastructure retrofitting and removal. It's anticipated this assessment will lead to a ten-mile conceptual design with large gains in channel complexity and floodplain connectivity.

The NPT has received a SRFB grant to improved fish passage in Tumalum Creek at the Tucannon Road crossing. This project was proposed to be implemented in 2022, but has been delayed to allow Columbia County to modify the engineers design. NPT also received a grant to make improvements to channel and floodplain connectivity in the lower mile of Cummings Creek, a cold-water tributary entering the Tucannon at ~ RM 38. The NPT has also been leading an effort with the WA Parks, WDFW and the USFS to develop restoration alternatives at PA5 & 6 which could capitalize on the large area of low-lying floodplain disconnected by a levee berm set to protect the Camp Wooten access road.

Lastly the Program has facilitated a materials acquisition contract for the fish passage work in Mill Creek, on behalf of WDFW and their efforts to provide fish passage to high quality spawning and rearing habitat in the upper Mill Creek basin upriver from the City of Walla Walla.

Partner – WDFW Projects:

Project Title: PA13 Function and Complexity

Implementer: Washington Department of Fish & Wildlife

BPA Programmatic Funding (2010-077-00): In FY23 \$485,000 (CR-353507), FY19, \$1,115,000 (#74314 REL 85), In FY18, \$93,666 (#74314), In FY17, \$58,500 (#75493), In FY16, \$69,669 (#72044).

Matching Funds: WDFW received Washington State Capitol Funding to remove levees surrounding Rainbow Lake increasing available floodplain to PA13, the WDFW contribution toward the project through levee removal is \$275,000 cash. WDFW also received a SRFB grant in FY19 for \$399,991 (19-1495) to be used for additional stream restoration implementation. In 2022, WDFW partnered with CCD in securing a grant \$375,000 matching grant from the Washington State Conservation Commission Salmon Recovery Fund to supplement funding of Phase I implementation in 2022.

Project Timeline: Concept Development 2017, Design 60%-90% 2018, Final design funding site preparation and material sourcing 2019/20, Phase I started in 2018/19 with wetland planting and site preparation, however instream work was delayed in 2020 following a significant flood in February 2020 which altered site conditions and access to the wildlife Area. In 2021, material delivery and site preparation were completed with instream work beginning on July 15th only to be discontinued on July 19th on the basis of minimizing fire risk during the Green Ridge Fire fight, fire that went on to burn >50k acres in the upper basin. Phase I was completed in July 2022, and will be followed by Phase II instream and riparian planting 2023-24.

Location: Tucannon valley mile 34.8 to river mile 35.5; Start Lat/Long 46.319376 / -117.664189 End (Lat/Long) 46.309638 / -117.657055 (Figure 13-1).

Recovery Expectations: Due to the degraded nature of this project reach (Figure 13-2), and the aggressive active nature of the project design including levee removal and channel reconfiguration, it is anticipated that as-built conditions will be very close to the anticipated design objectives. Winter freshets and high flow are anticipated to redistribute and sort gravel and cobble to increase spawning habitat quality over a 2-5 yr time frame.

Priority Populations & Life Stages: All life stage for Snake River ESU Spring/Summer Chinook (Threatened), all life stages for Snake River DPS Summer Steelhead (Threatened) and adult through juvenile rearing Columbia River bull trout. It is also anticipated that spawning and rearing Pacific Lamprey will benefit from this project as well as other native non-game fish and mussel species.

Potential Future Actions: Following implementation at this project, efforts will be made to monitor gravel deposition, side channel connectivity, floodplain connectivity and riparian health. In the event monitoring efforts indicate a deficiency in meeting objectives additional

gravel and LWD loading or riparian planting may be implemented as part of the management strategy.

Project Goals & Objectives: The goal for this project is to increase floodplain connectivity and channel complexity 1.26 river kilometers between the Tucannon Hatchery weir and the Hatchery Bridge (Figure 13-3).

Short Term Objectives: Increase channel roughness and LWD structure within the 1.26 rkm reach (Phase I & Phase II), for the purpose of reducing stream power currently in excess (Anchor 2021).

- Construct 31 ELJs and supplement gravel and a cobble material to raise bed elevation and increase channel complexity.
- Place LWD complexity to achieve a minimum of 2 pieces per bank full width over a 10-year average.

Short Term Objectives: Increase floodplain connectivity to the 1.28 river km reach (Phase I and Phase II). This objective will focus on habitat recovery.

- Improve floodplain connectivity and reduce excess stream power by removing approximate 499 m of river levee.
- Improve channel complexity and reduce excess stream power by reconnect > 1600 m of isolated side channels at base and mean winter flows
- Increase habitat resilience and riparian function by reconnecting >21 acres of new floodplain at or below the 2 yr return interval.
- Provide rearing habitats and increase habitat diversity and connectivity by connecting ~3.48 acres of off channel wetland habitat.
- Construct three roughened channel bed lifts to reconnect floodplain, connect secondary flow paths and increase channel length.

Long Term Objective:

- Reestablish floodplain associated habitats and benefits as identified in the 2021 Plan (Anchor QEA, 2021)
- Improve adult holding pools (>1m deep) for spring Chinook and steelhead
- Improve spring Chinook spawning habitat by reducing excess stream power and increasing residual pool depth and creating pool tail outs.

Project Background and Prior Efforts:

Background: Project Area 13 was identified as a high priority restoration project in the 2011 Plan (Anchor QEA, 2011) and was prioritized in the plan for early implementation and approved for funding by the Regional Technical Team and the SRSRB, in 2019. The project reach was

characterized as being highly confined by the levees protecting Rainbow Lake and the Tucannon Fish Hatchery infrastructure (Figure 13-3). As a result of infrastructure needs, the river reach had been straightened and became incised below the hatchery fish trap reducing channel complexity (Figure 13-2). The reach is located in the center of the Tucannon spring Chinook spawning reach and while a relatively high proportion of redds are observed within the reach annually, habitat conditions for spawning and redd integrity are poor due to high stream power (Anchor QEA 2020). Habitat complexity is also limiting, with few deep pools (Figure 13-3, Table 13-1) for adult holding or low velocities for juvenile rearing. Due to poor floodplain connectivity and low channel complexity the project design focused on expanding floodplain through a combination of removing confining levees, reducing channel incision and connecting disconnected side channels. The reach objectives for this project area were identified in the 2011 Plan and were supported and refined through data collected during the pre-project RHS in 2020 and 2021, which identified >1,200 m (Table 13-1) of disconnected perennial and ephemeral side channels that could be available for reconnection through removing confining features and reducing channel incision. Although mean pool depth was meeting the restoration objective in 2020, that value is a result of a couple very deep pools that formed during the 2020 flood, pool area and frequency remain below the objective for pools (Table 13-1).

In 2016, WDFW initiated the removal and set back of the Rainbow Lake dam, which was confining river meander and floodplain connectivity within PA13, increasing available disconnected floodplain by >3.6 acres. These acres were previously lake bed (Impoundment) and remained behind ~292 m of river levee until 2018 when the levee/dam was removed by WDFW (Figure 13-4) as the first action implemented out of the Floodplain Management Plan (WDFW 2012). The removal of the Rainbow Lake dam allowed for the creation of wetland habitats in the footprint of the displaced reservoir. In 2018/19, the Program worked with WDFW in the establishment of this wetland through the shaping of the landform (WDFW match) and planting of wetland plant species (Figure 13-5).

In early February of 2020, the upper Tucannon basin was impacted by a significant event flood (Figure 3) following a 5-9-inch rain on snow event which lead to significant landslides and road closures across the upper basin. As a result of the event and road closures the implementation of this project was delayed one work window from 2020 to 2021, with site access and materials sourcing being delayed into the spring of 2021. Site conditions were assessed and some minor adaptations were made to the design. Overall conditions in the project areas remained the same following the flooding however in areas where the river migrated and recruited LWD materials, habitat units like deep pools did form. A pre-construction survey was conducted prior to the window in 2021, with metrics available for comparison indicating very little change in 2020 following floods (Table 13-1).

In 2021, site access and material delivery were completed in the spring prior to July 15th when instream work was initiated. About the same time two wild fires had ignited following a

thunderstorm event which burned in both the Tucannon and Asotin basins. By July 19th the fire which was named the Green Ridge Fire had expanded leading to the suspension of all public and none fire related activities within the Wooten Wildlife Area and the Umatilla National Forest. This fire grew to ~ 50k acres and although the work site was not included in the burn area, the fire persisted throughout the remainder of the in-water work window, delaying Phase I into the 2022 work-window.

Prior Efforts: In 2019, the Program coordinated with WDFW in the planting of the Rainbow Lake wetland as part of the reconstruction of the off-channel impoundment seasonally used to supply water to the Tucannon Fish Hatchery (Figure 13-4, Figure13-5). The reservoir was built through the Lower Snake River Compensation Program to mitigate for lost fisheries in the Snake River, and is managed by WDFW. Beginning in 2017, WDFW began implementing the W.T. Wooten Floodplain Management Plan (WDFW, 2012) with the first project targeting reconfiguration and levee set back of the impoundment (Figure 13-4), funded by the State of WA as a capital project. The goals of this project were to reduce floodplain encroachment, improve public fishery value and enhance water supply to the Tucannon Fish Hatchery. The objective that most aligned with the Program was the removal of ~292 m of the original reservoir dam (Figure 13-4) and the creation of a 3.48-acre wetland on the previously inundated reservoir bed. The reservoir was drained in 2017 and the new impoundment was dredged to a new configuration and depth leaving an area of ~5.5 surface acres. In the fall of 2018, a new dam was constructed excluding ~3.5 acres of reservoir bed, which was reshaped and planted with wetland species (Figure 13-5) in a joint effort between the Program and WDFW. The wetland was planted in March 2019 with ~3,000 willow, and ~500 cottonwood plugs and 250 river birch plugs. Within the wetted perimeter ~500 Juncus and Carex native spp. plugs were planted (Figure 13-5). The wetland has become established and remains in good condition following inundation during 2020 flooding event, it is anticipated that this wetland complex will be connected to the main-stem Tucannon River as part of PA13 Phase II being implemented in 2023.

Project Summary: Project Area 13 was designed by WDFW in 2018-19 and updated in 2020, with the primary goal of reconnecting & creating floodplain to increase meander potential, inundation at base flows and reduce stream power through a variety of treatment actions in the main channel, along the banks, and within the floodplain (Figure 13-3). The treatments include; removal of river levees and rip rap, reconnecting side channels, construction of a channel meander, and construction of instream habitat features such as engineered log jams and hardened riffles to raise the river bed, the placement of LWD materials to provide channel roughness, and habitat complexity, and riparian planting. The principal benefits of implementation is restoration of historic spring Chinook spawning, juvenile summer and winter rearing and adult holding habitats. The associated recovery of riparian areas is expected to be enhanced resiliency by naturally occurring flooding over the long term.

Implementation Actions (Phase I 2022 implementation): In 2019, WDFW funded the removal of 292 m of levee associated with Rainbow Lake (Figure 13-4) in preparation of the floodplain and stream work being implemented in following years (2022 & 2023). As part of this effort a 3.48 ac wetland (Figure 13-5) was created within the displaced Rainbow Lake impoundment. This wetland is set within connected floodplain as part of Phase I, but will be connected to regular stream flows from the Tucannon as part of Phase II. In 2020, the wetland was inundated during the peak flows (Figure 3) >25 yr flood to an estimated depth of >0.3 m with no visible impacts or evidence of high velocities. Typical flood flows have not regularly inundated the wetlands.

In 2022 Phase I implementation, 287 m of river confining levees and rip-rap were removed and/or perforated to reconnect low-lying floodplain and disconnected side channels (Figure 13-3). In association with these removal efforts two main channel plugs were constructed to elevate surface water elevations, connecting large side channels (>25% total flow) and increasing frequency/duration of floodplain inundation. Log jams and mobile LWD were placed in 29 location (Table 13-1) to increase channel roughness, cover and support the development of channel complexity including developing bars, pools and side channels. Additionally, eleven structures were built on the floodplain to provide roughness during winter seasonal flows. Approximately 1.3 acres of adjacent floodplain and riparian areas disturbed by levee removal and project access were planted with mixed grass seeding, live stake willows and ~ 600 woody stemmed native shrubs and trees including river birch, cottonwood and ponderosa pines.

Phase II implementation is planned to occur in 2023, and will include the removal of 175 m of river levee and the construction of; ~ 100 m of new river meander, 110 m new perennial secondary channel and one ephemeral side channel connecting 3.48 ac of wetlands. A channel plug will be constructed to elevate water surface increasing connectivity to perennial side channels and floodplain. Engineered log jams and mobile LWD will be placed in the main channel and on the floodplain. A more detailed construction as-built summary will be produced in the 2023 update to this report.

Physical Habitat Results:

Floodplain connectivity and channel complexity were measured using three rapid habitat surveys conducted during base flow (<130 cfs) during the summer of 2020 & 2021 (pre-project) and 2022 post Phase I implementation (Table 4). These surveys in combination with pre-project remote sensing spatial data (2017 & 2020 bathymetric LiDAR) are the source for physical habitat data used to conduct implementation and change detection monitoring in this report. Metrics are summarized for the entire project reach (1.26 km) although Phase II has not been implemented, so project targets are not expected to meet overall project goals & objectives until the completion of Phase II in September 2023.

Phase I LWD installation increased the overall number of LWD key pieces from 0.31 to 2.38 key pieces per bankful width meeting the Program objective of 2 per bankful width. Fifty-eight

percent of log jam construction was associated with pool formation increasing pool frequency from 8 to 23 (Table 13-1), with a mean maximum depth of >1 m.

The removal of levees, associated channel plugs and placement of logjams reconnect 10.88 acres of low floodplain increasing connectivity by 28% (Figure 13-6 & Figure 13-8) at the 2 yr return flow or less. An additional 2.92 acres of existing wetland was connected just north of Rainbow Lake impoundment by replacing the culvert under the hatchery diversion pipeline access road (Figure 13-8). An additional 3.48 acres of wetland created in 2018/19 (Figure 13-5 & Figure 13.8) when 292 m of lake levee/dam was removed, is now included within the floodplain footprint, but is disconnected from the top end to perennial flow.

Overall floodplain connectivity increased 28 % (Figure 13-6 & Figure 13-8) and new low-lying floodplain increased 21%. The Phase II work in 2023 will further increase connected floodplain and connect the remaining wetland adjacent to Rainbow Lake (Figure 13-8) as well as the remaining available disconnected floodplain areas.

The immediate impacts to channel shape include an increase in active wetted area during base flows from ~3.87 ac to 5.76 acres a 33% increase, which is largely attributed to increase in large side channels (Figure 13-9). Channel habitat units show significant (40%) decrease from riffle/rapid habitat types to glides, pools and side channels (Figure 13.10), and improved channel unit diversity. Large planar riffles (Figure 13-13 & 13-14) were targeted for conversion to glides and pools (Figure 13-9) for the purpose of increasing deeper lower velocity Spring Chinook rearing habitats. The work reconnected >1.6 km isolated side channel (Figure 13-12) (~50/50 perennial-ephemeral) habitat through the removal of 287 m of river levee and riprap, and the placement of associated log jams and channel plugs (Figure 13-3).

One of the primary goals of this project was to increase river channel complexity demonstrated as an increase in stream length and intersection node measured by the River Complexity Index (RCI) (Brown, A.G, 2002). RCI was calculated for the project reach across the three survey years (Figure 13-11), in which post Phase I implement shows an 80% increase. This value will be used as one of the trigger metrics, in which a 20% decline would trigger consideration for adaptive management actions. Channel complexity is also being monitored using change in channel habitat units (Figure 13-9). The change in channel units between pre/post implementation exhibited a 40% decrease in plain bed riffle channel type distributed across pools, glides, slow off channel pools and side channels (Figure 13-10). These two metrics will be track (Figure 13-11) as part of the Tucannon Adaptive Management 2-5 yr review by the Program.

The last measure for this project area is Habitat Suitability Indices (HSI) for spring Chinook, summer steelhead and bull trout across low winter, mean winter and 1 yr flow events. The results of this effort can be visualized at the Tucannon River Restoration web-map at the following link

<https://ctuirgis.maps.arcgis.com/apps/MapSeries/index.html?appid=7961a9f233684f0daf87970b37d8dc1c>.

Initially in 2020, when this data was collected the analysis shows very little suitable habitat for any of the species of interest during the pre-project period (Figure 13-15). The near absence of slow deep water is the result of channel confinement and disconnected floodplain and has likely hindered the success of spawning and rearing Chinook within this reach. The target of this project was to increase the relative area of soft water winter rearing habitats (Figure 13-12 & 13-13), HSI will be updated in following future LiDAR surveys.

Current Emphasis:

Beginning in the winter of 2022-23, riparian planting was initiated and will be ongoing as the site shapes up and fine sediments are deposited on cobbles exposed during Phase I levee removal. Site access and material will begin for Phase II construction, which is planned for the summer of 2023.

Table 13-1: PA13 reach objectives and pre-project rapid habitat survey metric results collected 2020, and 2021 are presented below. The table provides the summery results of rapid habitat surveys conducted to capture pre-project post project conditions with future surveys identified as 2 year follow up on post project conditions. Project metrics in this table include main channel length in meters, side channel length for both perennial channels and ephemeral channels in meters, LWD key pieces (>6 m long and 0.3m dia.), the number and type of LWD jams or single logs and the frequency depth and areas of pools.

Project Area Survey Type	Main Channel Length (km)	Side Channel (m)		LWD Key Piece (#)	Structure #		Pools		
		Peren	Ephem		Jams	Single Log	Freq. (#)	Area (m ²)	# Pools > 1 m deep
PA13 Pre-project 2020	1.26	220	268	28	3	8	8	874	5
PA13 Pre-project 2021	1.26	71.5	307	36	7	7	8	882	8
PA13 Phase I Post 2022	1.28	1525	405	214	36	6	23	3923	16
PA13 Phase II Objective 2023		>1,800	>600	350	56	12	30	4000	18

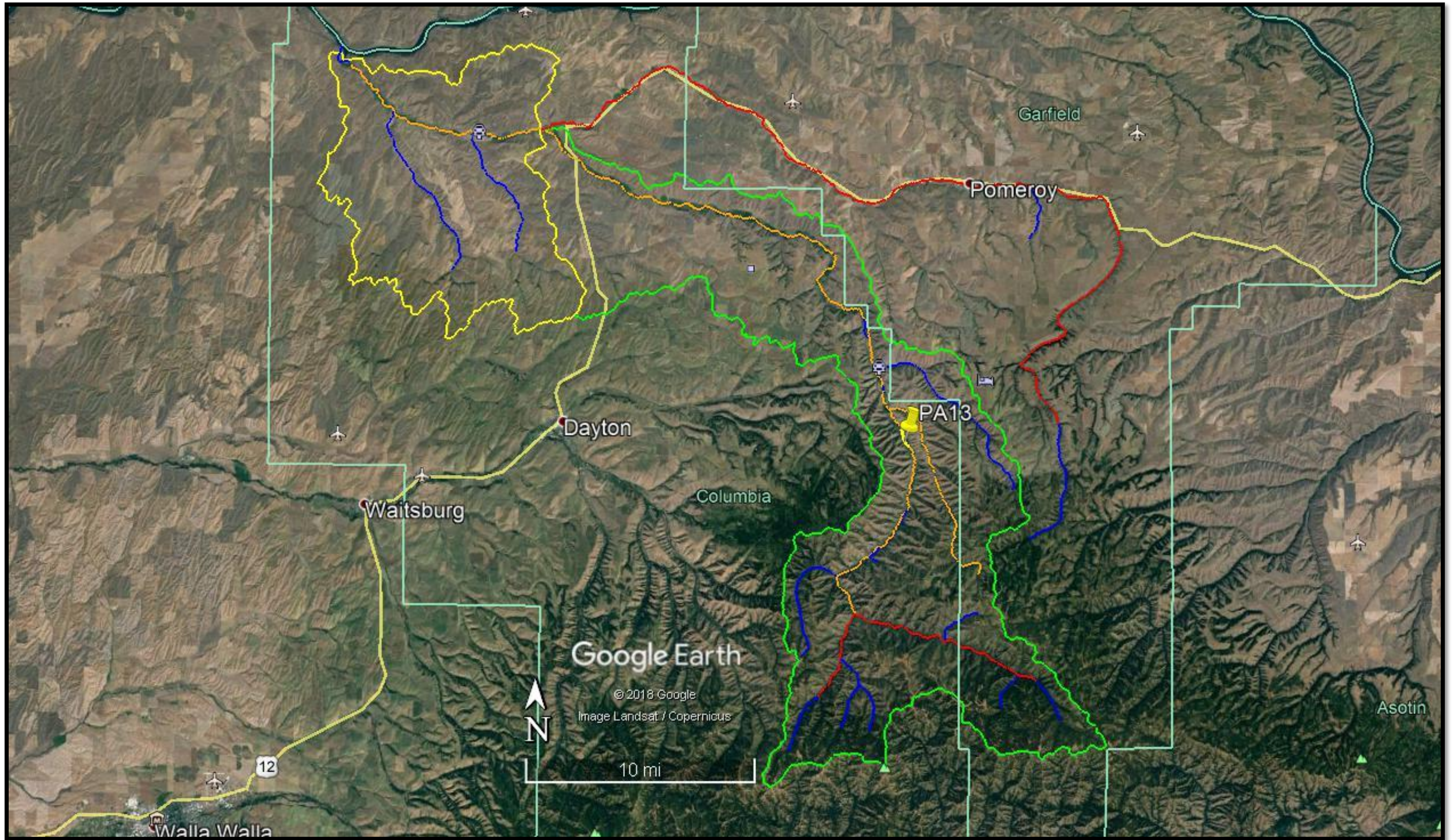
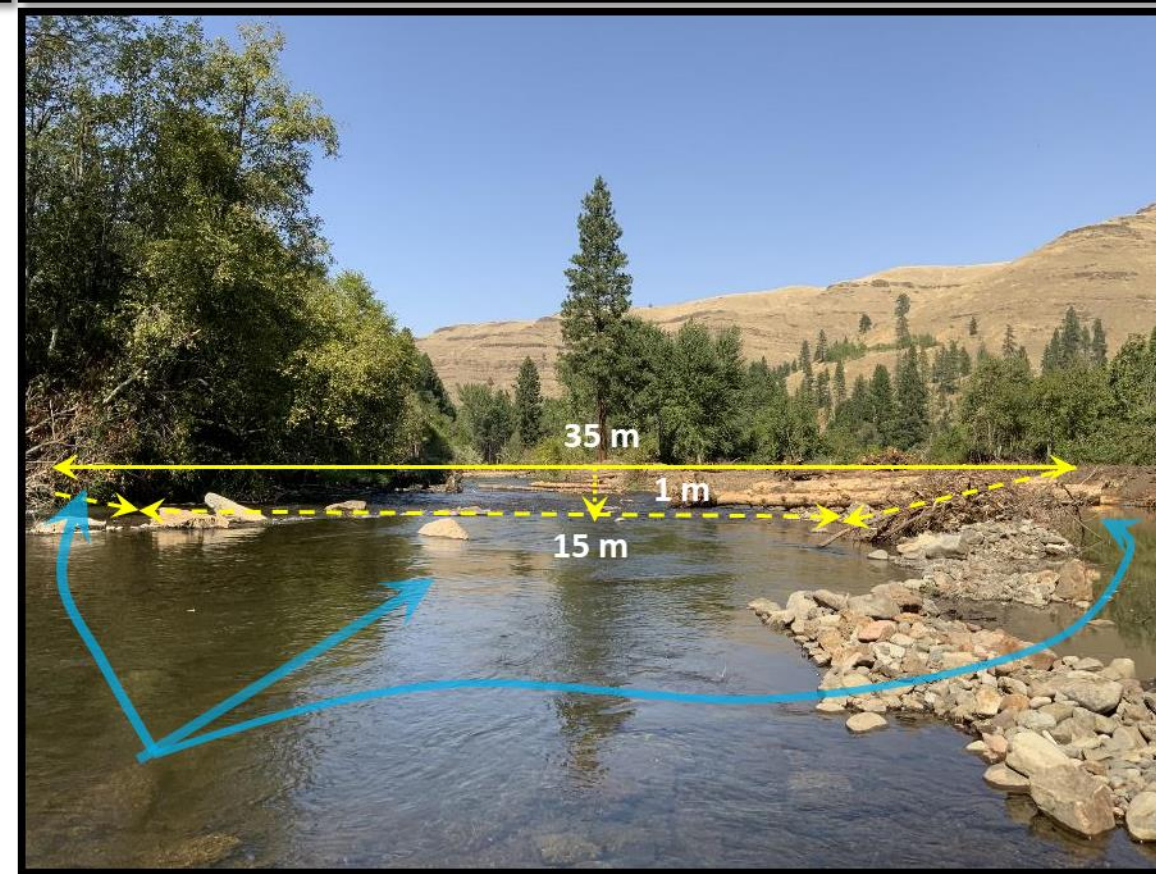


Figure 13-1: Project Area 13 is located in the upper Tucannon River from valley mile 34.8 to 35.5, center point Lat/Long: 46.314864 Long: -117.662192 on the WDFW managed Wooten Wildlife Area.



Figure 13-2: PA13 levee removal and channel plug location 2021 to post Phase I implementation in 2022. Upper left illustrates the river confined on the right by a steep rip-rap protected bank on the right and the valley wall on the left illustrating a confined bank full geometry which leads to unnatural stream power for the Tucannon and the stream bed exposed during construction dewatering (upper right). Removal of the right bank levee and rip-rap reduces the depth of bank full geometry (lower right) bring stream power back to values predicted based on valley metrics. The blue arrows indicate flow direction as well as flow paths during high water events.



