Tucannon Habitat Programmatic

2021 Annual Summary

(January 2021– December 2021)

BPA Project #2010-077-00

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Snake River Salmon Recovery Board
Regional Salmon Recovery Board
Dayton, WA 99328
Report Date: February, 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:

Contents

Introduction:

The Tucannon River Programmatic Habitat Project #2010-077-00 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 report summarizes the habitat restoration projects and associated restoration support funded, partially or entirely, through the Tucannon Programmatic Habitat and the Programs implementation partners (Program) for the calendar year of 2021. The primary funding sources for this report include; Bonneville Power Administration (BPA) and Washington State Salmon Recovery Funding Board (SRFB). Most projects include some level of cost share, both in-kind and cash, which are not included in this report. The Program is managed by the Snake River Salmon Recovery Board (SRSRB) and consists of the following partnership: the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Columbia Conservation District (CCD), Pomeroy Conservation District (PCD), Nez Perce Tribe (NPT), U.S. National Forest (USNF) and the Washington Department of Fish and Wildlife (WDFW). The Program has worked as a group since 2011, starting with the implementation of the Tucannon Conceptual Restoration Plan, Reaches 6 to 10 Phase II (Anchor QEA, 2011) (2011 Plan), and in 2021 the updated Conceptual Restoration Plan (2021 Plan) (Anchor QEA, 2021). In 2021, the Program initiated three restoration projects, completing implementation on two, with one project delayed due to wild fire risk. The Program supported the development of five conceptual/preliminary designs for implementation during the 2022-2024 construction years. Collectively, the Program has funded significant work in 24 project areas identified and prioritized in the 2011 & 2021 Plans (Figure 2).

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, 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 participates in monitoring and land management issues. Lastly, the SRSRB provides a sounding board (Table 1) for public input and involvement in salmon recovery in southeastern Washington, both with respect to floodplain restoration projects and building the baseline support need for large-scale restoration necessary to increase spring Chinook in the region.