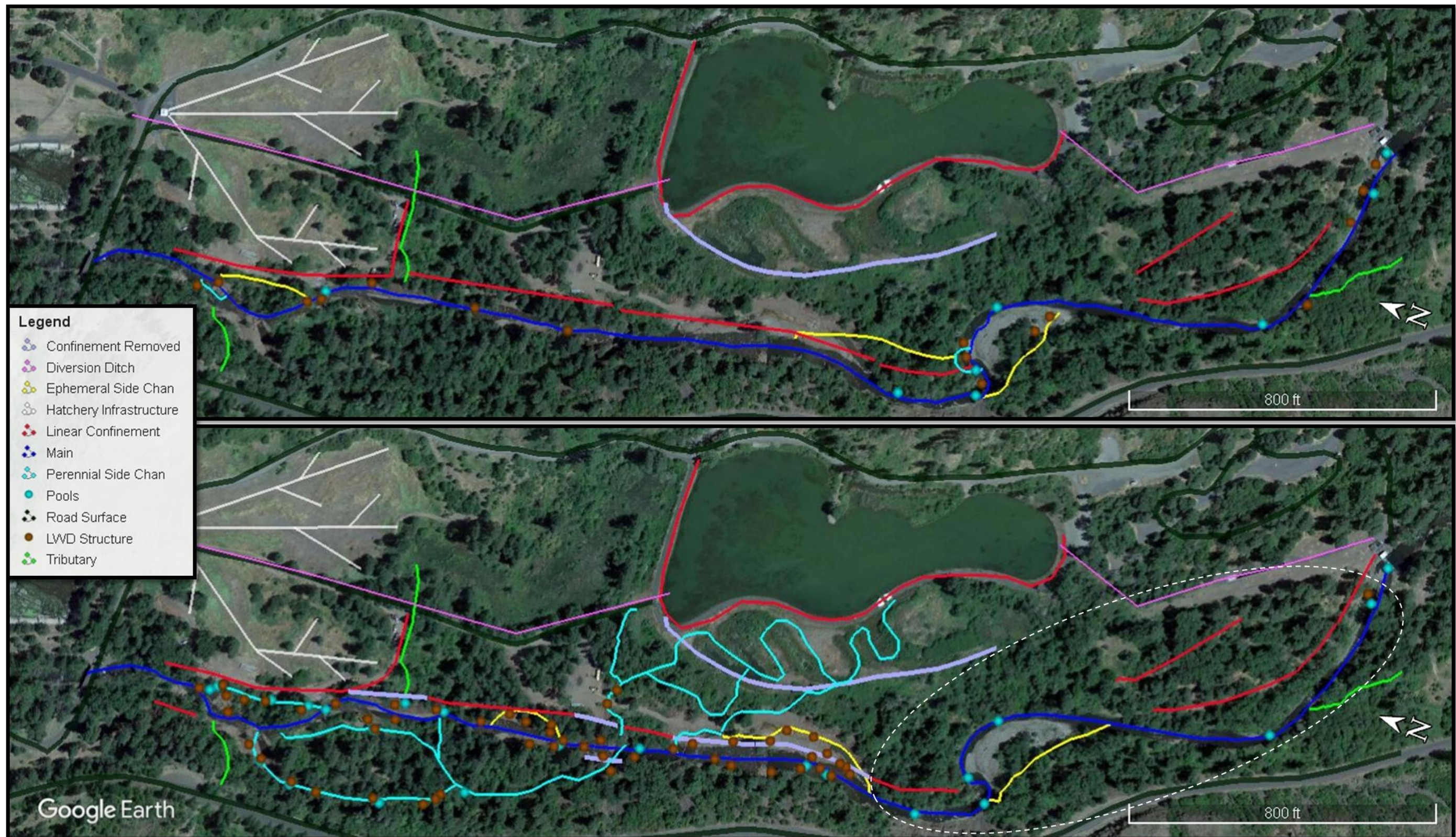


Figure 13-3: Project Area 13 (PA13) pre-project condition (upper map) as surveyed in the summer of 2020 in preparation for 2021/22 implementation. The pre-project condition exhibits a straight channel (Sinuosity of 1.15), which has been maintain adjacent to hatchery infrastructure (upper). In 2022, WDFW initiated Phase I implementation illustrated in the left half of the lower map image. The white dashed oval illustrates the project reach to be implemented during Phase II in 2023. Detailed habitat metrics can be viewed in the associated report (Table 13-1).



~7.5 ac Lake

Dry Lake Bed



Legend

Levee Removed



New Levee Setback



Wetland Planting

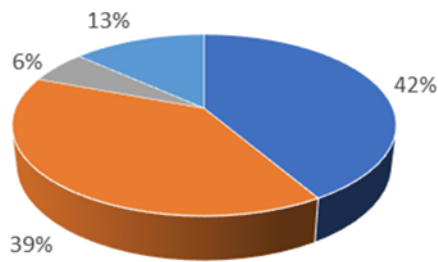


Figure 13-4. Rainbow Lake is an off-channel impoundment used to supply water to the Tucannon Fish Hatchery and is also used as a put and take fishery to offset lost fisheries in the lower Snake River basin (upper left). The reservoir was built through the Lower Snake River Compensation Program to mitigate for lost fisheries and is managed by WDFW. Beginning in 2017, WDFW began implementing their Floodplain Management Plan and initiated the reconfiguration of the impoundment funded by the State of WA as a capital project. The goal was to reduce the impoundments encroachment on the floodplain while improving public fishery value and hatchery use. The objective that most aligned with the Tucannon Habitat program is the removal of ~292 m of the original reservoir dam (upper right image) and the creation of ~3.5-acre wetland in the old reservoir bed. The reservoir was drained in 2017 (upper right) and the new impoundment bed was dredged to a new configuration and depth (lower left) leaving an area of ~5.5 surface acres. In the fall of 2018, a new dam was developed (lower left) excluding ~3.5 acres of reservoir bed (left two images) which was reshaped to be planted with wetland species. The wetland was planted in the November 2018 and March 2019 with ~3,000 willow, and ~500 cottonwood plugs and 250 river birch plugs. Within the wetted perimeter ~500 *Juncus* and *Carex native spp* plugs were planted. The wetland planting was conducted as a partnership between WDFW and the Tucannon Habitat Programmatic, it is anticipated that this wetland complex will be connected to the main-stem Tucannon River as part of PA13 being implemented in 2023.

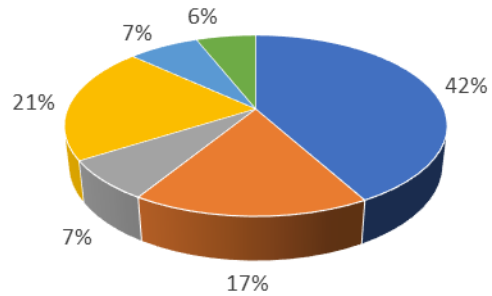


Figure 13-5: The Rainbow Lake Levee set back wetland was created in 2018/19 as part of an effort by WDFW to reduce the impacts of infrastructure on salmon habitats.

2021 Floodplain Connectivity



2022 Floodplain Connectivity



- Disconnected Unavailable
- Disconnected Floodplain
- Existing Low Floodplain
- New Low Floodplain
- Disconnected Wetlands
- Connected Wetlands

Figure 13-6: Floodplain connectivity measured in the field prior to implementation of Phase I in 2021 followed by the Phase I post construction survey in the autumn of 2022. Low lying floodplain is characterized as bring less than the 2 yr return interval. Disconnected floodplain is characterized as being greater than the 25 yr as measured in 2020 following an estimated 25 yr event in the basin. Floodplain disconnected and unavailable is floodplain separated from the active floodplain by levees protecting hatchery infrastructure. This site has a wetland within the riparian area and connectable to the low-lying floodplain. New low floodplain is floodplain connected through restoration actions in 2022 Phase I. Addition disconnected floodplain is targeted for connection in 2021



Figure 13-7: Low-lying floodplain reconnected in Phase I and inundated at base flow August 2022, at PA 13.

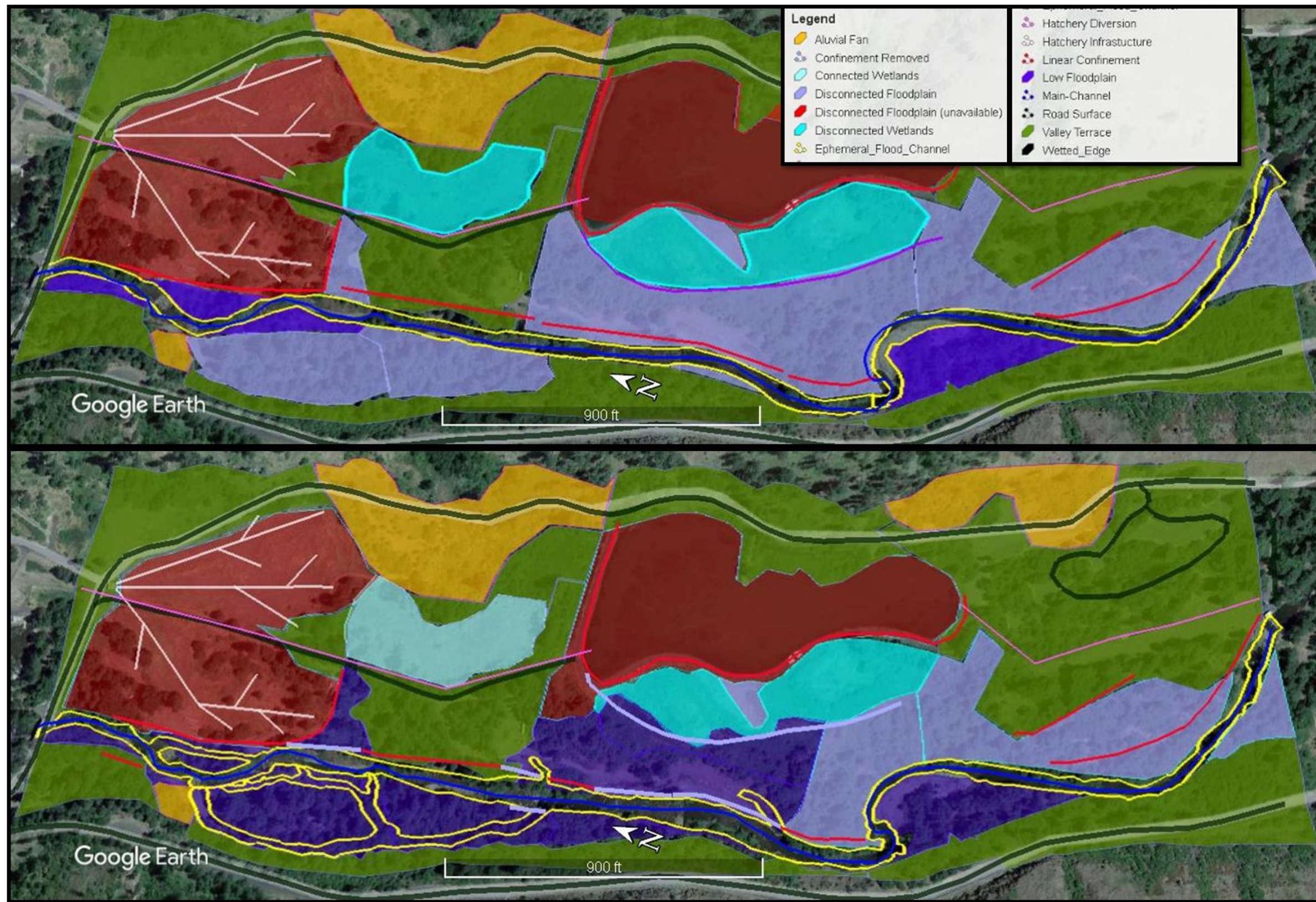


Figure 13-8: Project Area (PA) 13 valley bottom delineation map highlight existing connected, disconnected and disconnected unattainable floodplain acers. The PA has two riparian wetlands on the valley bottom including one associated with Rainbow Lake seepage and one created when Rainbow Lake was reconfigured in 2018 both wetlands will be connected to the river and flood flows following construction of Phase II. The yellow polygon in each map illustrates the delineated wetted perimeter at the time of the survey.

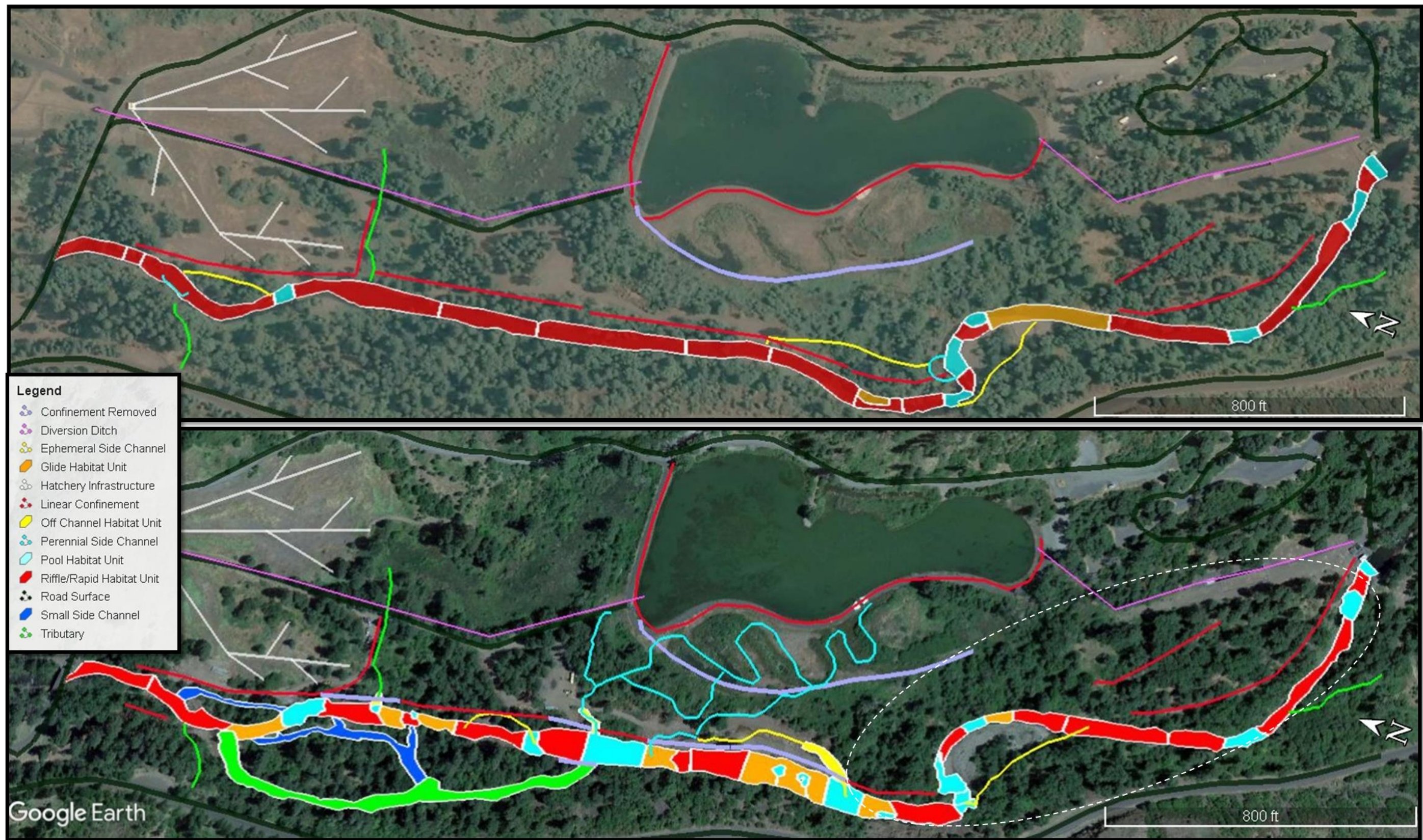


Figure 13-9: Project Area 13 channel habitat units assessed during rapid habitat surveys completed in 2021 (upper map) and post project 2022 (lower map). The white dashed oval indicated natural change that occurred between 2021 and 2022 in the Phase II reach of the project where implementation is planned for 2023. The large green polygon indicates the reconnection of a large side channel which was created in 2022 Phase I (lower map).

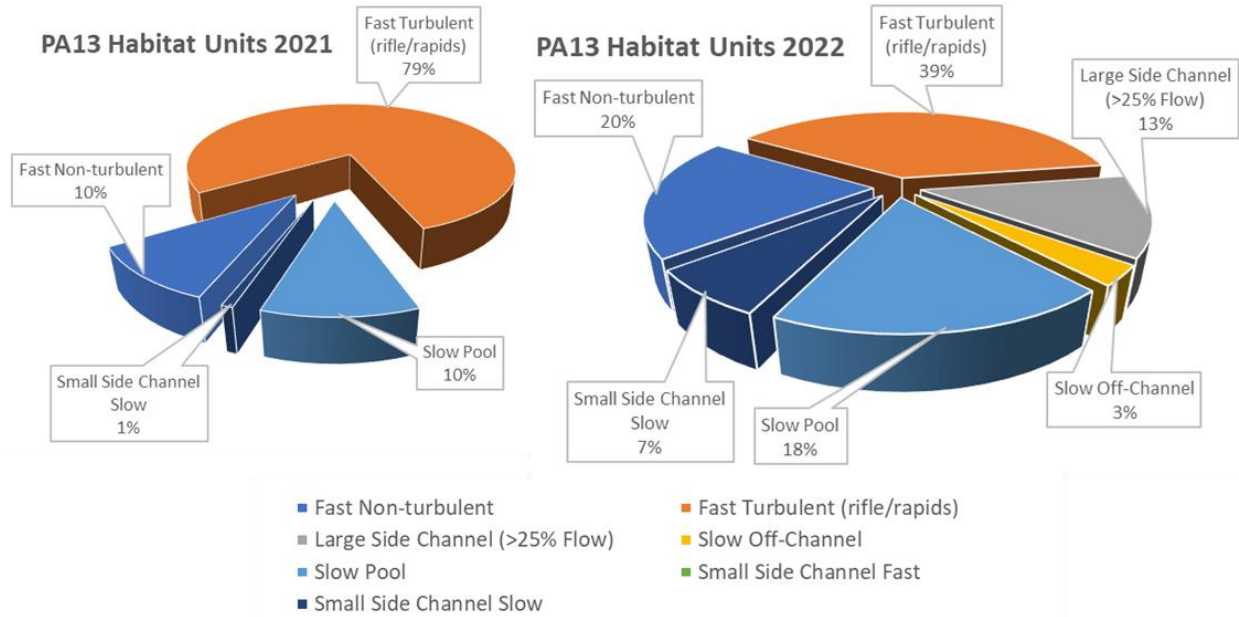


Figure 13-10: The Tucannon CHaMP program completed a habitat unit assessment in 2016 and found a ratio of 59% riffle rapids, 34% glide and 7 % slow pool. Following a similar strategy in 2021 the Program found the pre-project condition to be very similar (upper left). A follow up survey was completed in 2022 to capture the Phase I implementation (upper right) illustrating an increase in the number of channel unit especially an increase in slow water units.

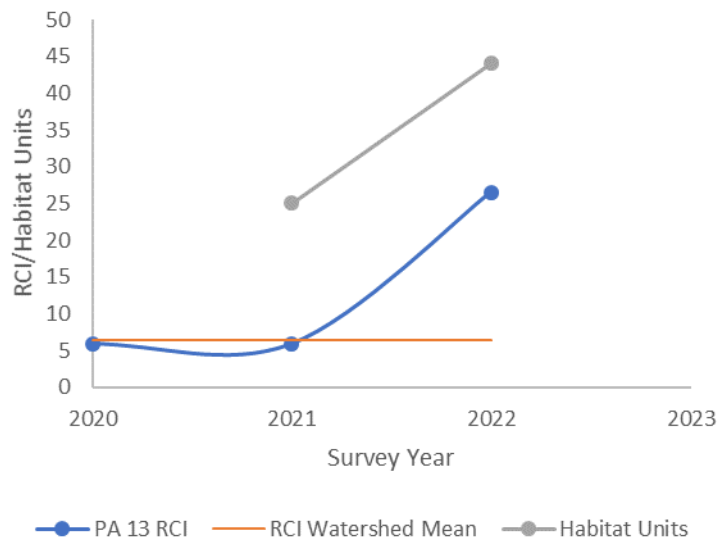


Figure 13-11: Project area 13 change in River Complexity Index (Citation) across three survey periods with two surveys prior to Phase I restoration actions and one following restoration in 2022. Channel complexity was calculated for the entire 1.28 miles survey reach although only the lower Phase I reach was implemented in 2022. It is anticipated this index will increase following restoration in 2023. The orange flat line represents the calculated mean RCI for all untreated project areas within the basin. The 2022 maximum



PA13-12: PA 13 Phase I side channel (upper right & left) and off channel units (lower left and right) created through removing confining features and channel plugs.



Figure 13-13: Project area 13 Phase I pre/post project images of areas influenced by channel plugs. The upper photo set illustrates the riffle rapids section of the river back watered and converted to a long glide by construction of the upper plug. The lower pair of images depicts the conversion of plain bed channel type to glide and deep pool habitats.



Figure 13-14: Project area 13 channel reached impacted by levee and rip-rap removal pre-project (left upper/lower) and post project as-built 2022. The upper photo set shows the upper leveed section with channel fill placed to elevate water surface to activate low-lying floodplain and side channels.



Figure 13-15: PA13 pre-project Habitat Suitability Index (HSI) for spring Chinook during under mean winter flows (300 cfs). Notice that pre-project condition harbored very little suitable habitat for spring Chinook in 2020 when this LiDAR data set and analysis was conducted. This is primarily due to the predominant plain bed channel form present 2020-up to construction in 2022 Phase I, illustrated by channel habitat unit surveys (Figure 13-9). A follow up survey will be conducted following completion of Phase II in 2023.

Partner – CCD Projects

Project Area 26 Phase I-IV

Project Area 26 Introduction: The CCD has been engaged working at Project Area 26 (Figure 26-1) predating the development of the Tucannon Conceptual Restoration Plan (Anchor 2011) with the planting of riparian, irrigation efficiencies and upland BMPs. In 2010, the CCD expanded the project concept for instream restoration at the site to conduct the Geomorphic Assessment (Anchor 2011) which led to the development of the 2011 Plan (Anchor 2011). The project's initial goal (Phase I) was to remove river confining features along the 4.11 km long reach, removing bank side levees and develop a levee set-back opening ~60 ac of floodplain (Figure 26-2). In 2011, conducting levee removal was new to the Tucannon and SE Washington, and the notion was that the river would develop habitat complexity given the increase in floodplain connectivity, however the 2021 Plan (Anchor QEA 2021) has identified greater site potential for floodplain side channels and floodplain connectivity. The resulting adaptive management actions have been developed into a number of phased restoration actions partitioning and over-lapping the larger project area over a number of years (Figure 26-2) with a purpose of increasing channel roughness increasing lateral channel migration and increased inundation of available floodplain. Phase I was implemented in 2010-13 and involved removing confining features, building a levee set-back and placing LWD structures (~3/km). Phase II was initiated in 2020 (Figure 26-2), and completed in 2021 with the construction of high density LWD structures (~28/km) to rebuild channel bars and increase inundation of available floodplain. Phase III-IV (Figure 26-2) is currently being developed, and focuses on reconnecting available floodplain and side channel habitats, with planned implementation in 2023. When all these projects are completed PA26 should have large areas of seasonal inundation, more than double the perennial length of channels and twice as many pools while maintaining current agricultural operations. The following sections will detail the Phase of restoration completed and planned for PA26.

Project Title: Tucannon (PA26 Phase I) River Off-Set Dike Design & Implementation

Implementer: Columbia Conservation District

BPA Programmatic Funding (2010-077-00): In 2010, the SRSRB (the “Program” was not yet developed) worked with the CCD providing technical support in developing grant request and in the field through biological technical review.

Other BPA Funding (1994-018-06): In 2011, \$64,000 (#50146) and in 2013 \$152,000 (#59663)

Matching Funds: In 2009 and 2010, the CCD was awarded two SRFB grants totaling \$694,260 (10-1633 & 9-1742) to remove the river levee. In 2016, a \$50,000 grant from the Conservation Commission was awarded to conduct maintenance actions.

Location: Tucannon River valley mile 21.5 to 23.9 (Figure 26-1), center point Lat/Long: 46.444158 Long: -117.760300.

Project Time Line: The initial project (Phase I) including levee removal and setback, was completed in 2011. Phase I of the LWD structure placement was completed in 2013 (#59663 - #50146).

Recovery Expectations: In 2011, levee removal was a novel restoration approach which required a subtle approach to build landowner buy-in and public support. As a result, the levee removal was completed by lowering it to the level of the surrounding floodplain without further channel modification. The plan was to wait to see if natural process would result in a return to more desired conditions. In 2013, it was apparent, by the lack of positive habitat gains, channel modifications would be required, so a small LWD project was incorporated to initiate channel migration. It was expected that these LWD jams would provide benefits in a 3-5-year timeframe.

Priority Populations: Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened), Columbia River bull trout (threatened), Pacific Lamprey (SPP of Concern). Freshwater mussels have not been identified in the project reach but are present locally.

Priority Life Stages Targeted: All life stages

Potential Future Actions: At the time of construction it was planned that LWD structures/channel manipulations would be constructed as future projects in the event river process were not able to increase pool, and LWD frequency on its own.

Project Goals and Objectives

Goal: Return ~ 4.1 km of the 4.8 km long PA26 (Phase I), identified in the Tucannon Conceptual Restoration Plan (Anchor QEA, 2011) and located on three private farms, closer to its historic, naturally functioning state, increase fish habitat quality/quantity and floodplain connectivity.

Objectives:

- Improve floodplain connectivity and channel complexity breaching/removing 2,611 m of existing levees and gravel berms.
- Conduct follow up surveys to determine if LWD structures would be needed as adaptive management.
- In 2013, 15 LWD jams were installed to increase channel roughness.
- Reestablish 4 ac of riparian habitat where levees were removed.

Background & Project Summary

Background: The river reach treated as part of this project was severely impacted by the flood of 1964 and again in 1996 (Figure 3) leading to the construction of a number of rock revetments, levees, rip rap and gravel berms (Figure 26-2) to protect infrastructure and agriculture. Between 1996 and 2005 much of the reach was enrolled in the CREP program and

the reestablishment of riparian trees was well underway in 2011 when levees were removed and set-back. Irrigation efficiencies were installed for irrigated agriculture and the riparian areas were fenced to exclude live stock. To minimize fine sediment inputs from upland activities an off-channel sediment basin was constructed on river left near the middle of the project area. By 2009, correspondence between the CCD and the two landowners began for developing a restoration project to aid and benefit salmon and steelhead. In the 2009 SRFB grant round, the CCD was asked to expand its site assessment from the PA26 footprint to a larger geomorphic assessment of the entirety of the Tucannon basin. The Tucannon Geomorphic Assessment (Anchor QEA 2011) and the subsequent Tucannon Conceptual Restoration Plan (Anchor 2011), were the result of the cooperation between the CCD, SRFB and landowners.

Summary: In 2011, 945 m of river levees, rip-rap and gravel berms were removed or breached throughout the entire reach (Figure 26-2) as part of the 4.1 km long PA 26 Phase I project. The goal of Phase I was to restore properly functioning geomorphic condition by reducing river channel and floodplain confinement from disconnected to connected at a 2 yr interval. In 2011, levee removal was a relatively new and innovative restoration technique for SE Washington, resulting in a conservative approach being implemented where the levee was removed and set back in the first year, and channel modifications would be delayed to make observations on how the channel would recover naturally (“letting the river do the work”). Based on observations made in 2013 following two high water events, fifteen log jams were placed within the 4.1 km reach as a pilot effort in accordance with landowner’s wishes at the time. Monitoring surveys conducted by CHaMP and the Program between 2012 and 2017 indicated limited change in channel shape or gravel storage within the reach and that the ~60 ac of low floodplain liberated by the 2011 levee removal project had experienced very limited flood inundation in 2012 and none between 2013 & 2017. The CHaMP program recommended additional LWD structure placement to sort and retain gravel bars to encourage lateral channel migration and increased floodplain inundation frequency and duration (Hill 2017).

Results/Discussion: In 2011, a little over 945 m of levee, rip-rap and gravel berms were removed as part of the work completed in Phase I (Figure 26-2). Following two high flow events in 2012 (Figure 3), inundation of the available floodplain had not been observed and a low-density LWD structure treatment was conducted to initiate habitat gains. By 2017, changes in channel habitat complexity like pools and bar had increased (Hill 2017) but floodplain connectivity and complexity remained below targets set in the Salmon Recovery Plan SE WA (SRSRB 2011). It is hypothesized that channel size/volume had not been reduced through roughness and deposition significantly enough to reduce power or increase inundation of adjacent floodplain. In 2019-20, the CCD initiated an adaptive management action (Phase II & Phase III-IV) developing a design through a phased approach (Figure 26-2) to increase floodplain connectivity and channel complexity. The action would focus on increasing channel roughness, reducing stream power and increasing access to side channels and more frequent inundation of the floodplain as described in the next two sections of this report.

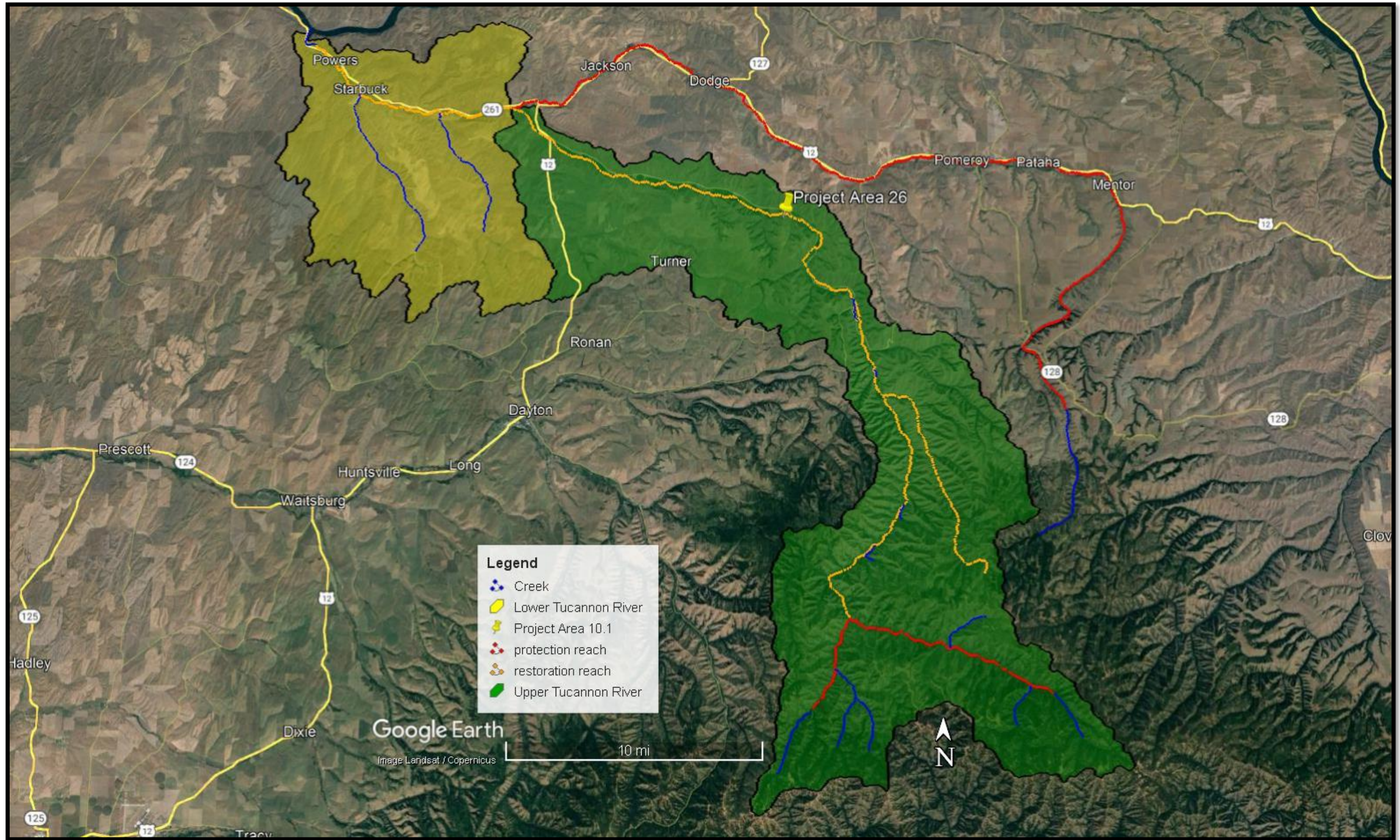


Figure 26-1: Project Area 26 located on the Tucannon River in Columbia County, WA, valley mile 21.5 to 23.9, center point Lat/Long: 46.444158 Long: -117.760300.

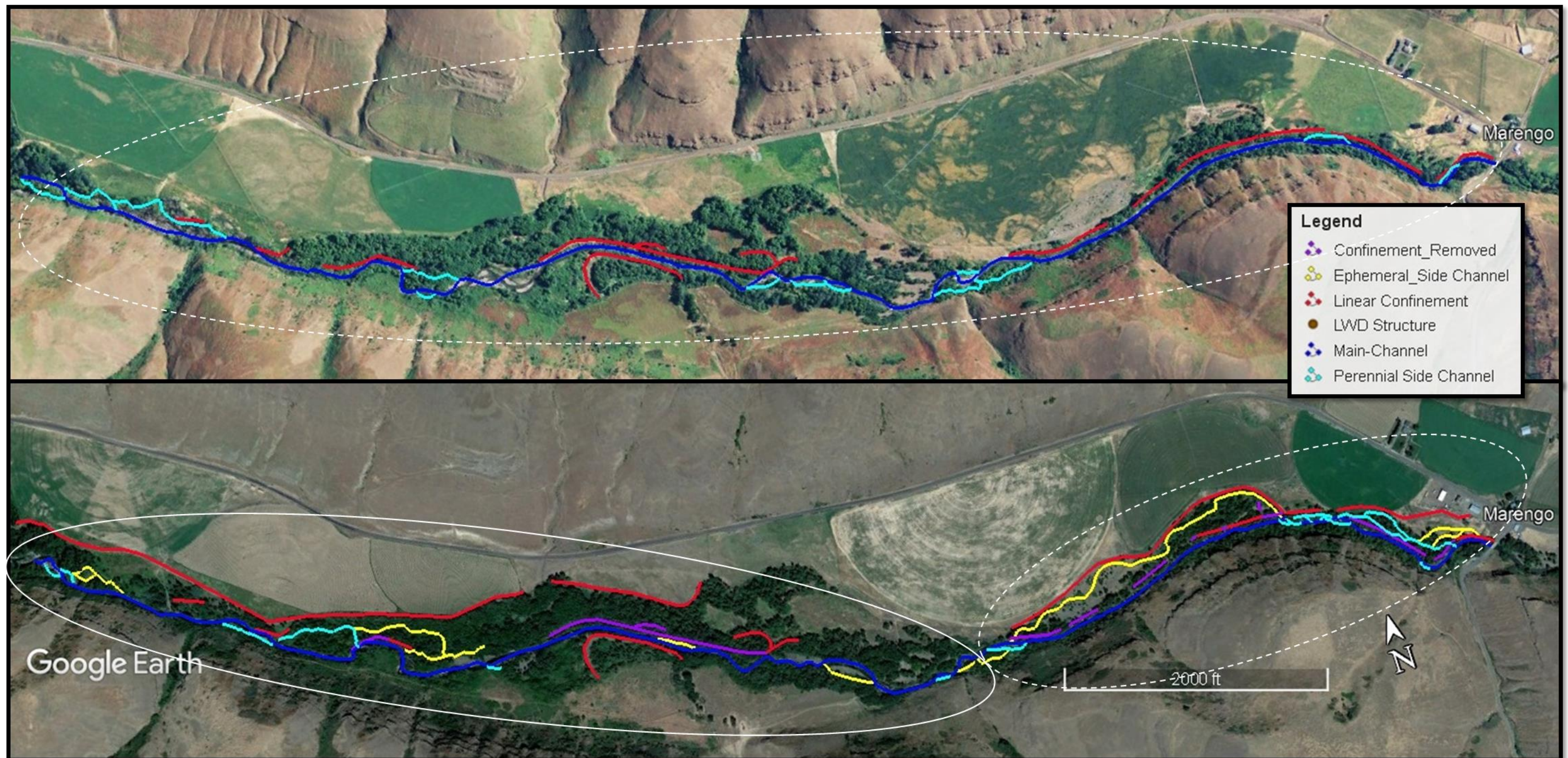


Figure 26-2: Project Area 26 located on the Tucannon River 2011 map (upper) and 2022 map (lower). The large white dashed oval on the upper map illustrates the approximate extent of Phase I, the smaller dashed oval (lower map) indicates the location of Phase II, while the large solid oval (lower map) indicated the footprint of Phase III and IV together. The upper map illustrates the position of river levees and other confinement in 2011 prior to the completion of Phase I. The lower map show the position of confinement removed in 2011, and the current remaining confining features including the levee set-back built in 2011.

Project Title: TUCANNON (PA-26) PHASE II: ADD FUNCTION & COMPLEX

Implementer: Columbia Conservation District

BPA Programmatic Funding (2010-077-00): In 2021 \$227,685 (#87504), \$10,000 (#87213) and in 2020, \$108,720 (84836).

Other BPA Funding (1994-018-06): In 2019, CCD committed ~\$26,000 (#81774)

Matching Funds: In 2019, the CCD was awarded a SRFB grant for \$304,775 (19-2094).

Location: Tucannon River valley mile 23.1 to 23.9 (Figure 26-1 & 26-2), center point Lat/Long: 46.442046 Long: -117.758077.

Project Time Line: The initial project discussed in the previous section, including levee removal and setback, was completed in 2011. Phase I of the LWD structure placement was implemented in 2013 (#59663 - #50146). Implementation of Phase II took place in 2021 on the upper 1.28 km of the overall PA26 reach.

Recovery Expectations: This project is located in a dynamic section of the Tucannon River Valley, and it is expected that changes in channel form and habitat complexity will occur at a relatively fast rate following LWD structure placement. The flow rate required to activate bed load in this reach occurs in a 1-2 return interval (~600-1,000 cfs), which is expected to result in a quick habitat response (Figure 26-3), of 5-10 yrs. Periodic site visits and rapid habitat surveys (following high water events) will continue to make observations in side channel connectivity, floodplain connectivity, LWD retention and pool frequency and mean depth.

Priority Populations: Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened), Columbia River bull trout (threatened), Pacific Lamprey (SPP of Concern). Freshwater mussels have not been identified in the project reach but are present locally.

Priority Life Stages Targeted: All life stages

Potential Future Actions: Field observation will be accompanied by rapid habitat surveys two winter flows or following a flood flow greater than the 2 yr return interval, post construction. These surveys will be used to inform adaptive management and guide decisions in implementing maintenance actions.

Due to the restoration goal of reconnecting floodplain it may be required in upcoming years to revisit pilot channel cuts and associated LWD structures to ensure side channel and floodplain objectives are being met. Additional floodplain structures may also be desired once the floodplain objectives are met. A revisit of riparian planting and health over time as floodplain land scape evolves from shrub step dominated to typical wetted Tucannon riparian forest type. Consideration of placing LWD structures strategically in the future to aid in maintaining the setback levee built in 2012.

Project Goals and Objectives

Goal: Return a 1.44 km reach (Phase II) of the 4.11 km long PA26, identified in the Tucannon Conceptual Restoration Plan (Anchor QEA, 2011) and located on three private farms, closer to its historic, naturally functioning state, increase fish habitat quality/quantity and floodplain connectivity.

Objectives:

- Phase II Short Term Obj. (3 yrs): Installing LWD structures within the bank full channel that create pool habitat, instream cover habitat, channel complexity, substrate sorting and floodplain connectivity.
 - Place 28 log jams within the main channel (1.29 km) for the purpose of creating channel complexity and increasing localized floodplain connectivity.
 - Place 15 log structure within floodplain flow paths to create complexity during winter and high flow periods
 - Increase pool frequency and volume > 50% within 3 years
 - Increase flood frequency and duration on 14 acres of available floodplain from the >5yr interval to <2 yr interval.
- Phase II Long Term Obj. (3-5 yrs): Increase floodplain connectivity and channel complexity.
 - Maintain > 2 key pieces beyond 10 years
 - Anticipated a 50% increase side channels within the first 10 yrs.
 - Connect disconnected low floodplain (<2 yr flow) ~ 14 acres
- Planting to restore a floodplain and upland terrace forest
 - 1,200 trees interstitially planted
 - 0.5 acres of new cover trees planted

Background & Project Summary

Background: In 1964 and again in 1996, this reach was severely impacted by the large floods (Figure 3) of that time which lead to property damage, triggered the construction of levees and the placement of rip-rap. Following the 1997 flooding, five rock vein weirs were constructed for the purpose of increase large pool frequency. At the time of the 2015 RHS these weirs had been buried under gravel and cobble deposition and were not observed until the 2020 flood survey after they were exposed by bed scour.

In 2011, river levees and gravel berms were removed or breached throughout the entire Phase II reach (Figure 26-2) as part of the 4.1 km long PA 26 Phase I project. The goal of Phase I was to restore properly functioning geomorphic condition by reducing river channel and floodplain confinement (discussed in the previous section). As part of Phase I, 5 log jams (15 key pieces) were placed within the 1.4 km Phase II (#87504) reach, to provide fish cover while river conditions were monitored. Surveys conducted by CHaMP and the Program between 2012 and 2017 indicated limited change in channel shape or gravel storage and that the ~14 ac of floodplain liberated by the 2011 levee removal project had experienced very limited inundation

in 2012, and none between 2013 & 2017. The CHaMP program recommended additional LWD structure placement to sort and retain gravel bars to encourage lateral channel migration and increased floodplain inundation frequency and duration (Hill 2017). In 2020, the flood (Figure 3) led to fairly significant export of bed load throughout the reach (Figure 26-4) including the few log jams that were observed in 2015 RHS (Table 26-1).

Problem Statement: Geomorphic processes, floodplain connectivity, and accompanying habitat for spring Chinook and summer steelhead within the reach have been influenced by historic land use practices within the 5-year floodplain. These activities have led to limited instream and floodplain habitat complexity, degraded floodplain connectivity, elevated and excess stream power and riparian condition and elevated summer water temperatures, are all key habitat limiting factors for Chinook and steelhead (Anchor QEA 2021).

Summary: The PA26 Phase II LWD structure placement focused on developing better connection of the winter/spring flood flow (>~140cfs or <1yr), with adjacent floodplain, where previously the levee and gravel berms were removed in 2011. The design used LWD roughness features within the ordinary wetted channel to encourage gravel bar development and stream bed aggradation (Figure 26-3) to initiate channel meander and more frequent floodplain inundation. It is anticipated that through regular floodplain inundation side channels and riparian function will be gained, contributing habitat resilience in salmonid recovery. In total, 29 log structures were constructed in channel (Figure 26-5). Fifteen floodplain structures were constructed in likely flow paths to aid in shaping of future side channels during inundation events (Figure 26-5).

As part of project habitat monitoring plan for this project RHS were conducted in 2020, 2021 (pre/post) and 2022 (Table 4) as well as the pre-project bathymetric LiDAR survey and model results from 2020. The available data allows for change detection in relation to LWD and log-jams, pools, (frequency, area and maximum depth), channel delineation (RCI), and wetted perimeter (inundated area). Channel habitat units were delineated (area estimated) in the field for pre-project (2021) followed up by the as-built condition, and repeated in 2022 (Figure 26-6, Figure 26-7) using field protocol identified in the Tucannon Monitoring Plan (Camp 2021). The pre-project topo-bathymetry (LiDAR) is used to produce models for floodplain connectivity, channel velocity, channel depth, habitat suitability, inundation, stream power and geomorphic change detection. These efforts will be repeated in follow up surveys; 2yr interval for RHS and every 5-7 years or following flood events greater than the 5 yr return interval for LiDAR surveys. Methods to assess floodplain connectivity, channel complexity and stream power have been developed (2021 Plan) to best utilize existing and future remote sensing data using change detection analysis at both the project up to basin scale.

In 2011, the Phase I work removed 700 m of river levee and rip rap and placed a set-back levee at the edge of the agricultural operations followed up with the addition of 5 LWD structures. At the time of. The five structures were observed during the RHS conducted in 2015 (Table 26-1),

however the total number of LWD key pieces and number of jams observed in the reach were considerably below the Program goals and objectives for restoration in 2015. All other metric in 2015 were also below restoration objective (Table 26-1) including those for floodplain connectivity and channel complexity. Looking to the pre-project surveys in 2020 (Table 26-1) LWD key pieces and log jam totals further declined between the 2015 & 2020 RHS. This is likely a result of limited natural LWD recruitment over that time period and the winter flood event in 2020 (Figure 3). Following the >25 yr flood event, RHS showed a decline in pool frequency, although the number of pools >1 m deep increased over that same time period (Table 26-1). This was largely attributed to the loss LWD structures, decreased channel roughness, and mobilization of bars and previous depositional deposits during the event (Figure 26-4) precipitating bed scour, exposing a number of rock veins/weirs placed following the 1996-97 floods to control grade (Figure 26-10).

In 2021, Phase II was completed (Figure 26-5) increasing the number of LWD key pieces and pool > 1m deep, and increase perennial side channel length by > 70%, meeting and exceeding Program reach goals. The Columbia Habitat and Monitoring Project (CHaMP) operated in the Tucannon Basin between 2013 and 2017 with two sample sites (CBW05583-465355 downstream and CBW05583-072139 upstream) located in the Phase II reach, when combined account for about ~50% of the Phase II length (Figure 26-6). Channel units for these sites were summed and converted to a proportion to provide another data point for comparison to current project channel unit distribution and diversity. The comparison highlights the decline in slow water habitat units between 2016 and the 2021 pre-project RHS event (Figure 26-6, Figure 26-7), and represents a 12% reduction in slow water pools. Following construction in 2021 and 2022, pool frequency and the number of pools > 1m deep also improved (Table 26-1) while area declined from the as-built value. The decline in pool area is a result of the placement of large channel spanning LWD structures and the changes water flow paths following consecutive flow events.

The Program calculates base flow RCI (Brown 2002) to make comparisons of change in relative channel complexity. The pre-project RCI value was very close to the watershed mean for pre-treatment projects, with a value < 10, following implementation this value increased at the as-built survey (Figure 26-6) and continued to increase over the first freshet interval with > 100% improvement. RCI will continue to be observed during the adaptive management loop in the 2 yr follow up surveys (2023-25).

Habitat units and channel complexity both exhibit increasing trends post project with a conversion of fast turbulent habitats to non-turbulent glides, side channels and pools (Table 26-1, Figure 26-7). The 2016 CHaMP site assessment provides a glimpse back to pre-flood conditions and the relationship of pool habitat and channel bed load. Many reaches in the Tucannon river exhibit greater pool frequency in reaches experiencing aggradation rather than degradation. This is likely due to legacy bed armor left as an artifact of past floods of record and confining features which have kept the river static. The layer of large material left on the bed is too large to be scoured and resist pool development. Excavation through this layer has revealed

smaller material matrix below this armor layer where it has been observed. Project design approach has changed as a result this observation to re-meander or aggrade channels when possible or perforate this layer when necessary.

Floodplain connectivity was one of the main goals of the Phase II project implementation focusing on improving connectivity on the ~14 ac of poorly connected floodplain available within the project reach (Figure 26-8). Low -lying floodplain was increased by ~25% through improved connection and increased channel roughness. In December 2022, the short duration (2 yr return) flood event (Figure 3) occurred flowing a rain on snow and rapid melt of low and mid-elevation snow, resulting in significant bed aggradation throughout the reach which lead to an apparent rapid change in habitat units, particularly bar develop and river bed aggradation (Figure 26-10-12) connecting floodplain more frequently (Figure 26-8). The event lead to inundation of the lower half of the project area (Figure 26-13) during the elevated flood (Figure 3).

Using the 2020 topo-bathymetric LiDAR the Program conducted a habitat suitability analysis (HSI) for the entire Tucannon basin considering the winter low flow, winter mean flow and 1 yr flow for spring Chinook juvenile life-stages (can be viewed on the Tucannon web-map). The HSI analysis for this project reach is available only for the 2020 pre-project condition (Figure 26-9). A follow up analysis will be conducted during the next LiDAR data acquisition.

Next Steps:

In 2023-24, this project reach will undergo a follow up RHS to best determine if restoration objectives are meeting or on a trajectory toward meeting restoration objectives as outline in the GARP (Anchor QEA 2021) Adaptive Management Strategy. In the event of observed deficiencies, the Program will work with the CCD to either take corrective measures or continue observations for an additional monitoring cycle. This project will be loosely tied to the Phase III-IV work discussed in the next section of this report.

Table 26-1: Project area 26 Phase II habitat metrics collected using the rapid habitat surveys in 2015 and in 2020. Restoration objectives for this project reach are based on priority restoration objectives identified in the Tucannon Conceptual Restoration Plan (Anchor 2021) and the envisioned site conditions. Project metrics in this table include main channel length in meters, side channel length for both perennial channels and ephemeral channels in meters, LWD key pieces (>6 m long and 0.3m dia.), the number and type of LWD jams or single logs and the frequency depth and areas of pools.

Project Area Survey Type	Main Channel Length (km)	Side Channel (m)		LWD Key Piece (#)	Structure #		Pools			
		Peren	Ephem		Jams	Single Log	Freq. (#)	Area (m ²)	Mean Depth Range (m)	# Pools > 1 m Deep
Phase II Reach Obj.2023	none	>800	>800	>175	36	5	18	~2,400	1.0-1.5	14
Pre-project Phase II (2015)	1.44	62	0	63	17	7	14	293	0.5-1.0	2
Pre-project Phase II Design (2020)	1.44	181	0	25	8	7	11	646	0.5-1.0	7
Phase II As-built (2021)	1.44	611	126	247	47	6	19	4610	0.5-1.0	15
Phase II (2022)	1.45	913	1281	243	45	5	21	2222	0.5-1.0-	13



Figure 26-3: Project Area 26 Phase II 2021 implementation project before (upper two images) after (lower two images) images Taken in 2021 pre-project and 2022 following one year of high flow in 2021/22.



Figure 26-4: Changes in bed deposition and bed scour during the 2020 flooding event within the Phase II reach of PA 26. Upper images show pre-project conditions in 2015 captured during the 2015 RHS. The lower two images illustrate the change in conditions at the same locations following severe flooding event and prior to implementation in 2021.

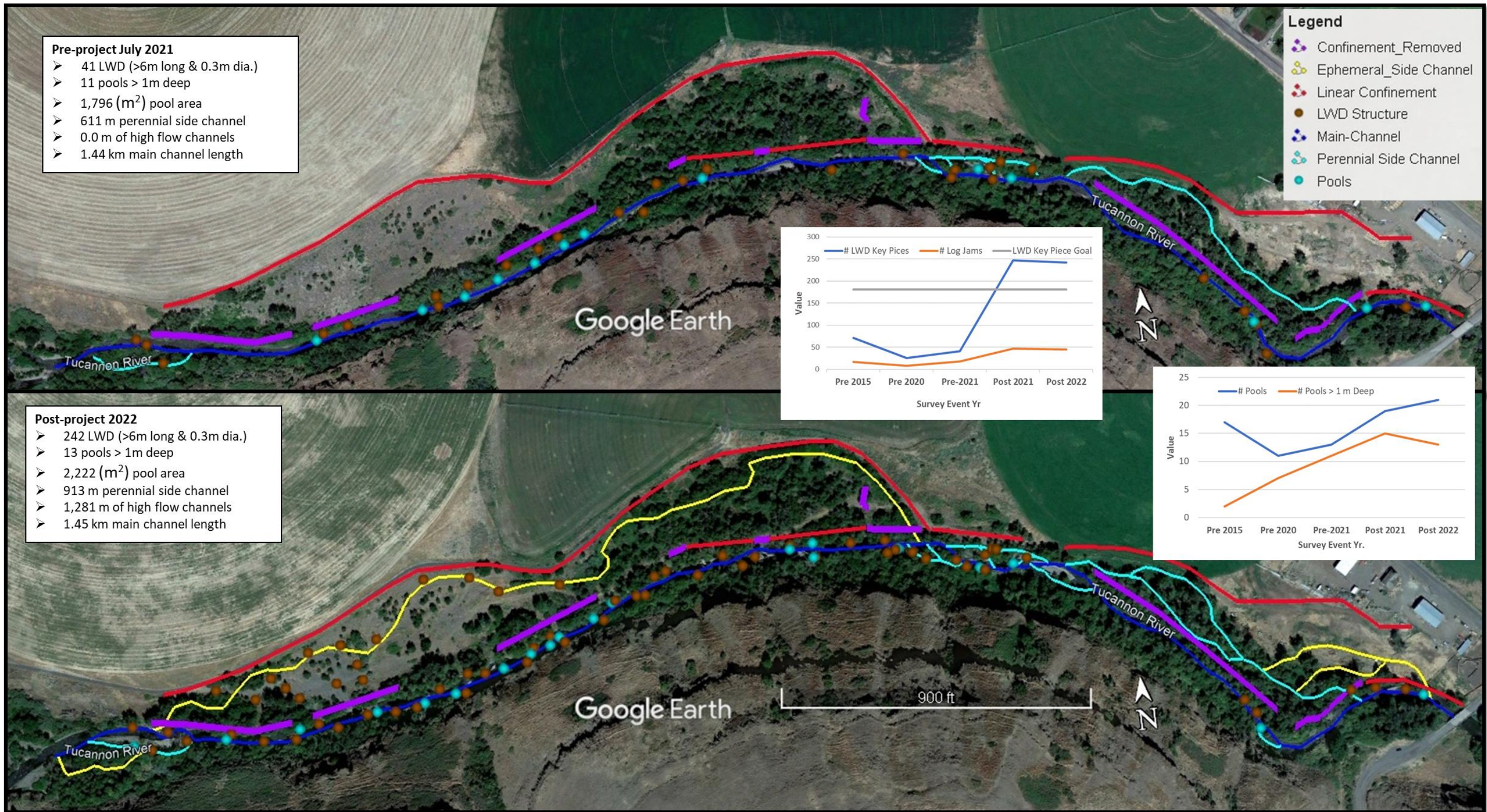


Figure 26-5: Project Area 26 Phase II pre/post project condition for side channel, pools and LWD structures. The upper map image illustrating the 2021 pre-project and the lower one the as-built in Sept 2021.

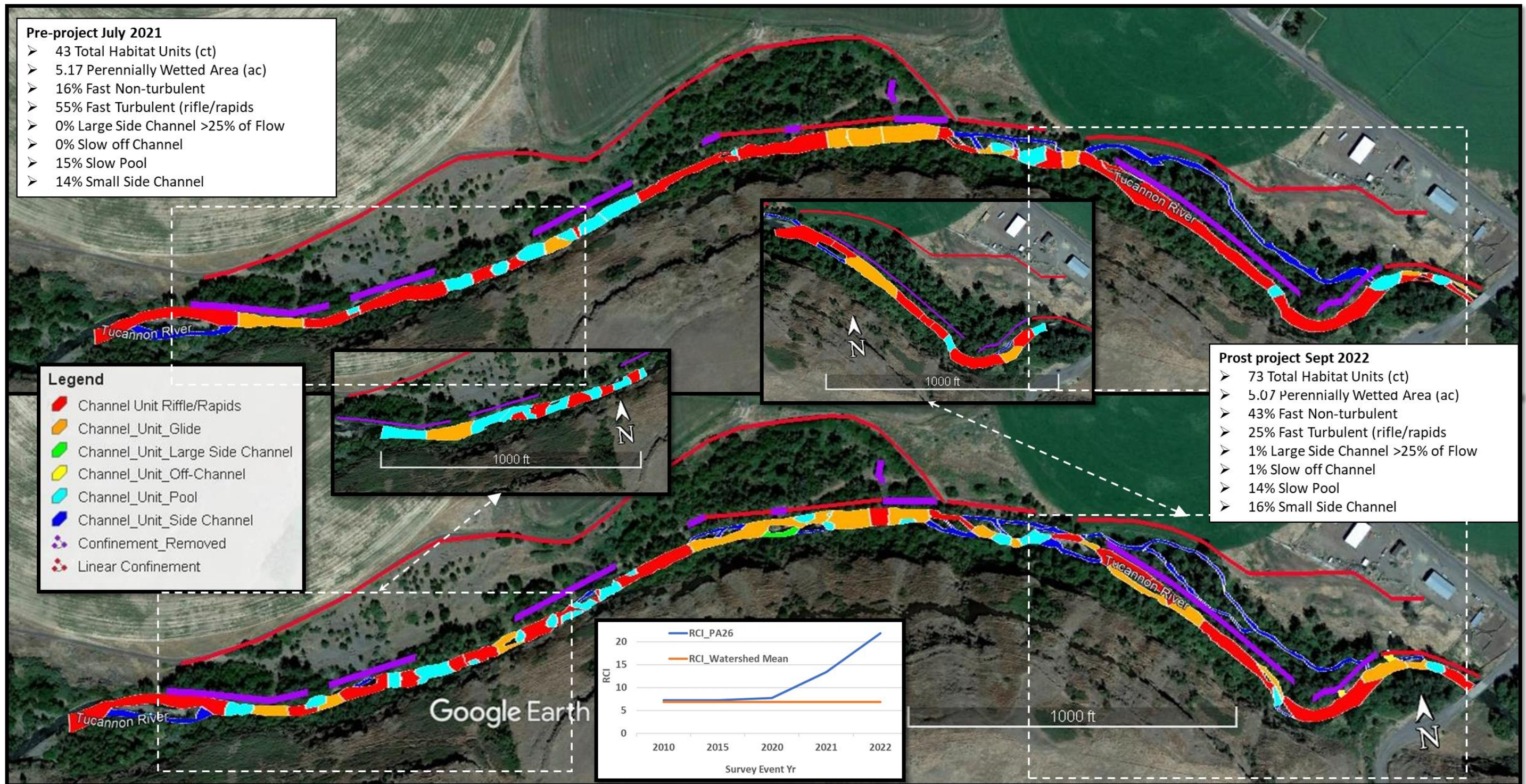


Figure 26-6: Project Area 26 (Phase II) channel habitats units delineated during the pre-project survey in July 2021 (upper map) and the as-built survey September 2021 (lower map). The proportion of each unit is provided within the map and graphically in the following figure (26-7). The Phase II reach had two channel unit survey reaches (CBW05583-465355 left and CBW05583-072139 right) embedded within the project and the results of those surveys are provided as insets on the map. The locations of the CHaMP sites are highlighted on the 2021 and 2022 maps by white dashed rectangles. The greatest immediate changes in habitat units from 2021-2022 were in conversion of riffle/rapid units to slow water pools and non-turbulent glides.

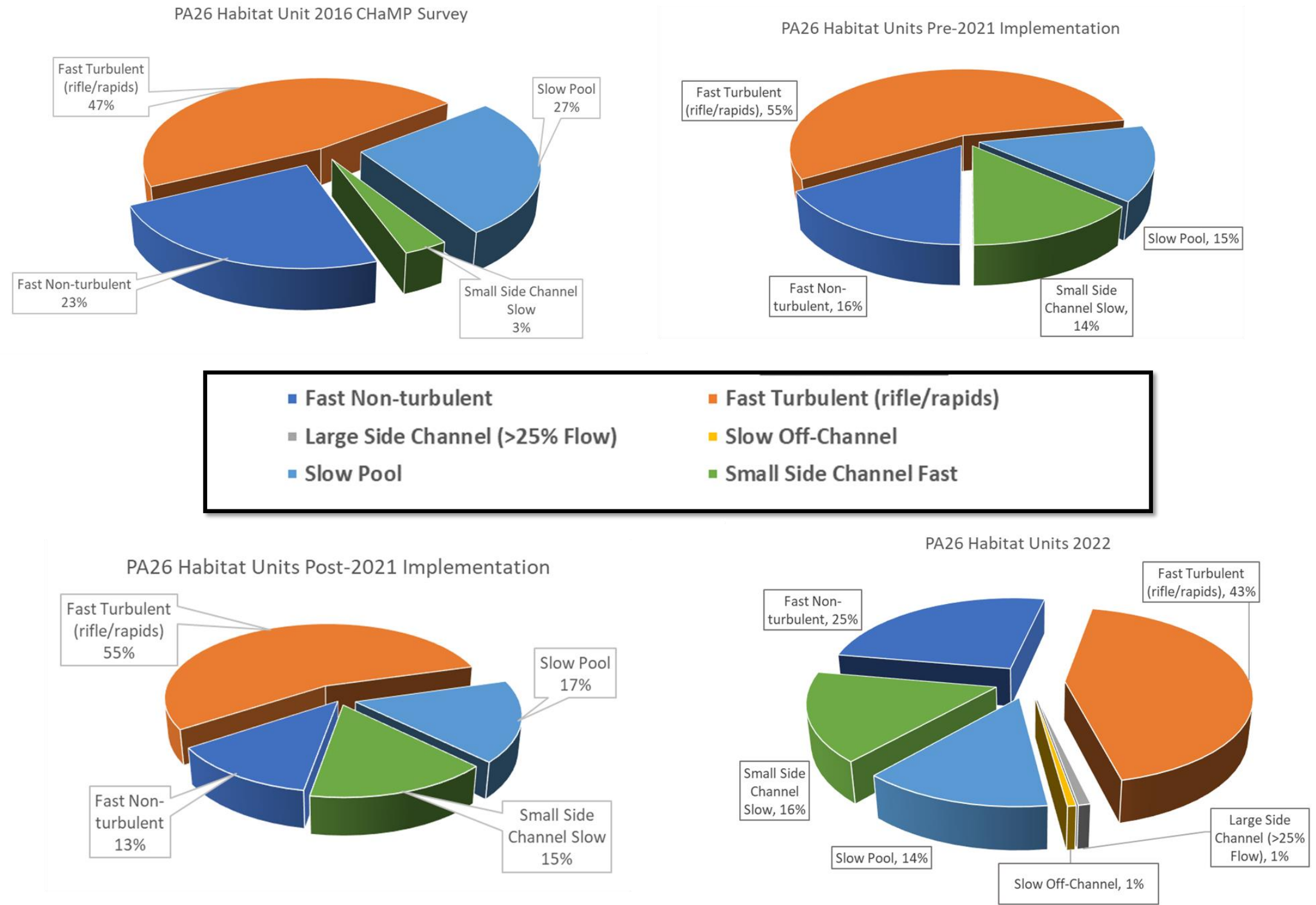


Figure 26-7: Project 26 Phase II channel habitat units summed across the two CHaMP sites measure in 2016 (upper left) compared to channel units measured in 2021 (upper right) prior to implementation and post project (lower left) and again in the summer of 2022 (lower right) for the purpose of comparison over time. The next survey period for this project will be in 2024 or following a significant flow event >2yr flow. Note: Channel units collected for the CHaMP sites (CBW05583-465355 and CBW05583-072139) reflect a sub-reach of the Phase II project captured by the RHSs in 2021 & 2022. The goals of the project are to increase floodplain connectivity and reduce stream power through greater inundation during flooding event increasing channel complexity for rearing spring Chinook. Prior to construction this project site experiences significant fluctuation in channel units over time, minimizing unit diversity. This was particularly evident for slow off channel and side channel units between 2016 and 2022.

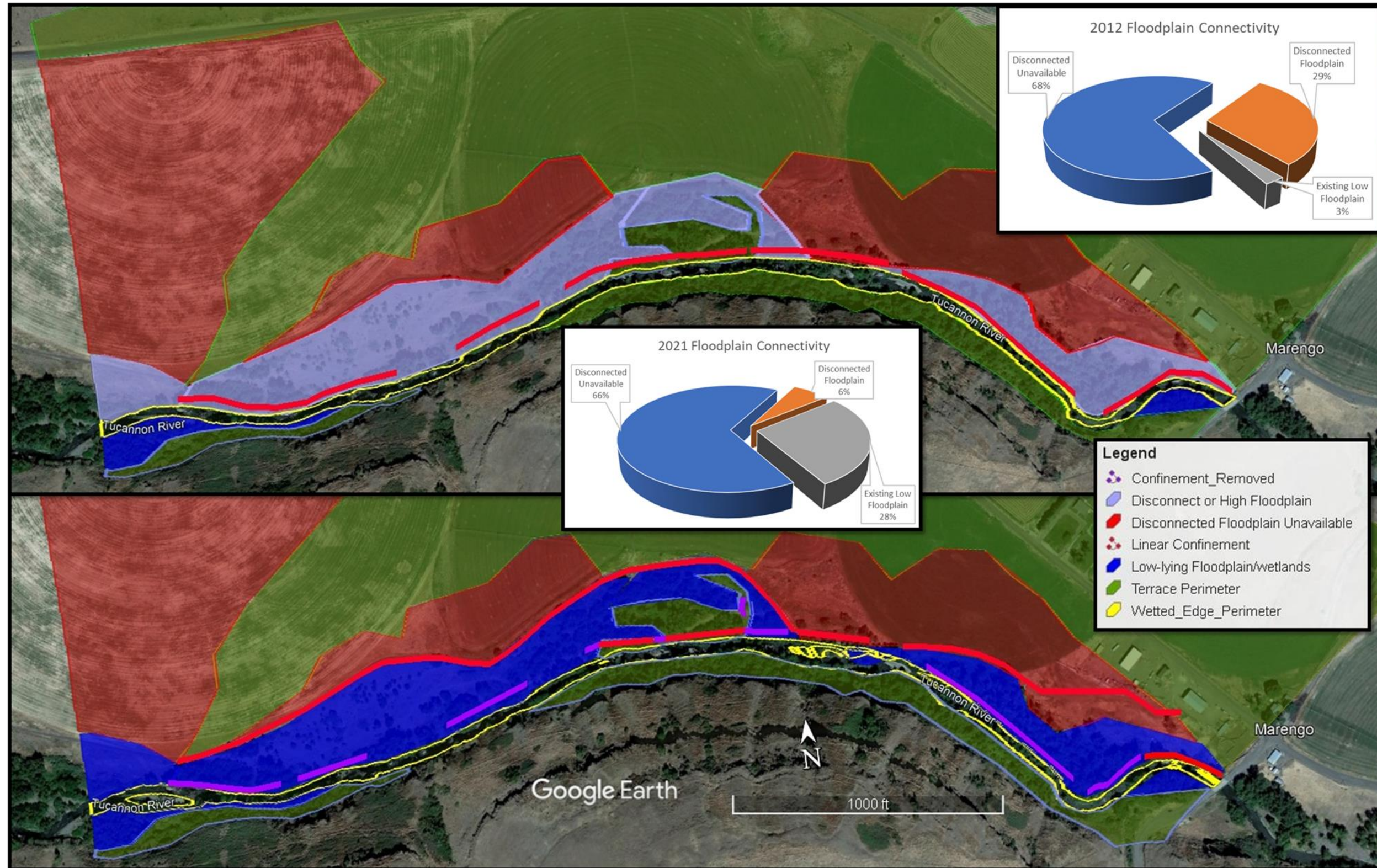


Figure 26-8: Project Area 26 Phase II floodplain map illustrating disconnected floodplain in 2011 (upper) and available and connected floodplain being targeted in 2021 for improved connectivity through implementation in Phase II. In 2011, a total of 14 ac off disconnected floodplain was exposed to flood flows through levees, rip-rap and gravel berm removal. Approximately 66% of the existing floodplain is unavailable for restoring channel and floodplain function in this reach due to infrastructure.

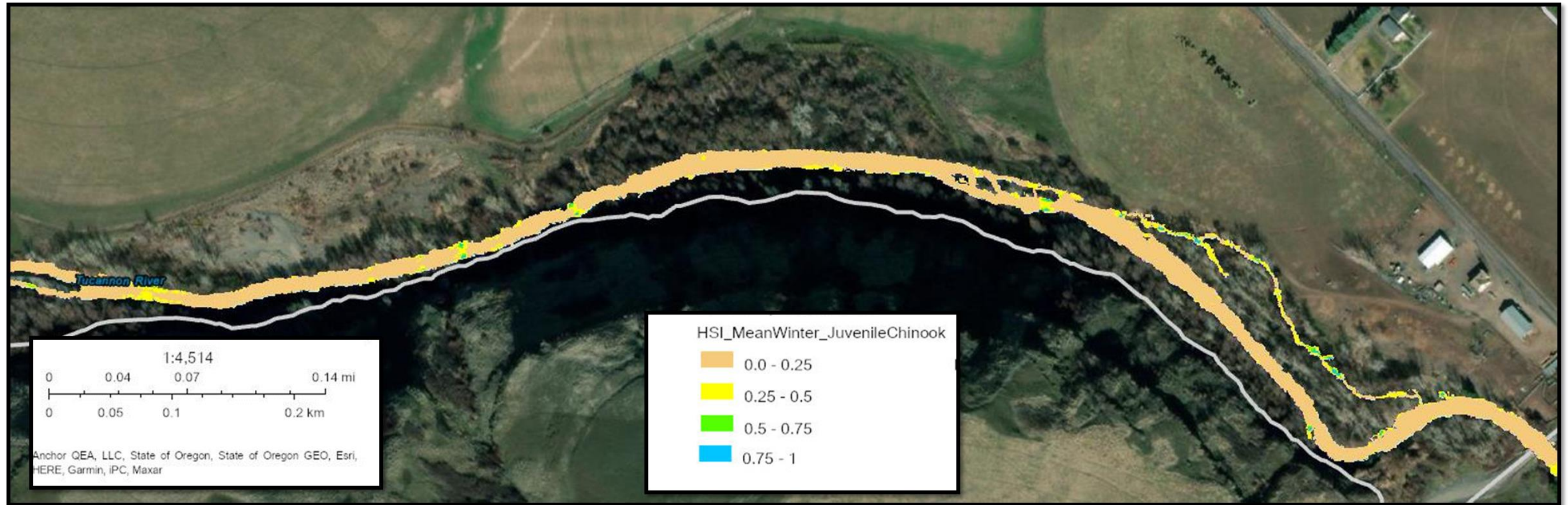


Figure 26-9: Project area 26 Phase II reach Habitat Suitability Index (HSI) for spring Chinook under mean winter flows modeled from Green LiDAR data-set collected by CTUIR in 2020 and modeled by Anchor QEA 2022 available at <https://ctuirgis.maps.arcgis.com/apps/MapSeries/index.html?appid=7961a9f233684f0daf87970b37d8dc1c>. This analysis will be completed as part of the Tucannon River Monitoring Plan (Camp 2020) which would be supported by the collection of 2028 bathymetric LiDAR and an analysis of change detection data as outline in the monitoring plan and the GARP 2021.



Figure 26-10: Project Area 26 Phase II pre (upper left) post project 2021 (upper right) and 2022 (lower right) above a channel spanning structure designed to aggrade the channel bed and increase floodplain inundation. The white dashed oval indicates the location of one rock weir structure placed post 1996-97 flood to control grade (upper left).



Figure 26-11: Project Area 26 Phase II pre (upper left) post project 2021 (upper right), post 1 flow summer 2022 (lower left) and post two flow events winter 2023 (lower right) above a apex spanning structure designed to aggrade the channel bed and increase channel meander and floodplain inundation over time. During the 2021-22 winter/spring flows which were moderate the structure was largely buried in gravel (lower right) and channel migration to river left began undercutting the left bank.



Figure 26-12: Project Area 26 Phase II pre (upper right & left) and post (lower right & left) plain bed reaches treated LWD structures to improve gravel deposition bar formation and habitat unit complexity. The two upper reaches were treated in 2021 and the lower two images are the result of a single year of moderate seasonal flow (~1Yr return interval).



Figure 26-13: Project photo point for channel spanning a structure designed to aggrade the river channel and increase floodplain connectivity, pre-project (upper left) as-built (upper right) and following two high flow events (lower left). The red arrow indicated a reference point pile placed during construction as a test pile and left in position for reference. During the high flow event in December 2022 (Figure 3) channel spanning structures captured significant gravel bed material resulting in an over bank event at less than the 2 yr flow interval indicated by the yellow arrow. Note: The pile when placed was measured to make future observation on bed elevation, which at as-built was measured to emerge 1.4 m out of the stream bed with 0.82 m of it sticking out of the water (upper right). Following two relatively low season low event the bed elevation has aggraded (~1 m) above the original water height with only 0.4 m above the river bed.

Project Title: Project 26 Phase III-IV

Implementer: Columbia Conservation District

BPA Programmatic Funding (2010-077-00): In 2023 \$515,000 construction support (#91598), in 2022 \$10,000 design support (#89977), in 2021 \$10,000 (#87434) field survey and design development (#87213).

Other BPA Funding (1994-018-06): In 2021, CCD committed ~\$60,000 (#87434) in 2013, \$152,000 (#59663). In 2011, \$64,000 (#50146)

Matching Funds: In 2022, the CCD SRFB grant (22-1015) for \$552,000. In 2016 a grant from the Conservation Commission \$50,000 and in 2009 and 2010, the CCD was awarded two SRFB grants totaling \$694,260 (10-1633 & 9-1742) to remove the river levee.

Location: Tucannon Valley Mile 21.5 to 23.1 (Figure 26-1), center point Lat/Long: 46.445633 Long: -117.784219.

Project Time Line: The initial project including levee removal and setback was completed in 2011. Phase I of the LWD structure placement was implemented in 2013 (#59663 - #50146), Phase II was initiated in 2019, and completed in early 2021. Phase III-IV field evaluation took place in 2021 with initial concept design review beginning in early 2022. Phase III-IV design were developed in 2022 with implementation in 2023.

Recovery Expectations: This project is located in a dynamic section of the Tucannon River Valley, and it is expected that changes in channel form and habitat complexity will occur at a relatively fast rate following LWD structure placement. The flow rate required to activate bed load in this reach occurs at a 1-2 return interval (~600-1,000 cfs), which is expected to result in a quick habitat response, of 5-10 yrs. Given the relatively wide available floodplain that is currently not regularly inundated it is anticipate work will be able to quickly capture a large area of floodplain and side channels (Figure 26-14). Periodic site visits and rapid habitat surveys (following high water events) will continue to make observations in side channel connectivity, floodplain connectivity, LWD retention and pool frequency and mean depth.

Priority Populations: Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened), Columbia River bull trout (threatened), Pacific Lamprey (SPP of Concern). Freshwater mussels have not been identified in the project reach but are present locally.

Priority Life Stages Targeted: All life stages

Potential Future Actions: Field observation will be accompanied by RHS following two winter flows or following a flood flow > 2 yr return interval, post construction. These surveys will be used to inform adaptive management and guide decisions in implementing maintenance actions.

Due to the restoration goal of reconnecting floodplain it may be required in upcoming years to revisit pilot channel cuts and associated LWD structures to ensure side channel and floodplain objectives are being met or are on a positive trajectory towards being met. Additional floodplain structures may also be desired once the floodplain objectives are met. Revisit riparian planting and health over time as floodplain land scape evolves from shrub step dominated to typical wetted Tucannon riparian forest type. Consideration of placing LWD structures strategically in the future to aid in maintaining the setback levee built in 2011.

Project Goals and Objectives

Goal: Return a 2.68 km reach (Phase III-IV) of the 5.95 km long PA 26, identified in the Tucannon Conceptual Restoration Plan (Anchor QEA, 2021) closer to its historic, naturally functioning state, increasing fish habitat quality/quantity through increasing floodplain connectivity and channel complexity.

Objectives:

- Short Term Obj. (3 yrs): Installing 71 LWD structures within the bank full channel that create pool habitat, instream cover habitat, channel complexity, substrate sorting and floodplain connectivity.
- Short Term Obj. (3 yrs): Remove channel confining features(1,000 m) and conduct three side channel pilot cuts to connect and initiate floodplain connectivity (RCI value of 15 to > 45).
- Phase III Long Term Obj. (3-5 yrs): Increase floodplain connectivity and channel complexity increase secondary channel length from 500 m to > 3000 m.
- Planting to restore a floodplain and upland terrace forest.

Background & Project Summary

Background: The 2011, river levees and gravel berms work describe in PA26 Phase I, levees and berms were removed breached throughout the entire reach (Figure 26-2) as part of the 4.11 km long PA 26 Phase I project. The goal of Phase I was to restore properly functioning geomorphic condition by reducing river channel and floodplain confinement (Figure 26-2) particularly along the 730 m levee removal, with the goal of inundating floodplain and developing side channels naturally during flood events. In 2011, levee removal was a relatively new and innovative restoration technique for SE Washington, resulting in a conservative implementation approach, where the levee would be removed and set back in the first year, and channel modifications would be delayed to make observations on how the channel would recover naturally (“letting the river do the work”). Based on observations made in 2013 following two high water events, 12 log jams were placed within the 2.68 km Phase III-IV reach as a pilot effort. Monitoring surveys conducted by CHaMP and the Program between 2012 and 2021 indicated limited change in channel shape or gravel storage within the reach and that the ~31 ac of floodplain liberated by the 2011 levee removal project had experienced very limited flood inundation in 2012 and none between 2013 & 2017. The CHaMP program recommended additional LWD

structure placement to sort and retain gravel bars to encourage lateral channel migration and increased floodplain inundation frequency and duration (Hill 2017). The Phase III-IV proposed work (#87504) is located (Figure 26-2) on the middle 2.68 km of the project reach with the remaining lower 0.75 km of the project area not included in this design and implementation effort.

Problem Statement: Geomorphic processes, floodplain connectivity, and accompanying habitat for spring Chinook and summer steelhead within the reach have been influenced by historic land use practices within the 5-year floodplain. These activities have led to limited instream and floodplain habitat complexity (Table 26-2), degraded floodplain connectivity and riparian condition and elevated summer water temperatures, all key habitat limiting factors for Chinook and steelhead (Anchor QEA 2011a).

Table 26-2: Project area 26 Phase III-IV habitat metrics collected using the rapid habitat surveys in 2021. Restoration objectives for this project reach are based on priority restoration objectives identified in the Tucannon Conceptual Restoration Plan (Anchor 2021) and the envisioned site conditions. Project metrics in this table include main channel length in meters, side channel length for both perennial channels and ephemeral channels in meters, LWD key pieces (>6 m long and 0.3m dia.), the number and type of LWD jams or single logs and the frequency depth and areas of pools.

Project Area Survey Type	Main Channel Length (km)	Side Channel (m)		LWD Key Piece (#)	Structure #		Pools			
		Peren	Ephem		Jams	Single Log	Freq. (#)	Area (m ²)	Mean Depth Range (m)	# Pools > 1m Deep
Phase III-IV Reach Obj.2023	none	>3000	>200	>335	~100	N/A	67	~4000	1.0-1.5	24
Pre-project Phase III-IV (2021)	2.68	581	1078	134	47	23	36	2550	0.5-1.0	26

Summary: The PA26 Phase III-IV design is focused on developing better connection of winter flood flow (>~140cfs or <1yr), with adjacent floodplain, where previously the levee and gravel berms were removed in 2011. As in the Phase II implemented in 2021, this reach is not meeting recovery potential described in the 2021 Plan (Anchor QEA 2021), as determined by 2021 RHS (Table 26-2). The design is using LWD roughness features within the ordinary wetted channel to encourage gravel bar development and stream bed aggradation to initiate channel meander and more frequent floodplain inundation. It is anticipated that through regular floodplain inundation side channels and riparian function will be gained contributing habitat resilience in

salmonid recovery. The design will focus on placing ~71 LWD structures of various purposes including channel spanning, apex and other cover forming jams. To aid in floodplain reconnection, three pilot channel cuts will be used to lower the river bank and remove gravel fill, reducing confinement throughout the 2.68 km reach (Figure 26-14). Remove and set back ~440 m of existing river levee and move exiting irrigation infrastructure to reconnect 3.5 ac of floodplain. The stream work will provide increased inundation both in frequency and duration of ~ 31 acres of floodplain (Figure 26-15) reconnecting > 4,000 m of disconnected or poorly connect existing side channels identified during the 2021 RHS (Figure 26-14). Habitat monitoring will be conducted using field protocol identified in the Tucannon Monitoring Plan (Camp 2021). This effort would be repeated in follow up surveys to determine progress toward the development of slow water habitats for winter rearing of sensitive species.

The site has relatively poor modeled habitat suitability based on winter mean flows in the pre-project condition using the 2020 LiDAR HSI model (Figure 26-16)

(<https://ctuirgis.maps.arcgis.com/apps/MapSeries/index.html?appid=7961a9f233684f0daf87970b37d8dc1c>). Across the entire reach only one location exhibits good HSI located in the lower end of the middle third of the reach in an off-channel pool maintained by a side channel returning from river right. This section was observed in a relative state of recovery following the high flows of 2020, possessing most of the side channels and pool complexity measured in PA26 Phase III-IV in 2021 (Figure 26-17). As a result, the section has been left out of the current design being implemented in 2023 to avoid wet areas and sensitive habitats.



Example of degraded habitat being targeted for increased complexity and connectivity

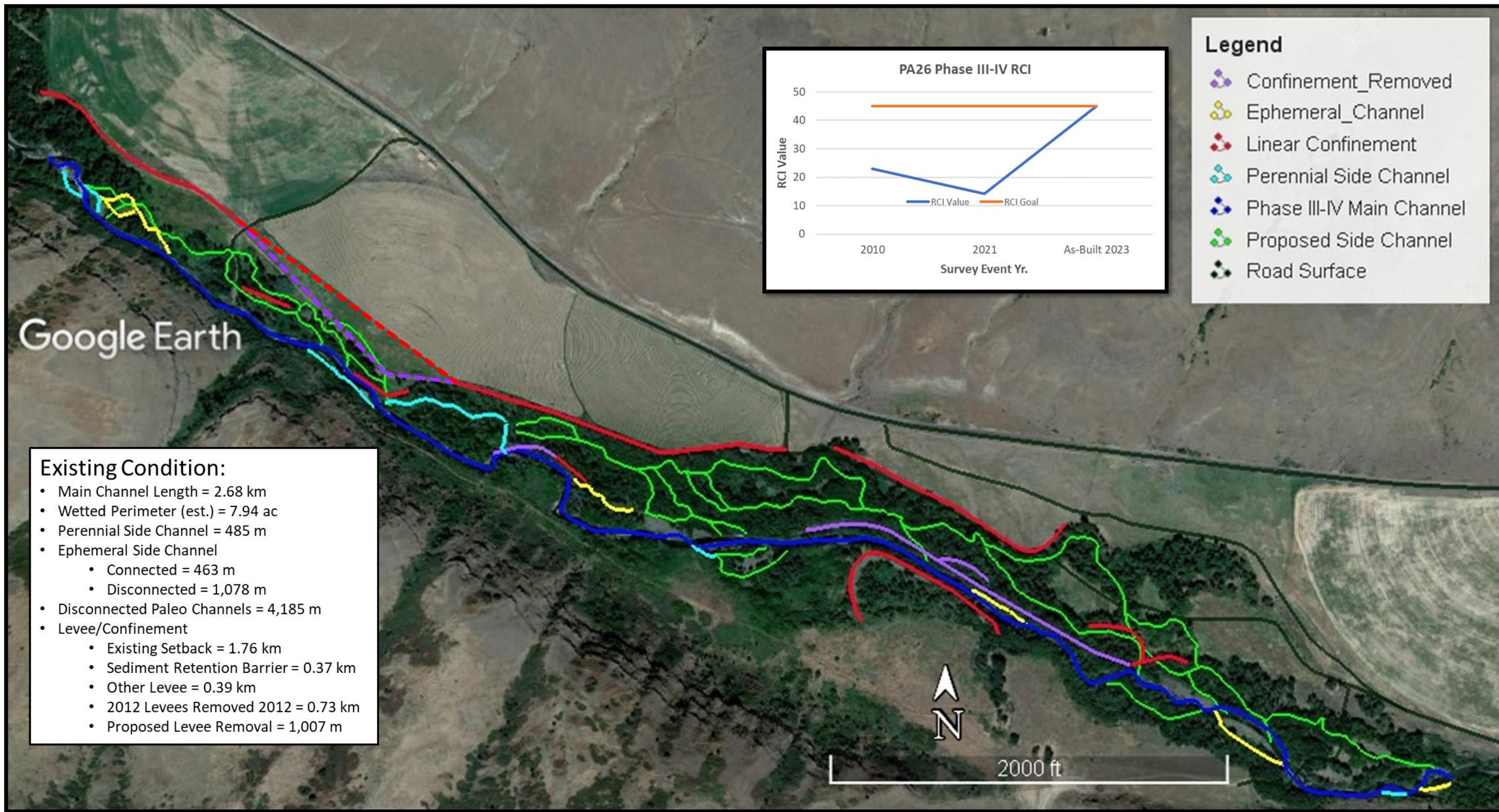


Figure 26-14: PA 26 Phase III-IV: The project reach being targeted during Phase III-IV design in 2022. The purple lines indicated disconnected side channels that have potential for reconnection and perennial flow. The red dashed line indicated an opportunity to add additional floodplain inside the setback levee highlight by the solid red line. The dashed yellow line highlights the location of the 730 m levee removed in 2011.

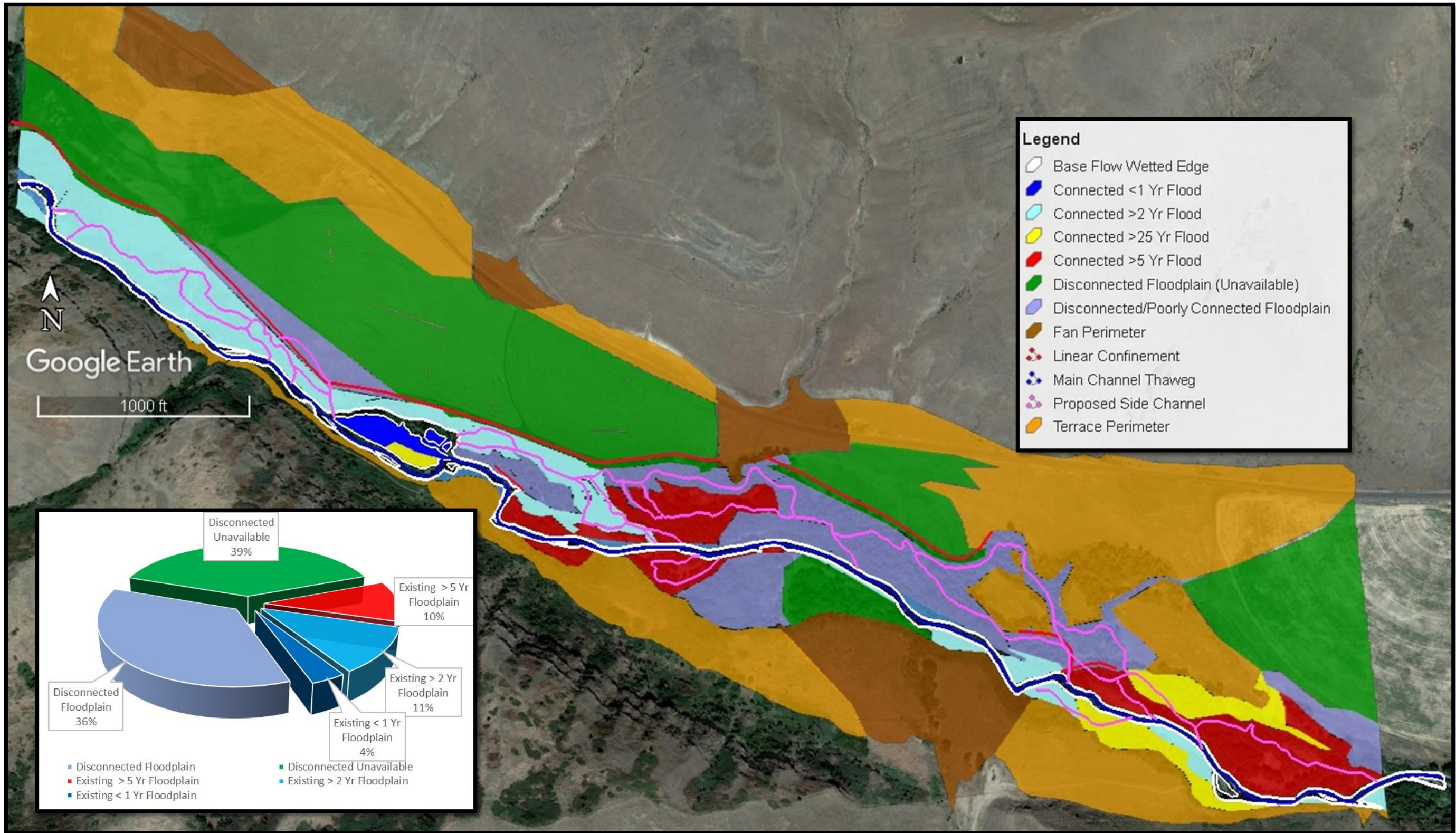


Figure 26-15: PA26 Phase III-IV valley bottom metrics pre-project condition includes a 2021 wetted perimeter of 8.73 ac, terrace Area 89 ac, and an alluvial fan area of 25 ac. Approximately 36 % of available floodplain within this reach is poorly connected or disconnected at regular flows (Low-lying 15 ac). The work will be re-connected 4 ac and improve connectivity to ~30 ac.



Figure-26-16: Habitat suitability index (HSI) model for juvenile spring Chinook at mean winter flows based on 2020 LiDAR and modeled velocities (Anchor QEA 2022). The model is indicating that HSI relatively low (<0.25) throughout most of the reach, with the exception to the lower middle of the project area where a large off-channel side channel feature exists creating a number of low velocity deep habitats with high HSI values (>0.5).



Figure 26-17: Project Area 26 Phase III-IV images showing existing conditions in 2022. The upper third of the reach is characterized by long wide reaches with simple plan bed riffles (upper left). Existing LWD jams create isolated bars (upper center) and long glides (Upper right) however few pools exist. The middle third of the reach is characterized by deposition with numerous side channels, pools and generally function habitat conditions (lower center and right), where no actions are identified in Phase III or IV. The lower third of the project reach is characterized by channel deposition with significant bar formation (lower left) but has been confined by channel confinement (red dashed line) by levees and riprap identified for removal.

Partner - CTUIR Projects

Project Title: PA27/28.1 Add Function & Complexity: Phase I-III Design & Implementation

Implementer: Confederated Tribes of the Umatilla Indian Reservation

BPA Programmatic Funding (2010-077-00): In 2022 \$625,500 (#73982) Phase III, in 2021 \$315,525 in (#73982 REL 132) Phase II, in 2021 \$684,015 (73982 REL132) Phase I, and in 2020 \$827,500 (#73982 REL 98).

Other BPA Funding (2008-202-00): In 2022 ~\$291,830 (73982 REL 157), in 2021, CTUIR ~\$636,000 (73982 REL130), In 2020, CTUIR committed ~\$151,000 (73982 REL100).

Matching Funds: Non-BPA match has not been monetized for this project area, but is in the form of low lying tilled agricultural lands (>14 ac) converted to floodplain.

Location: Tucannon Valley mile 19.6 to 20.38. With a start Lat/Lon 46.453672 -117.816916 and end Lat/Lon 46.456387 -117.832140 (Figure 27/28.1-1).

Project Time Line: Project design was initiated late in 2019 (73982 REL100) with the first half phase (Phase 0.5) being completed early in 2020. Phase I was split into two phases to accommodate both available funding and permitting timelines in 2020-21. Initial project Phase 0.5 was implemented in 2020 (73982 REL 98), with the final Phase I-b design completed in early 2021 and implemented in 2021 (73982 REL132 & 73982 REL130). PA27/28.1 Phase II was designed in 2021-22 with implementation in 2022 delayed into early 2023 due to difficulties regarding permitting (Section 106). Phase III is currently moving onto 80% Design to initiate permitting in the spring of 2023 with a planned implementation in 2023-24.

Recovery Expectations: This project is relatively aggressive in land form manipulation and located in a dynamic section of the Tucannon River Valley, and it is expected that change in channel form and habitat complexity will occur at a relatively fast rate compared to other projects and locations within the basin. The flow rate required to activate bed load in this reach occurs in a 1-2 recurrence interval, so the project is expected to contribute significantly to habitat uplift within 2-5 yrs. Periodic site visits and rapid surveys (+2 yrs. or following high water events) will continue to follow development in side channel and floodplain connectivity (Table 27/28.1-1).

Priority Populations: Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened), Columbia River bull trout (threatened), Pacific Lamprey (SPP of Concern), freshwater mussels and other native non-salmonid species.

Priority Life Stages Targeted: All life stages

Potential Future Actions: Due to the restoration goal of reconnecting floodplain, it may be required in upcoming years to revisit pilot channel cuts and associated LWD structures to ensure side channel and floodplain objective are met. Additional floodplain structures may also

be desired once floodplain objectives are met to ensure future desired condition and continued protection to existing infrastructure and properties. Revisit riparian planting and health over time as floodplain land scape evolves from shrub step or agriculture to a more functional riparian habitat. The 2 yr RHS is evaluation of Phase I would be conducted in 2023, with Phase II & III in 25 and in 2027 over the next 5 years. .

Project Goals and Objectives

Goal: Return a roughly 1.4 km reach within project area 27/28.1 identified in the 2021 Plan (Anchor QEA, 2021) and located on a private farm, closer to its historic, naturally functioning state, increasing fish habitat quality/quantity and resiliency through floodplain connectivity.

The goal of the project is to address the Primary Limiting Factors identified for the Tucannon River in the 2008 Fish Accords (Three Treaty Tribes-Action Agencies 2008), incorporating the primary touchstones described in the Umatilla River Vision (Jones, et al, 2008), and be consistent with the Snake River Salmon Recovery Plan for Southeast Washington (SRSRB 2006), Draft Columbia River Bull Trout Recovery Plan (USFWS 2010) and the Tucannon Sub basin Plan (CCD 2004).

Objectives:

- i. Short Term Obj. (3 yrs):
 - a. Increase floodplain connectivity and frequency of inundation to a condition closer to historical and natural (1-2 yr return) on approximately 24 acres of low-lying floodplain currently not frequently inundated (at < 5yr return). Re-engaging the floodplain will result in flows that are less confined, have decreased stream power, allow for increased and more variable gravel deposition, increase groundwater tables, and increased base flows and decreased water temperatures.
 - b. Increase channel complexity with channel morphology (channel form, sinuosity, complexity, geomorphic and hydrograph stability) closer to historical and functional possible maximum >1,600 m of perennial side >channel, and >1,000 m of ephemeral side channel.
 - c. Installing >134LWD structures within the bank full channel and on low-lying flood paths to create pool habitat, instream cover habitat, channel complexity, substrate sorting and floodplain connectivity and roughness.
- ii. Long Term Obj. (3-5 yrs):
 - d. Restore natural channel forming processes through the addition of large wood to increase channel complexity, and restoration of sediment routing processes through the removal of levees and other floodplain impediments.
 - e. Reestablish native floodplain plant communities and riparian function with site-appropriate native vegetation and off-channel habitat. Realistic, cost-effective planting plans will maximize plant survival and minimize labor and maintenance; the planting plan will reflect CTUIR First Food values.
 - f. Restore a floodplain and upland terrace forest.

Project Summary: Project Area (PA) 27/28.1 is located within the active river channel and floodplain of the Tucannon River, on private property from valley mile 19.6 to 20.38. The project is identified as a priority for restoration in the 2021 Plan (Anchor QEA, 2021). The primary reach goal is to increase floodplain connectivity through: removing channel confining features, the placement of LWD structure to reconnect perennial and ephemeral side channels (Figure 27/28.1-2) and prescribing channel gravel and bed load augmentation to elevate thalweg elevation. It is predicted that the reduction of channel confinement and the increase in channel and floodplain roughness (LWD) will lead to a reduction in excess stream power and the formation of longer perennial flow paths supporting > slow water frequency/area and increased depth range.

Status (FY22): Phase II project designs include modification to existing irrigation system access and efficiencies to aid in reducing the impacts of agricultural practices on the floodplain and waterway. Work on this project was anticipated to begin in the late winter 2022-23 to avoid field harvest or spring planting (Figure 27/28.1-3). Concurrent and following construction on Phase II, the Program supported CTUIR in the development of a 30% design concepts for Phase III, floodplain and riparian wetland development for implementation in 2023 (Figure 27/28.1-4). The project design involves a large floodplain reconnection component (all located in PA28.1) which will involve floodplain cuts and (Figure 27/28.1-5) and some main channel fill (Figure 27/28.1-6, Figure 27/28.1-7) to aid in reconnecting floodplain and capture the 14 ac of agricultural land liberated in Phase II. Phase III will involve a large riparian planting component, and may take a number of years to implement through 2025, as the land scape transitions from agricultural to wet floodplain.

Status (FY21): In the 2021 work window, Phase I-b (the second half of Phase I with Phase 0.5 being the 1st ½ of Phase I) was implemented, completing all the in-water work for PA 27/28.1 proposed by CTUIR in Phase I (Figure 27/28.1-8). Phase II project concepts were initiated and include modification existing irrigation access and efficiencies to aid in reducing the impacts of agricultural practices on the floodplain and waterway. The fall/winter of 2022 was be used to conceptualize and design Phase III, which will involve the reclamation of floodplain from its current agricultural use, returning it to river bottom and riparian habitat. It is anticipated Phase III will involve the development of channels addition of floodplain roughness and riparian planning over the entire 14 ac decommissioned field.

In total, the Phase I restoration efforts increased perennial side channel length by >1,400 m for the entire Phase I over both years (Figure 27/28.1-9), through channel connectivity measures and increased LWD jam frequency (Table 27/28.1-1). Pools were not directly developed during construction and are expected to develop naturally, following changes in channel geomorphology during high flow events, but as a result of reconnecting channels and LWD placement 28 additional pools were created (Figure 27/28.1-10). These features are intended to benefit spring Chinook by providing better refuge and spawning habitat for adults, reducing redd scour during winter flood events, and increasing rearing habitat and over-winter survivals for juvenile salmonids. Project restoration objectives have been developed for this project area and are based on conditions observed during pre-project field visits metric data and use the

recommendations identified in the 2021 Plan (Anchor QEA 2021) for floodplain channel complexity, LWD key pieces, pool frequency and pool area.

Note: Immediately, following implementation in 2021, a spring Chinook redd was identified within the project area indicating habitat selection on behalf of available habitat. Additionally, spring Chinook parr and large numbers of summer steelhead parr were observed during construction and salvage relocation activities.

Background: This project has been designed and is being implemented using “Stage-0” (Clure 2018) as defined in the River Evolution Model (Clure 2018) as the restoration target for river and floodplain in this project. This treatment approach requires some additional explanation given their relative infancy as a restoration approach. The driving goal of restoring to “Stage-0” is a type of approach to address channel-floodplain disconnection through lowering (grading) of artificially high (i.e. disconnected) floodplain areas and filling of incised channels (Figure 4). These actions effectively equalize floodplain and channel elevations to maximize floodplain engagement, minimize stream power per unit width, re-initiate sediment deposition, and raise groundwater tables to promote vegetation success. Specific elements of this approach include:

- Floodplain grading that targets removal of artificially high areas (such as berms and roads). Importantly, low areas such as those containing wetlands are avoided with floodplain excavations.
- Designs error on the side of more rather than less connectivity to allow the stream to find its natural multi-threaded dynamic equilibrium. Maximum connectivity is achieved through partial filling of the channel with material excavated from high floodplain areas. Excavation of narrow side channels are de-emphasized.
- Placement of loose logs and other roughness elements further decrease unit stream power (stream power per unit width) across the floodplain.

A focus on less engineered elements of a Stage-0 approach, including loose logs and broad (low-detail) excavations, can save significant construction costs.

Initial as-built results of the RHS data set includes two indices used by the Program to monitor change in river channel complexity and habitat complexity. Channel complexity is measured by RCI a function of river perennial length and the braiding parameter indicating changes in stream power and gravel bar development, along with the conversion of plain bed confined channels to a more anastomosing channel form. To qualify that the conversion of channel form is providing quality habitat for spring Chinook, the program also identifies channel habitat unit types while conducting RHS (Figure 27/28.1-11).

The increase in floodplain connectivity caused by the implementation of Phase I lead to an increase in RCI value (Figure 27/28.1-12) in both project areas with a significant increase observed in PA28.2. This is primarily due to the impacts of the King Grade Rd. and bridge

separating the two project areas. An increase in channel habitat units both in number and diversity (Figure 27/28.1-1 & 27/28.1-13) was observed in both project areas.

This approach is reflected in the creation of slow water side channels and the transition of plain bed riffle to non-turbulent glides, to capture this change channel units were delineated for all Phase 1 implementation (Figure 27/28.1 -13). Overall, there was a 40% increase in the number of channel units, with about a 37% reduction in riffle habitats.

Table 27/28.1-1: Project Area 27 and 28.1 project habitat metrics collected in pre and post project rapid habitat surveys conducted in 2020 for Phase 0.5 and in 2021 for Phase I.b. Project metrics in this table include main channel length in meters, side channel length for both perennial channels and ephemeral channels in meters, LWD key pieces (>6 m long and 0.3m dia.), the number and type of LWD jams or single logs and the frequency depth and areas of pools.

Project Area Survey Type	Main Channel Length (km)	Side Channel (m)		LWD Key Piece (#)	Structure #		Pools		
		Peren	Ephem		Jams	Single Log	Freq. (#)	Area (m ²)	# pools > 1 m
PA27 Reach Obj. 2023	None	~500	~200	>54	>15	>12	15	1,030	N/A
PA27_Pre-project Phase 0.5 (2020)	0.43	204	49	24	7	6	11	571	5
PA27_Post-project as-built Phase 0.5 (2021)	0.45	529	0	190	34	12	22	1287	12
PA28.1 Reach Obj. 2023	None	1,600	1,000	>123	>160	30	45	2,360	N/A
PA28.1_Pre-project Phase 1 (2020)	1.12	270	620	83	19	16	32	1385	22
PA28.1_Post-project as-built Phase 1 (2021)	1.2	1702	2410	728	145	36	59	4443	36
PA28.1 Phase III Objectives	N/A	1,800	>3,000	925	160	45	60	3000	22

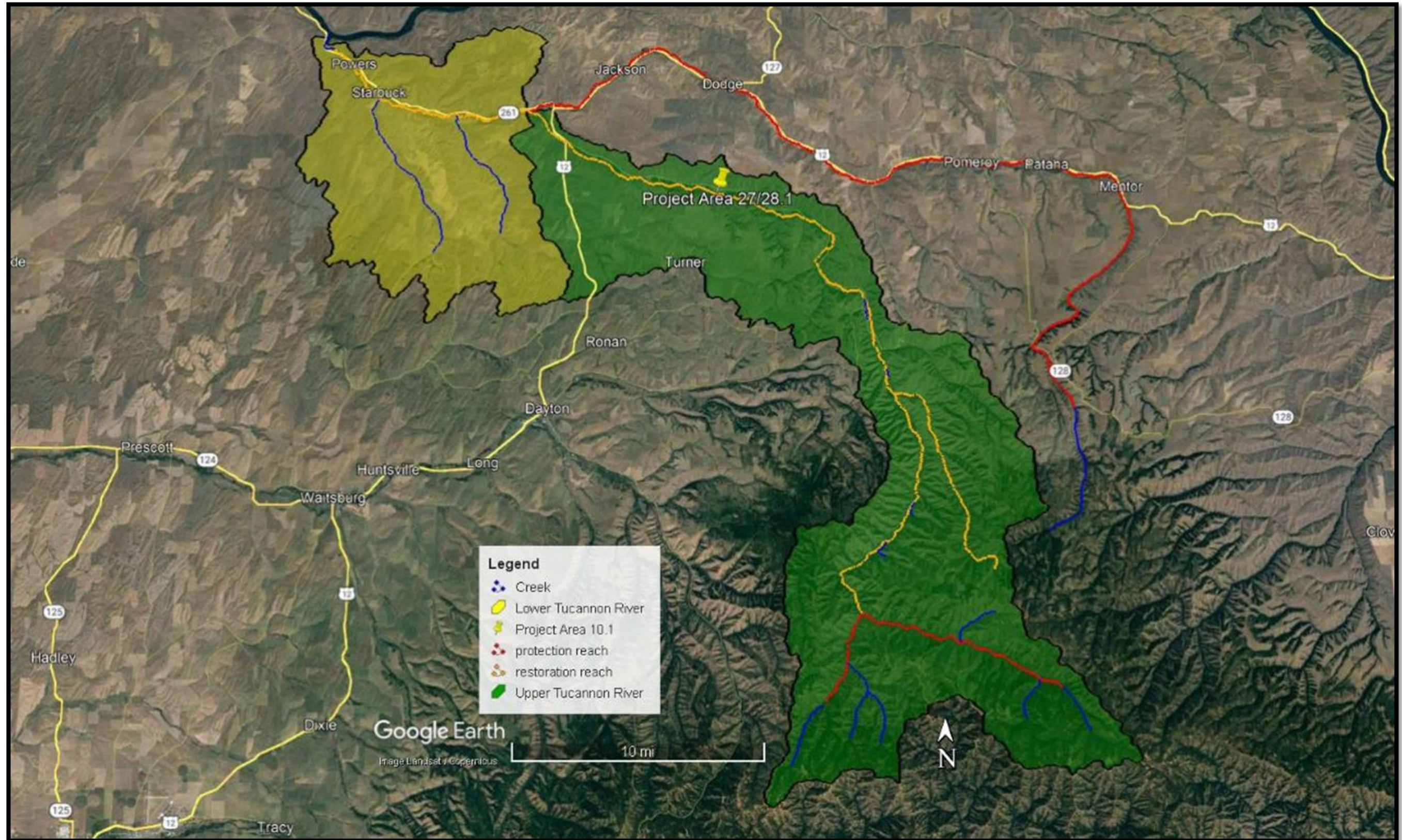


Figure 27/28.1-1: Project Area 27/28.1 project vicinity map. Tucannon Valley mile 19.6 to 20.38, with a start Lat/Lon 46.453672 -117.816916 and end Lat/Lon 46.456387 -117.832140.



Figure 27/28.1-2: PA28.1 Pre/post Photo Point 2021 illustrating a channel fill reach where thalweg elevation was increased, with LWD secured within the bed matrix.

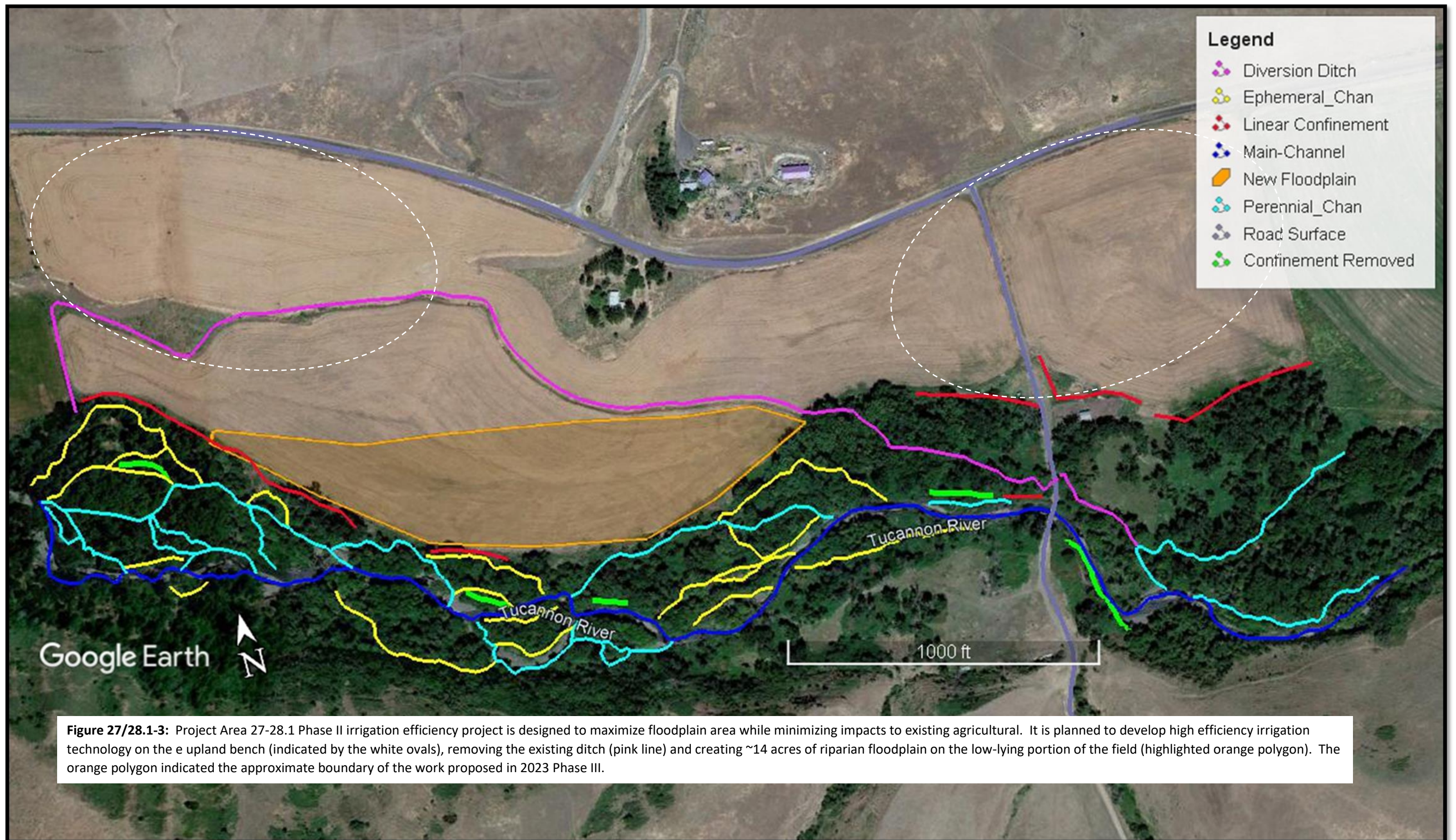
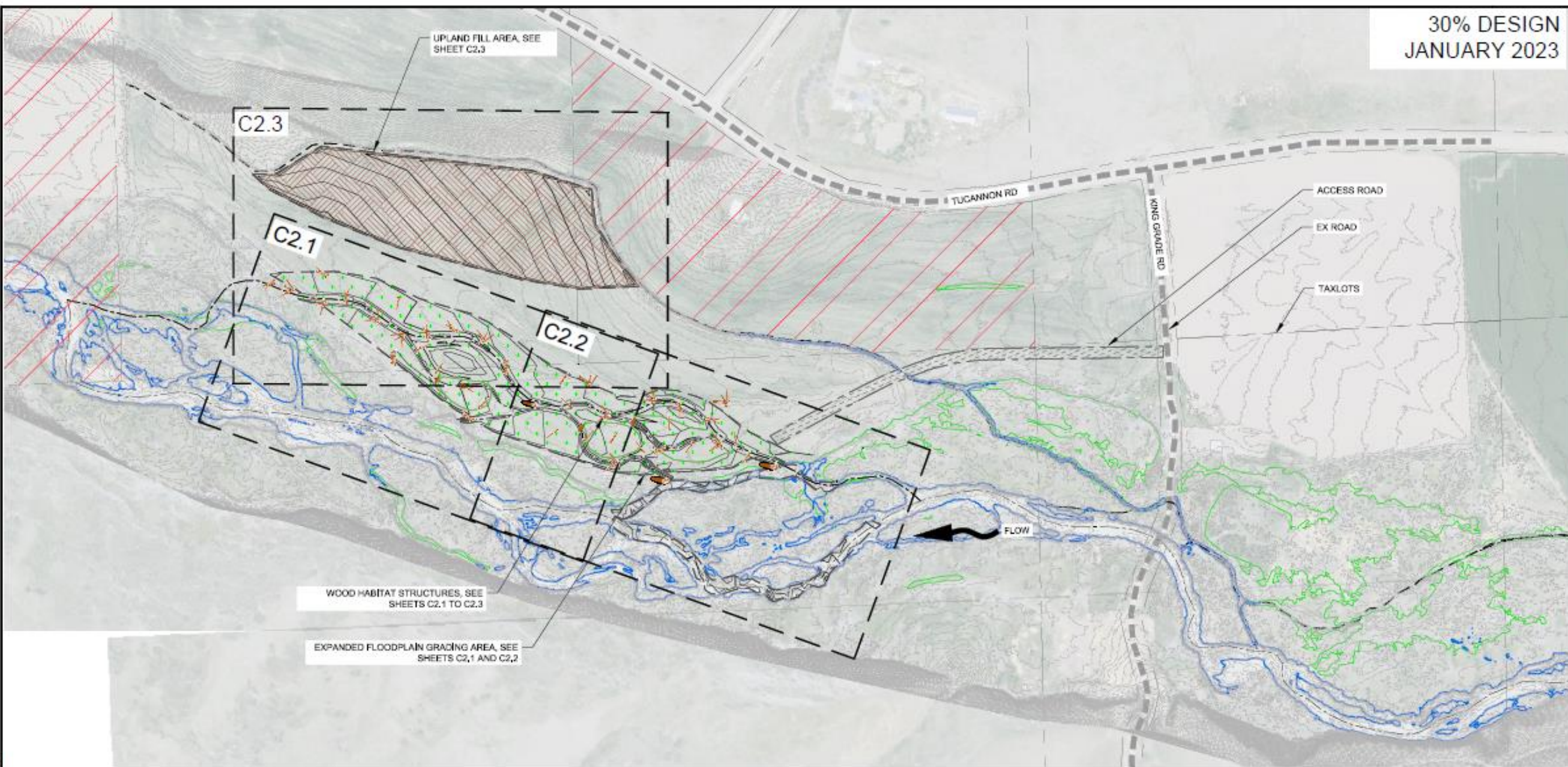


Figure 27/28.1-3: Project Area 27-28.1 Phase II irrigation efficiency project is designed to maximize floodplain area while minimizing impacts to existing agricultural. It is planned to develop high efficiency irrigation technology on the e upland bench (indicated by the white ovals), removing the existing ditch (pink line) and creating ~14 acres of riparian floodplain on the low-lying portion of the field (highlighted orange polygon). The orange polygon indicated the approximate boundary of the work proposed in 2023 Phase III.

30% DESIGN
JANUARY 2023



UPLAND FILL AREA, SEE SHEET C2.3

C2.3

C2.1

C2.2

WOOD HABITAT STRUCTURES, SEE SHEETS C2.1 TO C2.3

EXPANDED FLOODPLAIN GRADING AREA, SEE SHEETS C2.1 AND C2.2

ACCESS ROAD

EX ROAD

TAXLOTS

FLOW

TUCANNON RD

KING GRADE RD



SCALE
150 0 75 150 300
SCALE FEET

NOT FOR CONSTRUCTION



CTUIR
TUCANNON RIVER
PROJECT AREA 27/28
PHASE 3
COLUMBIA COUNTY, WA

SITE OVERVIEW

REVISION NUMBER	
No.	Date
X	DATE

Date: 01/2023
Designed by: AJ
Checked by: LH, AD
Created by: MW, AJ



JOB NO.
SHEET NO.
C1.1
6 of 16

DRAWN: 2/28/2023 1:21 PM USER: ajones
 DATE: 01/09/2023 1:21 PM USER: ajones
 FILE: 27281-PA28.1-III-DESIGN-30% X-PLAN-3-18-2023.dwg
 USER: ajones

SITE OVERVIEW

Figure 27/28.1-4: PA28.1 Phase III design overview sheet from the 30% Design, 2023. Sheets C2.1 and C2.2 are in the following design sheets. It's important to note that all design for Phase III are located in PA28.1 downstream from King Grade Rd.



Figure 27/28.1-7: Project 28.1 pre and post implementation photo points 2020 (upper) and 2021 (lower). Both photo points illustrate conversion of riffle habitats to less gradient broadly floodplain connected low energy reaches.

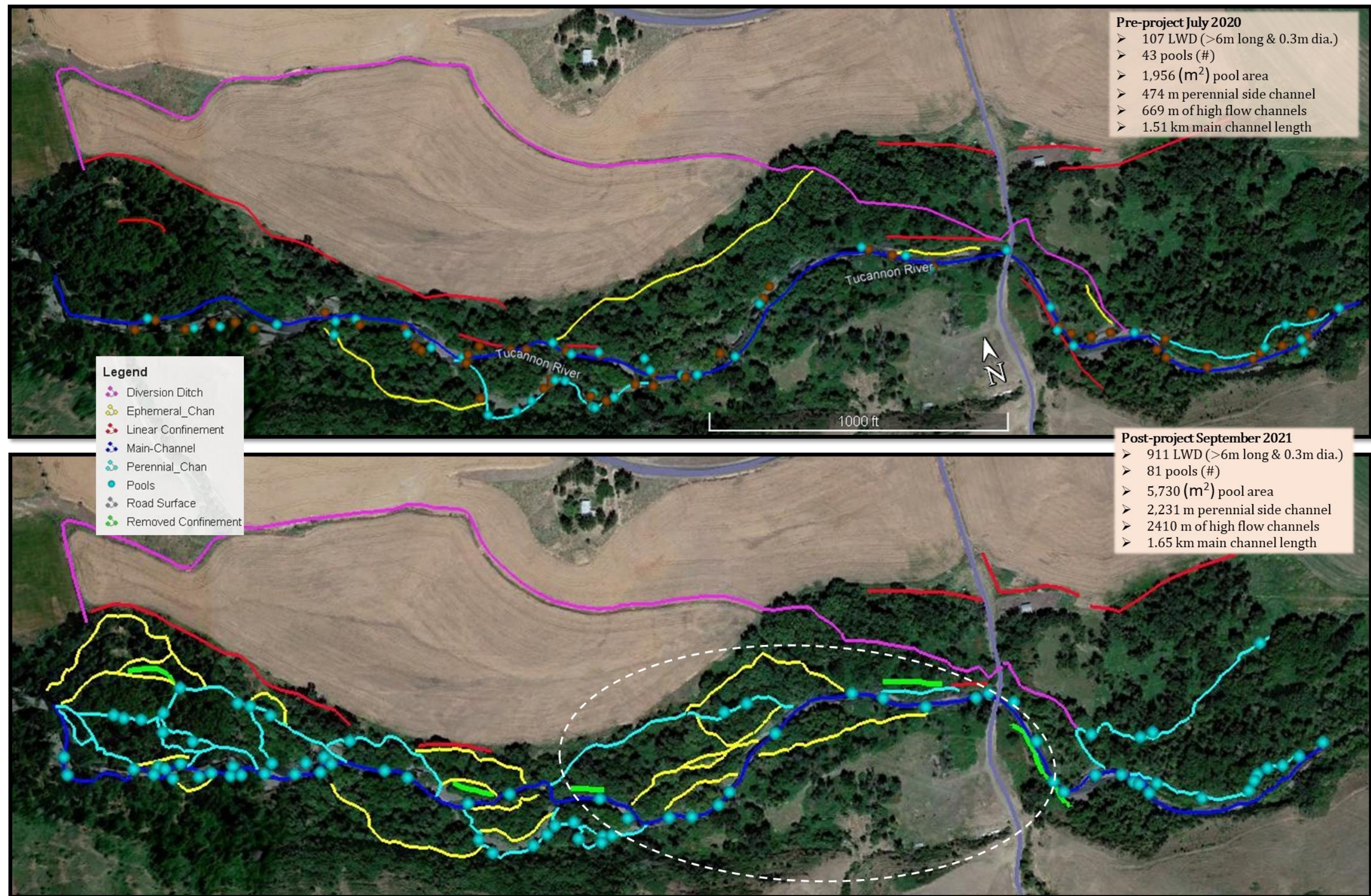


Figure 27/28.1-8: Project map illustrates pre and post project conditions within PA27/28.1 Phase I floodplain connection and LWD project implemented in 2020-2021. The dashed oval indicates the approximate area of work in 2020 Phase 0.5 reported in 2020 Annual Report.

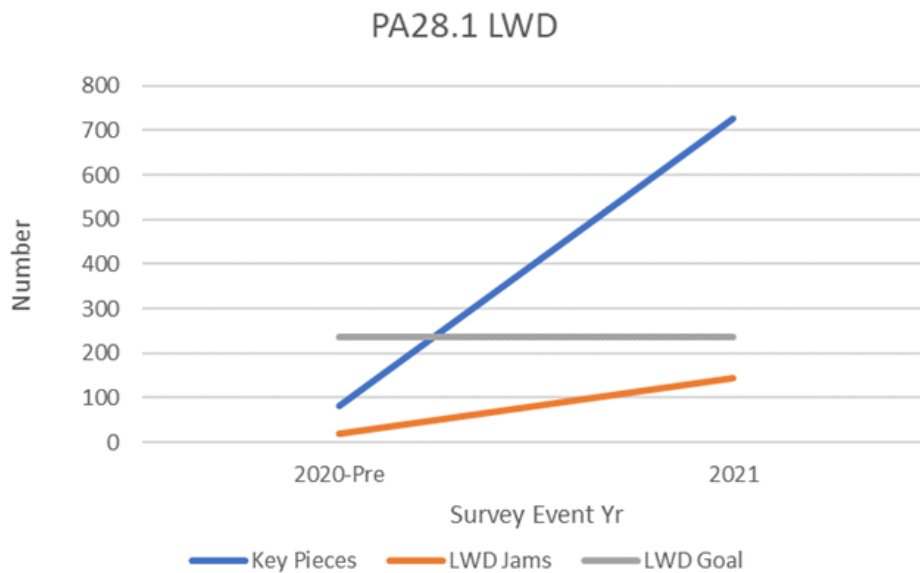
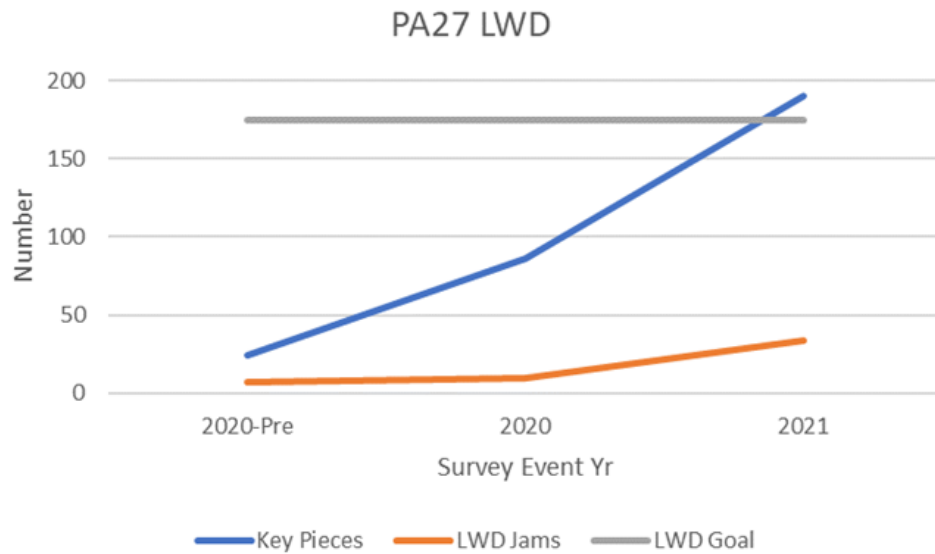


Figure 27/28.1-9: Project Area 27/28.1 large woody debris key pieces (>6 m long & 0.3 m dia.) and number of multi key piece log jams during pre-project and post-project rapid habitat surveys for PA 27 (upper) and PA28.1 (lower). The grey horizontal line represents the project goal base on 2 key pieces per bank full width. There has not been a goal for the number of log jams.

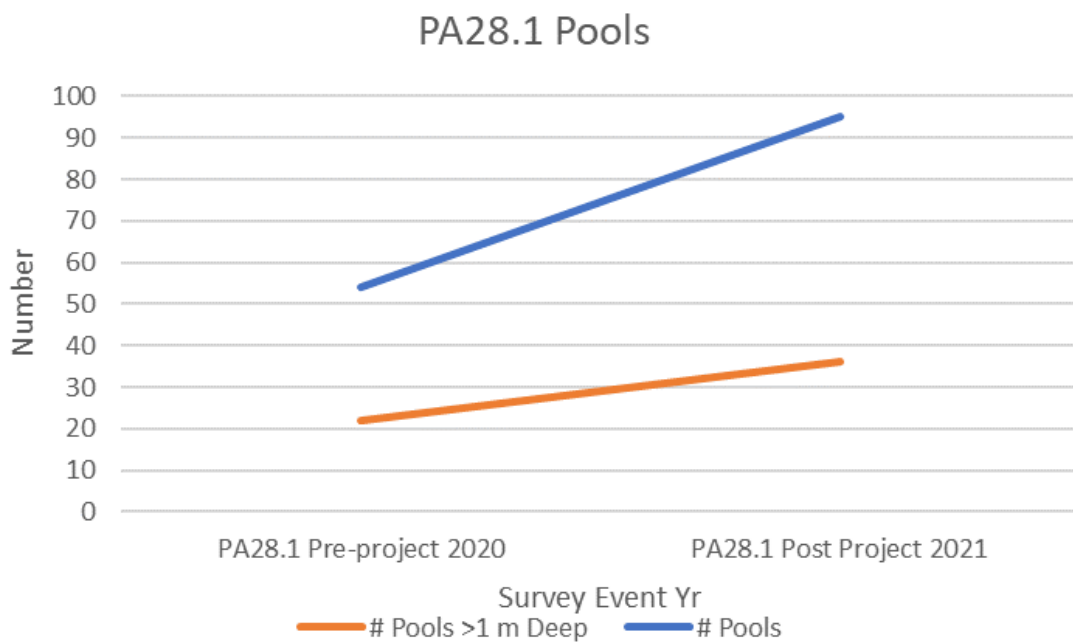
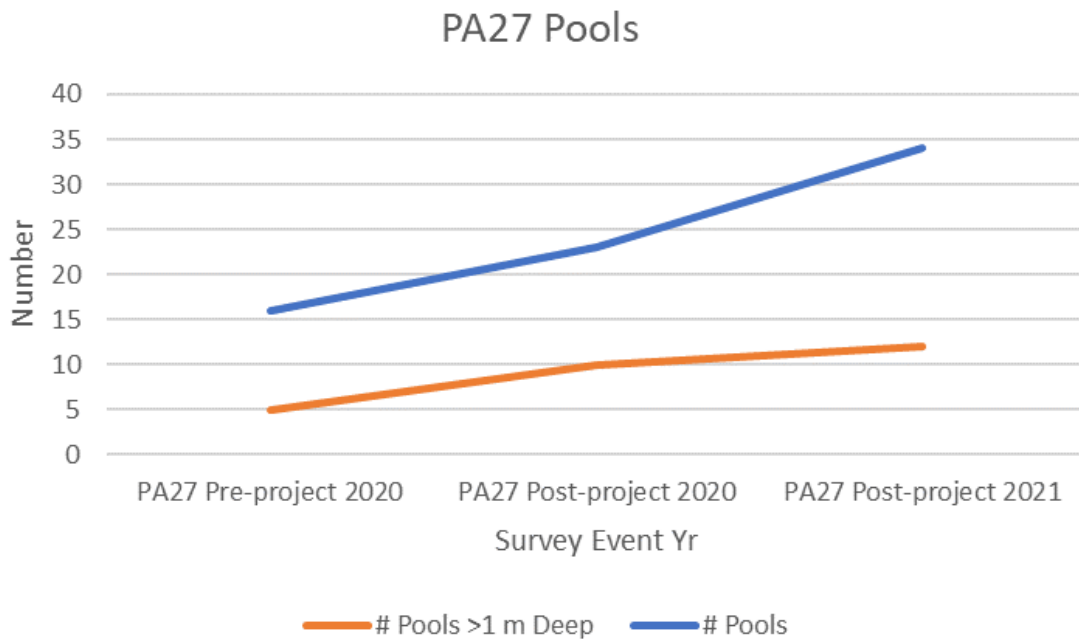


Figure 27/28.1-10: Project Area 27/28.1 pool frequency and number of pools deeper than 1 m measured during pre-project and post-project rapid habitat surveys for PA 27 (upper) and PA28.1 (lower).

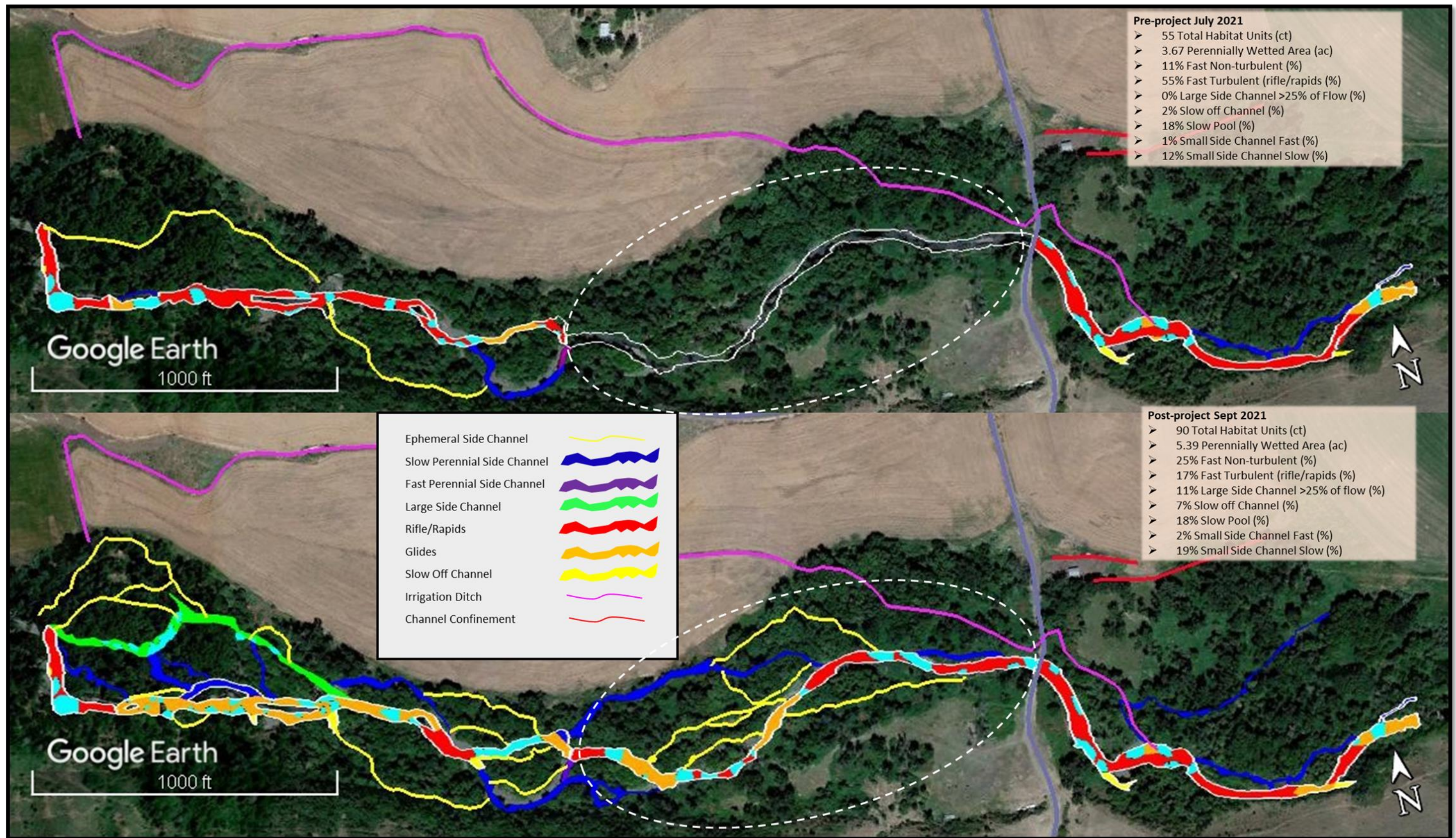


Figure 27/28.1-11: Project Area 27 & 28.1 Phase 1 all work completed in 2020 (highlighted by the dashed oval) and 2021 by CTUIR. The project reach runs from right to left under the King Grade Rd. The map above illustrates the whole of the project which was initiated in 2020 (Phase 0.5) highlighted by the white dashed oval in both pre and post project maps. In 2020, habitat units were not drawn in the field so the units shown in the map above reflect a post project survey completed in 2021 and are not reflected in the data call outs for the pre & post project maps. Note, the light blue shaded areas are slow pools in all maps above.

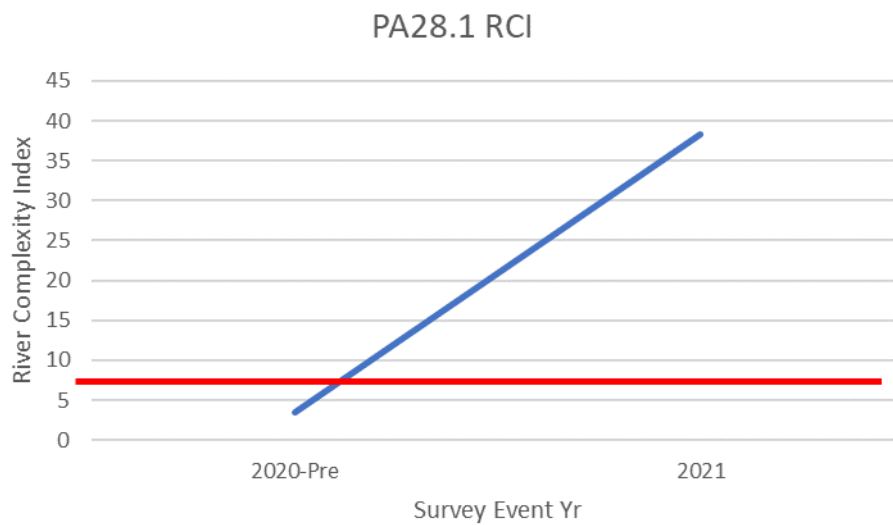
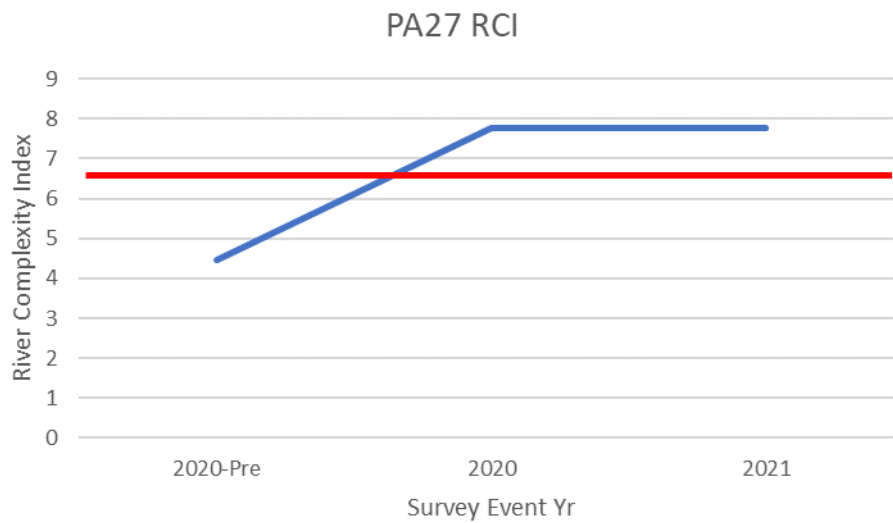


Figure 27/28.1-12: Project Area 27/28.1 River Complexity Index (RCI) value calculated from the channel delineations measured during pre-project and post-project rapid habitat surveys for PA 27 (upper) and PA28.1 (lower). The RCI value will be calculated in 2023 following the 2 yr post implementation monitoring interval. The RCI goal for this site has not been estimated but it is suspected to become similar to other higher values in the watershed and will likely double the as-built in 2-4 years.

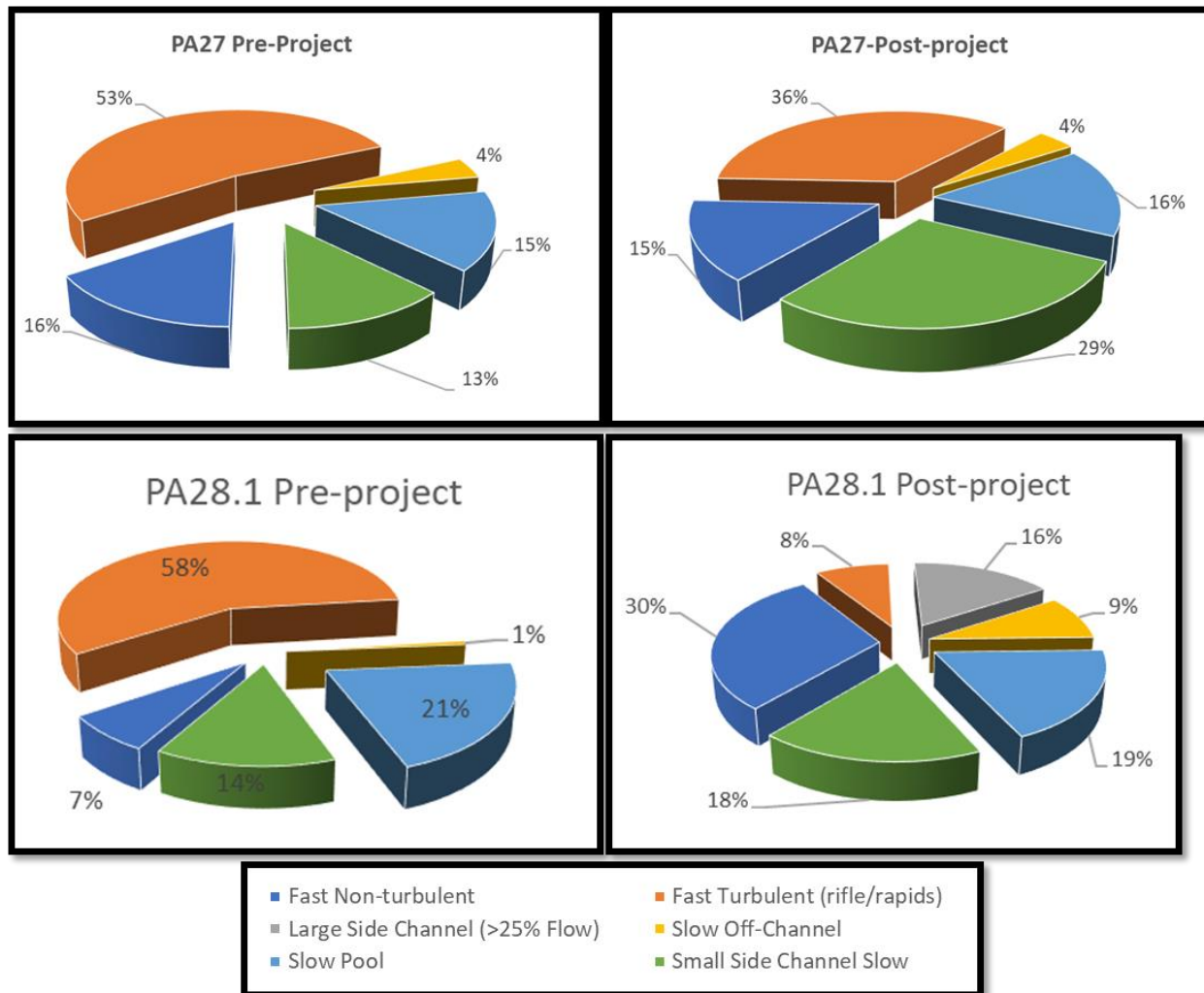


Figure 27/28.1-13: Project Area 27/28.1 channel habitat units measured in the field during the pre-project and post-project rapid habitat surveys for PA 27 (upper) and PA28.1 (lower). The largest change in the channel unit type and diversity involves the conversion of riffle type units to glide unit types and the creation of large side channels.

Project Title: 2022 Tucannon River Project 5-15.2 Assess/Design

Implementer: Confederated Tribes of the Umatilla Reservation

Project Partners: Nez Pierce Tribe & Washington Department of Fish & Wildlife

BPA Programmatic Funding (2010-077-00): In 2022, \$210,350 (#73982 REL164).

Matching Funds: Matching funding were awarded in the 2022 SRFB grant round \$150,000 (22-1021) in 2022. WDFW is also providing an additional \$70,000 in funds through the Floodplain Management Plan.

Location: Tucannon Basin floodplain from valley mile (VM) VM 32.29 to VM 41.23. (Figure 15).

Project Time Line: The Tucannon Floodplain Management Plan (WDFW 2012) was completed in 2012, with two actions identified in the plan implemented as of 2022. The Tucannon River Project 5-15.2 Assessment and Design will function to update and advance the original effort in 2023 and wrap up in 2024 with conceptual designs and construction to follow in 2024-2030.

Priority Populations: Although these efforts are targeting Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened), Snake River Fall Chinook (Threatened), Columbia Basin Bull trout (Threatened) the process is intended to restore natural process that will provide habitat for all species present including pacific lamprey and bivalves.

Priority Life Stages: All life stages.

Project Goal & Objectives:

The project goals are to (1) assess the Tucannon River floodplain in PA 5-1.25 and (2) to create a conceptual design for the project reaches based on the preferred alternatives. The assessment will analyze the impacts of infrastructure on the floodplain and river channel to develop restoration alternatives that prioritize solutions that minimize or eliminate these impacts. The conceptual designs will be created for all the project areas included in the assessment and will focus on improving habitat for listed species by identifying solutions that best address the underlying impairments to river and floodplain processes focusing on:

- Increase floodplain connectivity, promote lateral migration, increase wetland area – reducing stream power and recruit gravel for spawning
- Increase channel complexity. Less confinement and incision, more pools and wood increasing prime rearing habitat and refuge areas for juveniles and returning adults during high stream flow events
- Reducing temperatures contributed by lake outflows during the summer months. The desired future condition includes a properly functioning stream system which promotes free migration with an accessible and functioning floodplain. All aquatic species would benefit, with emphasis on ESA listed species like Chinook salmon, steelhead, and bull trout benefitting all life stages, but focusing on egg to fry, juvenile rearing and returning adult spawning life stages.

Project Objectives: Within two years of funding, the assessment and conceptual design will develop and prioritize alternatives to floodplain infrastructure.

1. Evaluate degree of floodplain confinement –
2. Assess impacts of infrastructure on floodplain functions, using the following physical habitat criteria:

- a. existing fisheries habitat availability
 - b. Existing stream power
 - c. Existing floodplain connectivity and channel complexity
3. Develop alternatives that include modification, relocation, and removal of infrastructure (1.5 years)
 4. Quantify fisheries habitat improvements under each alternative (1.5 years)
 5. Estimate potential cost/benefit for modification to floodplain infrastructure (1.5 years)
 6. Develop evaluation criteria to determine co-manager preferred restoration approaches for each alternative (1 year)

Description: The Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and its co-managers, the Washington Department of Fish and Wildlife (WDFW) and the Nez Perce Tribe (NPT), are co-sponsoring the Tucannon River PA 5-15 Assessment and Design Study. Grant funds will be used to hire an engineering firm to assist with the completion of an assessment and conceptual design for the Tucannon River and its floodplain on the W.T. Wooten Wildlife Area in Columbia County, in southeast Washington. The study will identify the effects of infrastructure encroachment on the Tucannon River and its floodplain by focusing on the reach below Camp Wooten Environmental Learning Center (PA-5) downstream to PA-15.2 just up-stream from the community at the mouth of Tumulum Creek. The assessment will help co-managers identify and prioritize multiple use management alternatives for existing state-owned infrastructure including the put and take fishing lake sites. Alternatives analysis will include the possibility of lake modification, lake relocation, or lake removal. These actions are necessary in light of the current management concerns and the need for reevaluation of floodplain habitat and river habitat (Figure 16) to support declining ESA-listed Snake River spring Chinook, summer steelhead populations and bull trout. Tucannon River's floodplain function has been reduced by infrastructure encroachment (Figure 17), large wood removal, reduction in riparian vegetation, channel straightening, dike building and devastating floods and fires. The study will produce conceptual designs to identify priority restoration actions within this 14-mile reach of the Tucannon River.

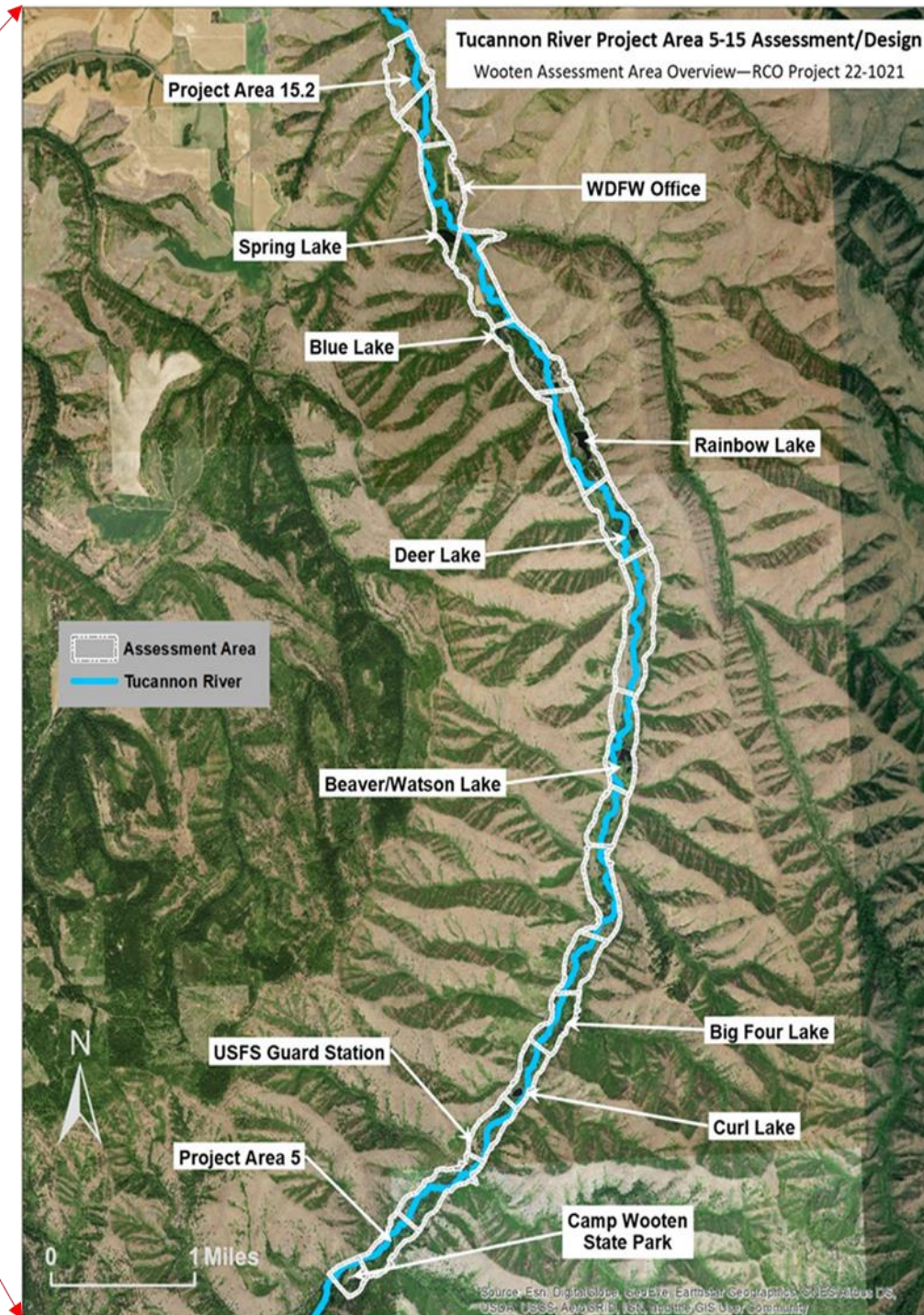
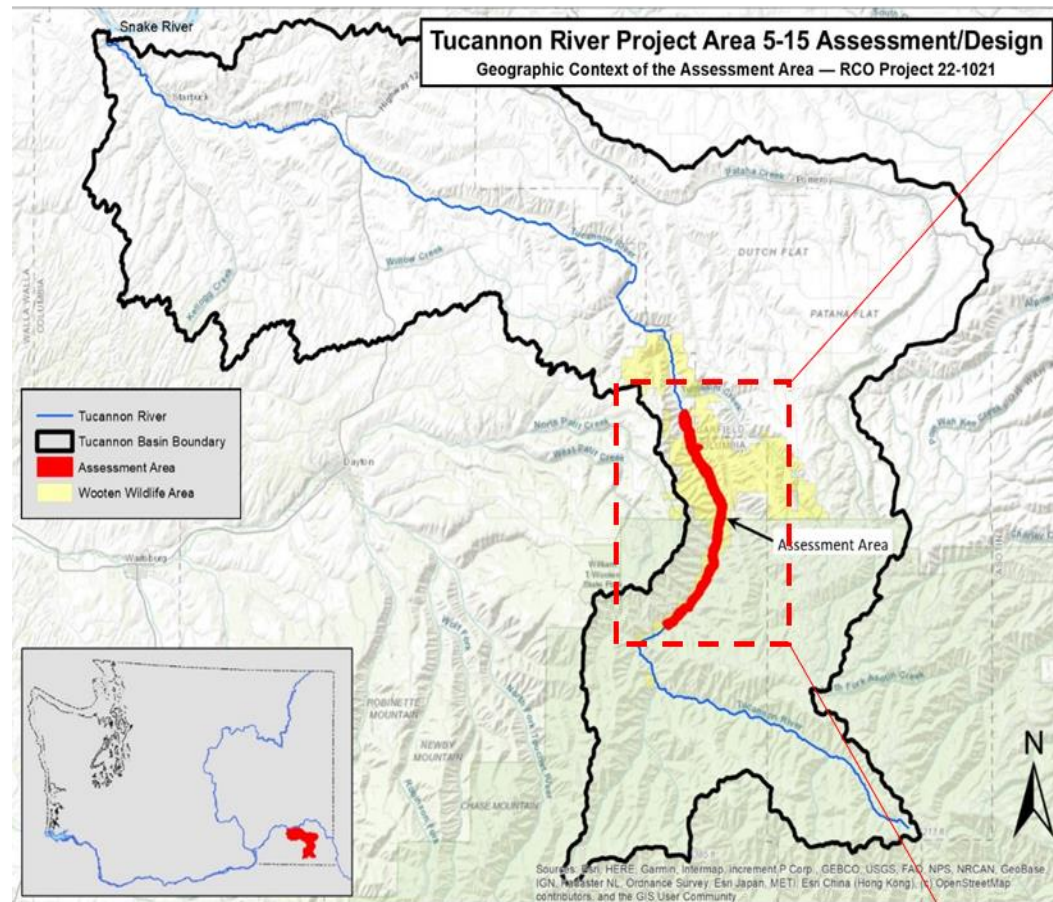


Figure 15: Tucannon River Project Area 5015 Assessment and Design project vicinity valley mile 32.29 to 41.23. The left expansion box lists the larger infrastructure facilities located in the floodplain on the wild life area.



Figure 16: River condition 2020 flooding looking upstream to Beaver Watson diversion point

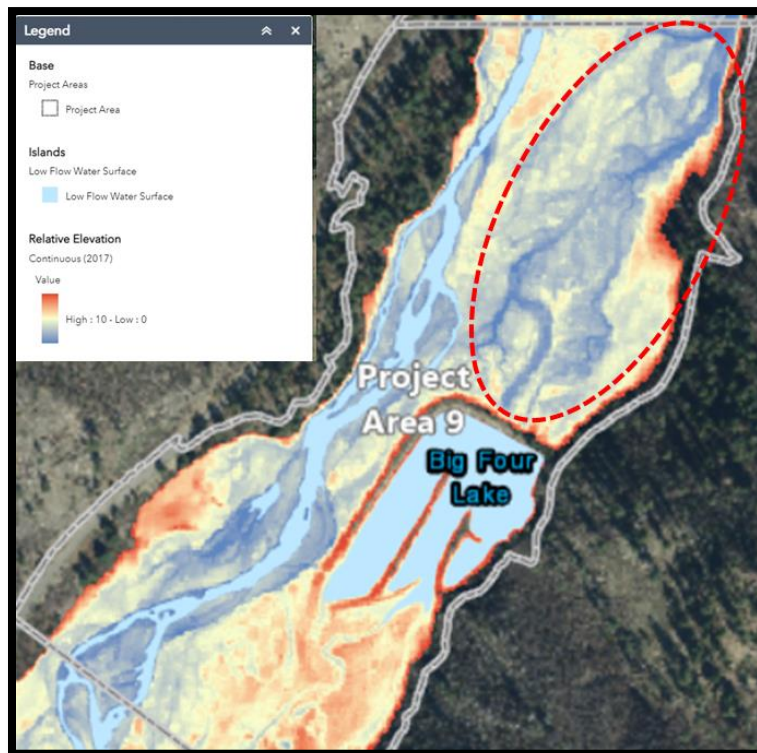


Figure 17: Example REM from PA9 which contains Big 4 Lake. The read dashed oval indicated the area of floodplain disconnected in the downstream shadow of the impoundment which is nearly $\frac{1}{2}$ of the available floodplain in this project area.

Partner – NPT Projects

Project Title: Tualum Fish Passage

Implementer: Nez Pierce Tribe

BPA Programmatic Funding (2010-077-00): In 2021, \$215,150 (#74017 REL100)

Other BPA Funding (2007-393-00): In 2020, NPT ~\$116,000 (#74017 REL 45)

Matching Funds: Matching funding toward this project come from the FY20 SRFB grant round, through the SRSRB LE process at sum of \$316,110 (20-1053).

Location: Tucannon Valley mile ~31.75 and Lat/long 46.358986 -117.685199 (Figure 18).

Project Time Line: Initial preliminary design development began in 2019 (#74017 REL 45) to be completed by April, 2020. Implementation was delayed in 2021 during the Columbia County final review, in 2022 NPT continues to work with the Columbia County determine the potential to move forward with replacing the counties fish passage barrier. In early 2023, a field meeting between NPT, SRSRB and the County is planned to determine the steps needed to move forward.

Recovery Expectations: This project is located in Tualum Creek a small disconnected (33% passable culvert) tributary to the main stem Tucannon. It is anticipated this project will reconnect the tributary and increase fish access and use through channel improvement in the lower mile of the tributary.

Priority Populations: Snake River DPS Summer Steelhead (Threatened), for all life stages.

Potential Future Actions: It is not anticipated that future actions would be required in relation to the removal of the fish passage barrier. Additional floodplain structures may be desired once the floodplain and stream channel objective is met. Revisit riparian planting and health over time as floodplain land scape evolves from shrub step dominated to typical wetted Tucannon riparian forest type.

Project Goals and Objectives

Goal: Restore (100%) fish passage into the Tualum watershed through the modification of the Tucannon Road crossing located ~762 m from the confluence with the Tucannon.

Conceptual Project Objectives: Detailed objectives will be developed during project development.

- I. Develop a fish passage design for the Tucannon Road Crossing, to provide 100% passage
- II. Long Term Obj. (3-5 yrs): Improve stream channel and Riparian function in this stream delta for both fish passage and geomorphic process.
- III. Planting to restore a floodplain and upland terrace forest.

Project Background & Summary

Background: Tumalum Creek is a tributary of the Tucannon River that has been disconnected by a road culvert under the Tucannon Rd. The culvert has formed a barrier based on slope and drop, and currently blocks fish passage (33% passable based on slope and drop, 2019 WDFW survey) into the basin (Figure 19). The road crossing is located within the tributary delta which has been modified, channelized and leveed to flow directly downstream to the Tucannon. Fish access to the main stem will be improved by reducing confinement on the delta and increasing channel complexity.

Summary: Tumalum Creek is a tributary to the Tucannon River in Southeast Washington located within the Tucannon Major Spawning Area as identified in the Snake River Salmon Recovery Plan (2011). The overall project goal is to implement a project to resolve a partial fish passage barrier for the Tumalum Creek culvert that will pass all life stages of ESA-listed Snake River summer steelhead and allow access to spawning and rearing habitat to approximately 10.8 km upstream of the existing culvert. The barrier was identified in the 2008 Walla Walla Community College Road Crossing Barrier Assessment and included in the WDFW Inventory Assessment.

The existing barrier culvert is an approximate 20 m long corrugated metal pipe which was installed sometime prior to 1996. The culvert itself is in good condition, however, it is considered only 33% passable due to a slope of 1.91%, and in most seasons has a drop exceeding 30 cm.

The NPT worked to secure a habitat resource design sub-contractor to produce preliminary designs to a 60% level beginning in 2019 and final design in March 2021. The NPT has been awarded a SRFB grant to match BPA funds to initiate implementation in 2022 work window.

The project will work to replace one passage barrier culvert with a 60 ft. L x 15 ft. W x 11 ft. H open-bottom concrete box culvert and install a WDFW stream simulation immobile roughened channel throughout the extent of the culvert and approximately 3 m. above and below the culvert inlet and outlet to provide passage for all life stages of Snake River summer steelhead.

Maintain existing mature riparian forest on 1.25 acres to the largest extent possible to provide the maximum amount of shade and natural recruitment while contributing to water temperature regulation in the project reach and future natural wood recruitment to Tumalum Creek and the Tucannon River. Any riparian lost during construction will be replanted as appropriate.

TUMALUM CREEK FISH PASSAGE AND HABITAT ENHANCEMENT

NEZ PERCE TRIBE

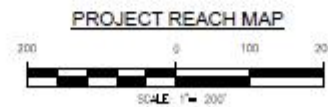
TUCANNON RIVER ROAD CULVERT REPLACEMENT

PROJECT MANAGER: KATHRYN FRENYESA

100% DESIGN

SHEET INDEX	
SHEET NAME	SHEET #
COVER SHEET, SHEET INDEX, LOCATION MAP	1
LEGEND, SURVEY DATUM, DRAWING REFERENCES	2
EXISTING SITE PLAN, PROPERTY BOUNDARIES	3
PROPOSED SITE PLAN, PROJECT ELEMENTS	4
STAGING, WATER, CONSTRUCTION MANAGEMENT PLANS	5
CULVERT PLAN, SECTIONS, STREAMBED DETAILS	6
CULVERT MATERIALS, CONNECTIONS DETAILS	7
GUARD RAIL, SURFACING PLAN, SECTION, DETAILS	8
GRADING PLAN, REVEGETATION NOTES	9
LOG, BOULDER PLACEMENT, PLAN, SECTION	10

TOWNSHIP 10N RANGE 41E SECTION 9



NO.	DATE	REVISION DESCRIPTION	BY	CHK



NEZ PERCE TRIBE		TUMALUM CREEK FISH PASSAGE AND HABITAT ENHANCEMENT	
DESIGNED BY: P DEVRIES	 Resource Consultants, Inc. REDMOND, WA 98052 PHONE: (425) 556-1288	COVER SHEET SHEET INDEX, LOCATION MAP 100% DESIGN	DATE: MARCH 11, 2021
DRAWN BY: P DEVRIES			SHEET: 1
CHECKED BY: B JOHNSON		REV: -	
PROJECT MGR: P DEVRIES			

Figure 18: Tumulum fish passage project vicinity map produced by R2 Consultants for the final design completed in 2021.



Figure 19: Tumulum Creek is a tributary of the Tucannon and currently is utilized by summer steelhead as spawning and rearing habitat. The culvert at the Tucannon Road crossing is currently only 33% passable based on slope and drop out of the culvert. The image above shows the stream crossing with two images showing the entrance (upper right) and exit from the culvert (lower left).

Project Title: Cumming Creek

Implementer: Nez Pierce Tribe

BPA Programmatic Funding (2010-077-00): In 2022, technical support and Phase II survey, in 2021 In-kind field survey completed.

Other BPA Funding (2007-393-00): In 2021, NPT Staff in-kind with anticipated future support.

Matching Funds: Matching funding toward this project was secured in the FY21 SRFB grant round, through the SRSRB LE process at sum of~ \$121,986 (21-1013).

Location: Tucannon River mile ~38.0 and Lat/long 46.333 -117.670 (Figure 20).

Project Time Line: Initial preliminary design development began in 2021 (#74017 REL 45) for the purpose of collecting existing condition type data to be used in developing a grant request for surfboard. In 2022, NPT worked to develop designs and (74017 REL 45) initiate implementation in 2023-24. Early in 2023, for implementation in 2024-25, NPT is pursuing an additional SRFB grant to conduct both a Phase II on the next mile upriver as well as anticipated adaptive management grant (Phase III) to take advantage of progress Phase I.

Recovery Expectations: This project is located in Cummings Creek a small tributary to the main stem Tucannon. It is anticipated this project will improve habitat complexity and reconnect floodplain to increase fish access and use through channel improvement in the lower mile of the tributary.

Priority Populations: Snake River DPS Summer Steelhead (Threatened), for all life stages. Positive impacts to Spring Chinook (Threatened) are indirect downstream in the mainstem Tucannon.

Potential Future Actions: It is anticipated that future actions may be required in relation to additional gains or replacement of fish structures in the event of losses. The adaptive management plan would consider modifications to structures in the unlikely event that fish passage barriers were to develop in association with one or more structures. Observations would be made during the post implementation 2yr recurring surveys conducted by NPT and the Program Partners. Additional floodplain structures may be desired once the floodplain and stream channel objective is met. Revisit riparian planting and health over time as floodplain land scape evolves from shrub step dominated to typical wetted Tucannon riparian forest type.

Project Goals and Objectives

Goal: Increase channel function and floodplain connectivity of the lower 2.0 km of Cummings Creek from the confluence with the Tucannon upstream using the less invasive technique of PALs and BDAs.

Conceptual Project Objectives:

- I. Design and place complexes of LWD PAL and BDA structures to capture and inundate lower lying areas.
- II. Design and place LWD BDAs and PAL type structures to encourage lateral channel migration, increase sediment sources and LWD recruitment, while reducing channel incision.
- III. Long Term Obj. (3-5 yrs): Improve stream channel migration floodplain connectivity and riparian function in this stream reach.
- IV. Planting to restore a floodplain and upland terrace forest

Project Background & Summary

Background: Cummings Creek is a tributary of the Tucannon River that is incised in its floodplain and remains relatively locked into its current degraded form (Figure 21) offering very little in quality salmonid habitat (Figure 3). The existing channel has relatively low habitat complexity (Table 6) though it supports a population of summer steelhead and bull trout and it has potential to provide benefits to spring Chinook through improved water temperature and productivity (Anchor 2021). The project area is located on the Wooten Wildlife Area and the drainage is accessed by a gated road closed to protect wildlife in the drainage. The reach has riparian trees rooted in the existing floodplain inset as well as on the historic disconnected floodplain providing good opportunities to recruit LWD through lateral migration and inundation. Beaver activity was noted during the project survey and in 2017 a number of very large dams and a lodge were established ~3 miles upriver, though they seemed to be unoccupied in a 2020 visit. In 2009 WDFW, CTUIR and the USFS supplemented LWD in the drainage following previous wildfire by culling large trees and snags felling them in the channel corridor. During the survey some of these trees were observed though the number of effective LWD was below targets set for the Tucannon basin (Table 6).

Table 6: Habitat metric surveyed in 2021 as part of a pre-project rapid habitat survey completed by SRSRB and NPT.

Project Area Survey Type	Main Channel Length (km)	Side Channel (m)		LWD Key Piece (#)	Structure #		Pools		
		Peren	Ephem		Jams	Single Log	Freq. (#)	Area (m ²)	Mean Depth Range (m)
Obj.2023	none	>500	>500	>300	36	5	>75	~15% of surface area	1.0-1.5
Pre-project (2021)	2.05	77	0.0	44	19	20	33	528	0.5-1.0

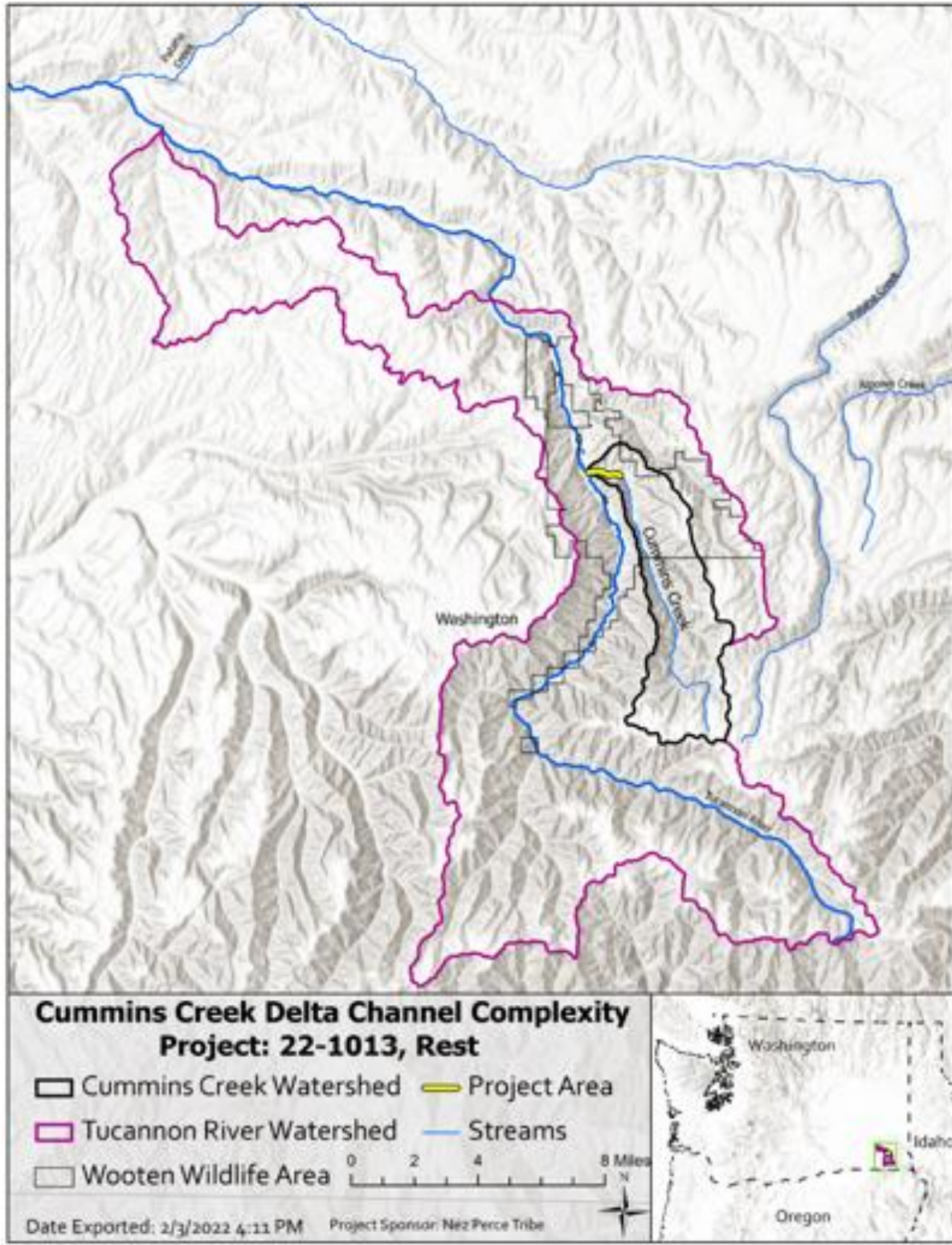


Figure 20: Cummings Creek vicinity map presented by NPT at the SRSRB Lead Entity meeting in 2022.

Summary: Cummings Creek is a tributary to the Tucannon River in Southeast Washington located within the Tucannon Major Spawning Area as identified in the Snake River Salmon Recovery Plan (2011). The overall project goal is to implement a project to improve ecological function within the project reach for all life stages of ESA-listed Snake River summer steelhead and to improve Chinook spawning and rearing opportunity in approximately the lower 2 km upstream from the main stem Tucannon. The design was developed in 2022 supported by Cramer Fish Sciences and will incorporate lessons learned in the Asotin Creek IMW and previous PALs work implemented in the Tucannon basin. Preliminary field investigation (in 2021) indicate this reach fits within the guidance for implementing PALs and BDA scale projects and has potential to integrate with beaver restoration activities within the Tucannon basin. One unique attribute to this project is to improve habitat conditions for encouraging beaver establishment and pass those benefit onto the local salmon populations.



Figure 21: Cummings Creek photo points established in November 2021 during a rapid habitat survey conducted for reach observation and concept design development. The left three images indicate typical condition of channel habitat, which the right (4th) image illustrating habitat potential observed at the upper most part of the project area.

Project Title: PA5-6 Floodplain and Complexity Alternative Analysis

Implementer: Nez Pierce Tribe

BPA Programmatic Funding (2010-077-00): In-kind field survey completed in 2020 & 21

Other BPA Funding (2007-393-00): In 2022 in-kind staff time for meeting and coordination in alternate development, In 2021, NPT Staff in-kind

Matching Funds: Matching funding toward this project has not been secured in 2022, although the NPT partnered with CTUIR and the SRSRB to pursue a NOAA grant to complete design and implement this project at a level exceeding 3 million in 2023. The partnership is waiting to hear back in regard to this opportunity and will consider future opportunities in 2023-24.

Location: Tucannon Valley mile 40.49 -41.22 and Lat/long 46.242 -117.687 (Figure 22).

Project Time Line: This project is in the early stages of development conducting early stakeholder involvement meeting to determine potential restoration alternatives which might be put forward in 2023-4 for alternative analysis and concept development. Initial preliminary rapid habitat surveys were conducted in 2020 & 2021 to determine existing condition and support alternative analysis. In 2022, NPT brought stake holders together in support of leading toward a design early 2023.

Recovery Expectations: This project is located in PA 5 & 6 of the main stem Tucannon with a large amount of low-lying floodplain disconnected by the Camp Wooten access road and the gravel berm protecting the road. Due to the large and healthy riparian forest in these project areas floodplain reconnection would lead to a relatively fast recovery of natural process.

Priority Populations: Although these efforts are targeting Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened), Snake River Fall Chinook (Threatened), Columbia Basin Bull trout (Threatened) the process is intended to restore natural process that will provide habitat for all species present including pacific lamprey and bivalves.

Priority Life Stages: All life stages.

Potential Future Actions: Following positive result of stakeholder outreach the next steps would be to select alternative and begin design development.

Project Goals and Objectives

Goal: Increase channel function and floodplain connectivity along the 1.92 rkm of the main stem Tucannon and its right bank floodplain while maintaining recreational opportunities to stakeholders.

Conceptual Project Objectives: Detailed objectives will be developed during project development.

- I. Remove and relocated floodplain encroaching infrastructure to connect ~19 ac of disconnected available 2 yr floodplain on river right.
- II. Design and place pilot cuts and LWD structure to connect >1,500 m of disconnected historic channels on river right
- III. Aid WA Stake Parks Camp Wooten in upgrading to renewable power sources and removing REA power line back to Tucannon Fish Hatchery
- IV. Replace 2 fish passage barriers located in the Tucannon Camp Ground

Project Background & Summary

Background: This project has a large opportunity to connect a large portion of the disconnected low-lying floodplain (19 ac) located in PA5 & 6 (Figure 23), as well as the numerous disconnected side channels (3,000 m). In 2022, the NPT coordinated two meetings to visit the project site and meet with the land managers. During these meeting the SRSRB staff provided discussion on potential habitat gains that exist within the reach, and the group discusses/brainstormed opportunities and actions which could lead toward those habitat goals. Actions identified during the meeting included but were not limited to road removal, levee removal and access relocation to open floodplain access. Modification of existing USFS campground to better fit within the floodplain requiring less infrastructure protection. There was also discussion to convert the Wooten State Park to off the grid renewable power, which could result in the removal of 4.8 km of power line if removed to the USFS Guard station and a total of 10.18 km if the guard station was also converted to off grid power. Removing the power line has been a priority for riparian and floodplain restoration in the basin as the line sparked the 2005 School wild fire showing an elevated risk of riparian fire and also has significant floodplain encroachment where it crosses or parallels the river requiring significant trimming of riparian habitat to and 80 ft. corridor.

This project is congruent and coordinating with the planned Tucannon River Project 5-15.2 Assess/Design currently being scoped for implementation by CTUIR, and is planned to overlap and provide information and analysis support for this project once it is initiated.



Channel Shape at PA5 in 2020

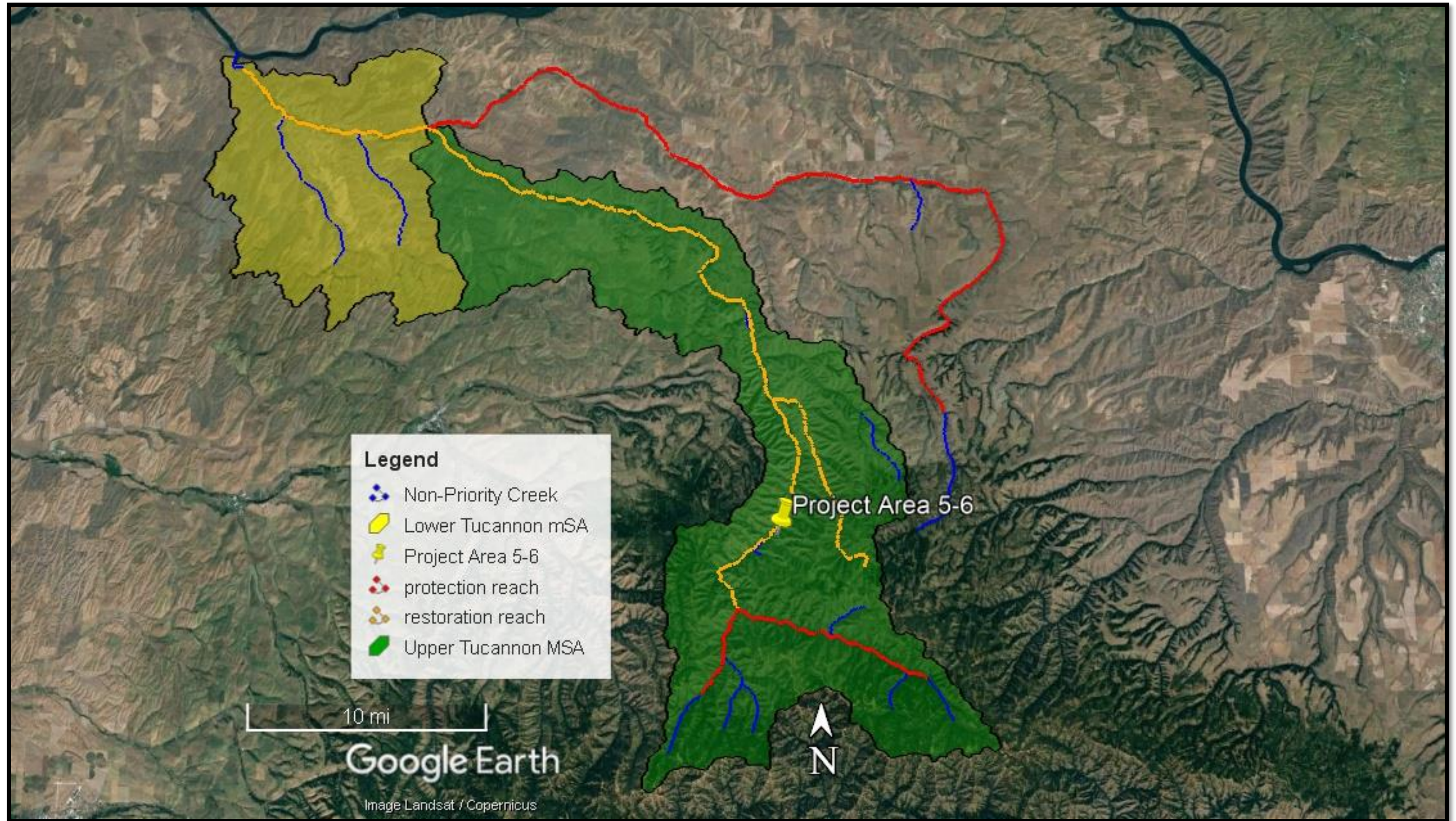


Figure 22: Project Area 5-6 concept development and alternative analysis vicinity in relation to regional SRSRB priorities for Spring Chinook.

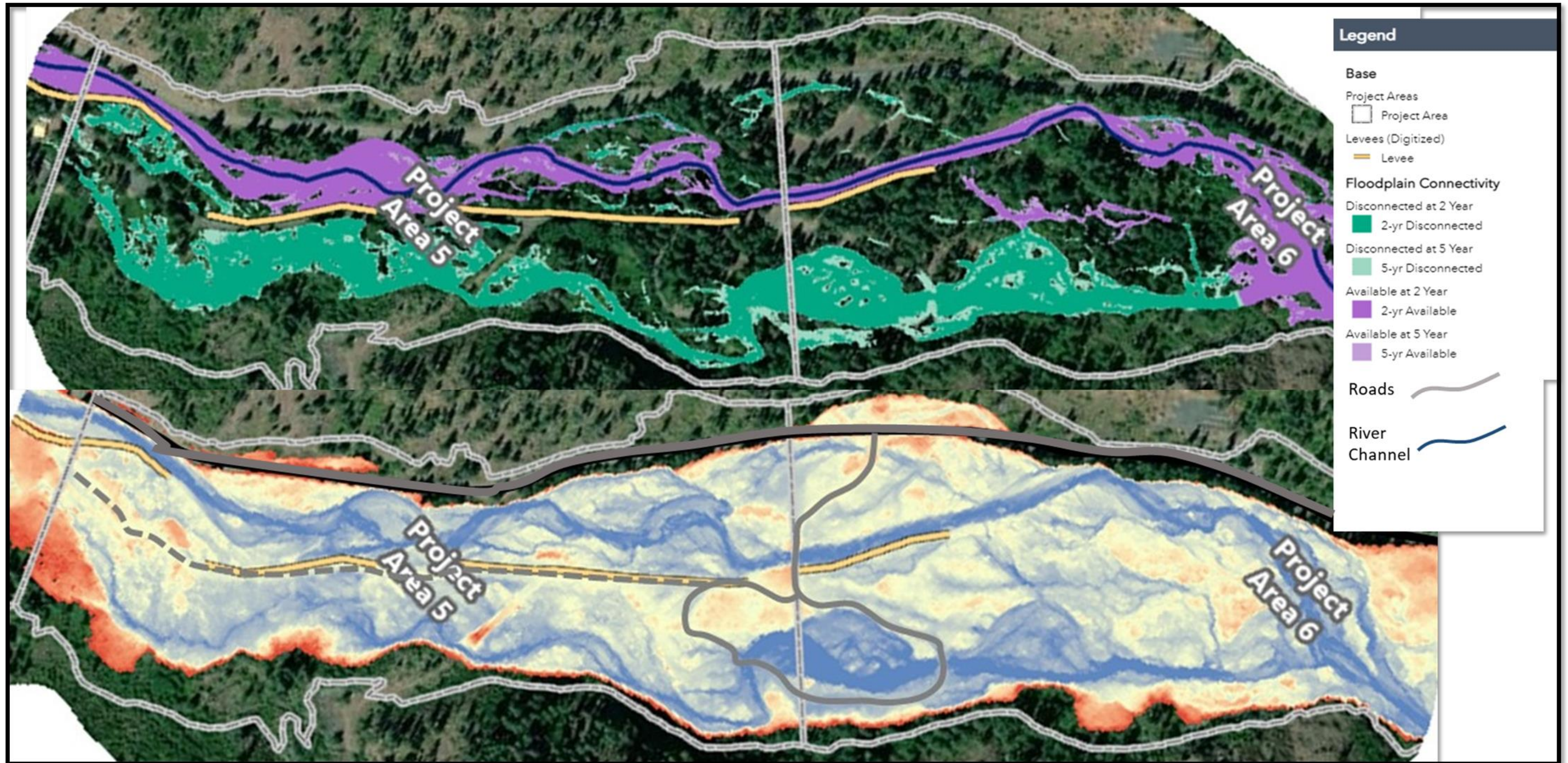


Figure 23: Project Area 5 & 6 just downstream from WA State Parks Camp Wooten. The upper map illustrates low-lying floodplain across both project areas with the lower map showing the relative elevation model based on 2017 LiDAR (<https://ctuirgis.maps.arcgis.com/apps/MapSeries/index.html?appid=7961a9f233684f0daf87970b37d8dc1c>). The upper map illustrated connected 5yr floodplain in purple with the disconnected floodplain in green. In total >19 acres of green shaded floodplain are disconnected by the road and associated gravel berms protecting the road.

Partner – Tri-State Steelheaders Project

Project Title: Mill Creek Passage Concrete Panels (Fabrication)

Implementer: Tri-State Steelheaders (TSS)

Partners: WDFW

BPA Programmatic Funding (2010-077-00): In FY21, \$850,000 (#86820). Note: the funds did not come out of the annual FY21 Programmatic budget but were transferred from the WDFW project for implementation in Mill Creek.

Matching Funds: Non-BPA matching funds that have been committed to fish passage in Mill Creek total \$2,644,107

Project Timeline: This project initiated in 2021 with purchasing concrete fishway panels for Mill Creek. It is anticipated these funds be fully early in 2023.

Location: Panels were purchased used these funds and delivered to Mill Creek using other funds in 2022 and 2023; Lat/Long 46.066910 / -118.344333 (Figure 24).

Recovery Expectations: The Mill Creek fish passage effort is an ongoing effort to reconnect >40 km of cold-water salmon and steelhead habitat above the City of Walla Walla. Fish passage is progressively improving with each implementation year.

Priority Populations & Life Stages: Adult mid-Columbia Spring/Summer Chinook (reintroduced), Adult/juvenile migrants' mid-Columbia Summer Steelhead (Threatened) and adult through juvenile Columbia River bull trout.

Potential Future Actions: No future actions are currently planned, but in the event more WDFW funds are identified the Program may once aging provide a contracting vehicle for convenience of the parties involved.

Project Goals & Objectives: The goal for this project is to increase fish passage through the Walla Walla floodway structure upstream to the >40km of available salmon habitat.

Short Term Objectives:

Provide funds to construct concrete textured panels and stockpile for implementation.

Long Term Objective:

Provide support and materials to implement >4,000 ft passage fish way in Mill Creek.

Project Background and Summary:

Background: Fish passage in Mill Creek was initiated in 2006 with the Mill Creek Barrier Assessment was completed to better understand the challenges to salmonids to pass up and downstream in the concrete section of the Mill Creek floodway through downtown Walla

Walla. The floodway was constructed following numerous significant floods in 1930's to protect infrastructure on the alluvial fan which underlies the City of Walla Walla. The reach assessment found that passage barriers existed in all the floodway channel types under various flows (Table 7) for all species of salmonids including summer steelhead, bull trout and spring Chinook. To provide passage while maintain flood protection the Mill Creek Passage Work Group engineered channel roughness panels that could be casted off site and installed in stream providing passage benefits without generating flood rise (Figure 25).

Table 7: Summary table of reach type pass ability by species. (Burns et all 2009)

<file:///C:/Users/Kris%20Buelow/Downloads/320-9201.pdf>

	Steelhead	Spring Chinook	Bull Trout	Reach Type Average
Reach Type 1	59%	42%	89%	63%
Reach Type 2	44%	43%	0%	29%
Reach Type 3	60%	50%	0%	37%
Reach Type 4	60%	50%	0%	37%
Reach Type 5	33%	40%	0%	24%
Reach Type 6	59%	50%	0%	36%
Reach Type 7	33%	40%	0%	24%
Reach Type 8	39%	42%	4%	28%
Reach Type 9	47%	50%	0%	32%
Reach Type 10	68%	67%	0%	45%
Reach Type 11	69%	70%	39%	59%
Reach Type 12	37%	30%	31%	33%

In 2010, initial pilot passage project lead by TSS supported by WDFW and CTUIR with a number of projects being implemented to date bring this effort closer to completion.

Current Status 2022: In 2022, the TSS used this contract to purchase materials (Figure 25) totaling 104 concrete panels which were provided for passage of 1,200 feet of the fishway from Division St. to Blue St. in the upper channel flume in downtown Walla Walla (Figure 26).

In the fall of 2022, the TSS plans to utilize the remaining contract balance to purchase an additional 49 panels for implementation in 2023.

In 2021, this contract supported the construction of 182 concrete panels that were used to improve passage in 2,100 feet of the floodway (Figure 27). It is anticipated that the remaining funds will develop and additional 182 panels for implementation and extend fish passage for anal additional 2,000 ft. during the 2023 construction work window.



Figure 24: Mill Creek floodway fish passage project general location within the priority watershed. The yellow arrows indicated reach where panels were built for.



Figure 25: Fish way roughness panel purchased with BPA contract (#86820) in 2022.



Figure 26: Panels being installed using non-BPA funding in through the State of Washington.

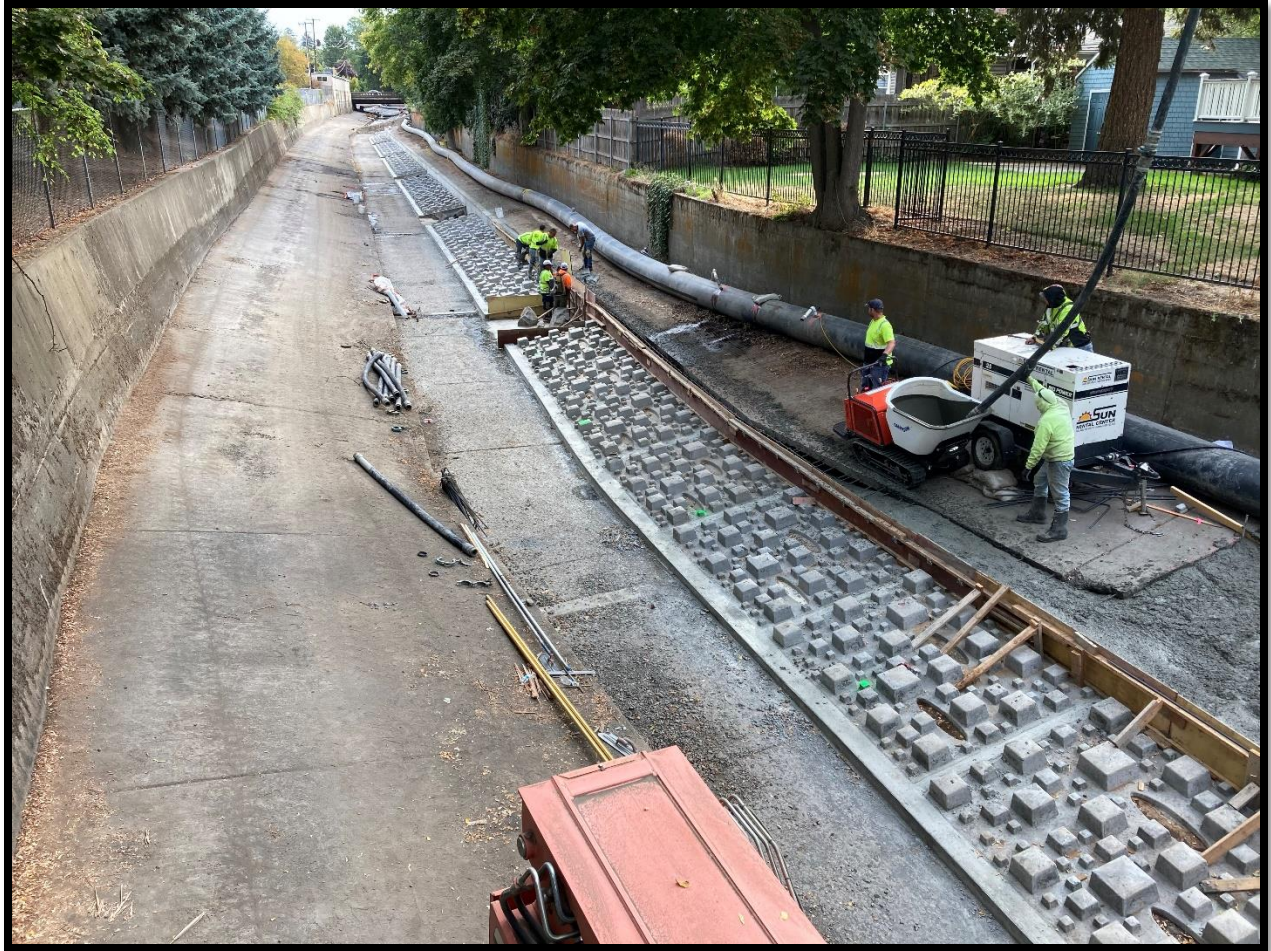


Figure 27: Mill Creek floodway fish passage construction showing the concrete roughness panels while flows are diverted.

Future Project Implementation (3-5 Year Plan)

In 2021, the Program worked to finalize project designs for implementation in out years and is planning future implementation on a number of projects identified as future work from the 2021 Restoration Plan. In 2022, the Program and its partners continued to address the priority work outlined in 2021 Plan, as identified in the 5-year work plan (Table 8). The program coordinates with all the restoration partners in the Tucannon basin to provide up to date and current information of restoration priorities and future implementation. The timelines in the work plan are subject to funding levels and success of the partners in securing matching fund as well as meeting design and permitting objectives. As detailed in this report project timelines are often spread across many phases and fiscal years to reach completion.

Table 8: Tucannon River 3-5 Year Work Plan developed in 2021 and updated in 2022 (sheet 1).

Project Title	Priority Population	Limiting Habitat Condition(s)	Prioritized Habitat Action Types	Proponent Organization	Proposed Year of Implementation	Notes:
Project Area 13	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Removal of channel confining features, addition of large wood, channel modification, side channel reconnection and riparian enhancement	WDFW	Phase I -2022 Phase II - 2023	Phase I Completed in 2022
Project Area 27/28.1	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Removal of channel confining features, addition of large wood, channel modification, side channel reconnection and riparian enhancement	CTUIR	Phase 2 – 2022 Phase 3 - 2023	Phase I Completed in 2020 & 2021 Phase II delayed to 2023
Tucannon LiDAR	All	Floodplain connectivity, channel complexity, excessive stream power, and pools	Assessment	CTUIR	2022	Data set was collected and Analysis is underway
Tumalum Fish Passage	Tucannon DPS Summer Steelhead	Passage Barrier	Fish Passage under Tumalum	NPT	2022	This project was delayed in 2022 and is currently proposed for 2023
Project Area 26 Phase II	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Riparian enhancement	CCD	2022-24	Riparian planting was done in 2022 and will be on-going while floodplain conditions continue to improve.
Project Area 26 Phase III-IV	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Addition of large wood, channel modification, side channel reconnection and riparian enhancement	CCD	Phase III 2022-23 Phase IV 2023-24	Phase III irrigation efficiencies were completed in 2022. The instream work and levee set back are planned for 2023.
Project Area 34.1	Tucannon DPS Spring Chinook, Fall Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Removal of channel confining features, addition of large wood, channel modification, side channel reconnection and riparian enhancement	CCD	2024-25	The CCD is currently seeking funding for implementation of this work in 2024-25
Project Area 34.2	Tucannon DPS Spring Chinook, Fall Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Removal of channel confining features, addition of large wood, channel modification, side channel reconnection and riparian enhancement	CCD	2024-25	The CCD is currently seeking funding for implementation of this work in 2024-25
Project Area 10.3	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Channel reconfiguration, addition of large wood, channel modification, side channel reconnection, gravel augmentation and riparian enhancement	WDFW	2024-25	This effort is planned for design in 2024 and implementation in 2025.
Project Area 14.1-14.3	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Channel reconfiguration, addition of large wood, channel modification, side channel reconnection, gravel augmentation and riparian enhancement	WDFW	After 2025	This effort would be conceptualized and prioritized during the floodplain assessment in 2023-24
Project Area 1.1	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Channel reconfiguration, addition of large wood, channel modification, side channel reconnection, gravel augmentation and riparian enhancement	CTUIR	2024-2025	

Table 8: (Continued) Tucannon River 3-5 Year Work Plan developed in 2021 and updated in 2022 (sheet 2).

Project Title	Priority Population	Limiting Habitat Condition(s)	Prioritized Habitat Action Types	Proponent Organization	Proposed Year of Implementation	Notes
Project Area 5	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Channel reconfiguration, addition of large wood, channel modification, side channel reconnection, gravel augmentation and riparian enhancement	NPT	2026	This project is part of the current floodplain assessment and will be prioritized and conceptualized in 2023-24
Project Area 6 Hixon Creek & Floodplain	Tucannon DPS Spring Chinook, Summer Steelhead, and Bull Trout	Fish Passage and connectivity	Channel connectivity and fish passage	NPT	2023-25	This project is part of the current floodplain assessment and will be prioritized and conceptualized in 2023-24
Cummins Creek Delta Channel Complexity	Tucannon DPS Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Addition of large wood, channel modification, side channel reconnection, beaver augmentation and riparian enhancement	NPT	2023-2024	Implementation on this work is planned to begin 2023 and will continue in 2024-25.
Little Tucannon Bridge	Tucannon Summer Steelhead, Bull Trout	Fish Passage and floodplain connectivity and habitat complexity	Bridge relocation, delta reconfiguration, addition of large wood, channel modification, side channel reconnection, and riparian enhancement	CTUIR	2023-24	The USFS has funds to conduct this work in 23-24.
Tucannon Floodplain Management Plan Update	Tucannon DPS Spring Chinook, Summer Steelhead, and Bull Trout	Floodplain connectivity, channel complexity, excessive stream power, and pools	The update would involve an assessment of existing flood plan in PA 5-15.2 to quantify and better understand the floodplain and geomorphic impacts of the Tucannon Lakes and the supporting infrastructure.	CTUIR, WDFW, NPT	2022-23	This assessment is planned to start in 2023 with concepts being developed in 2023-24.

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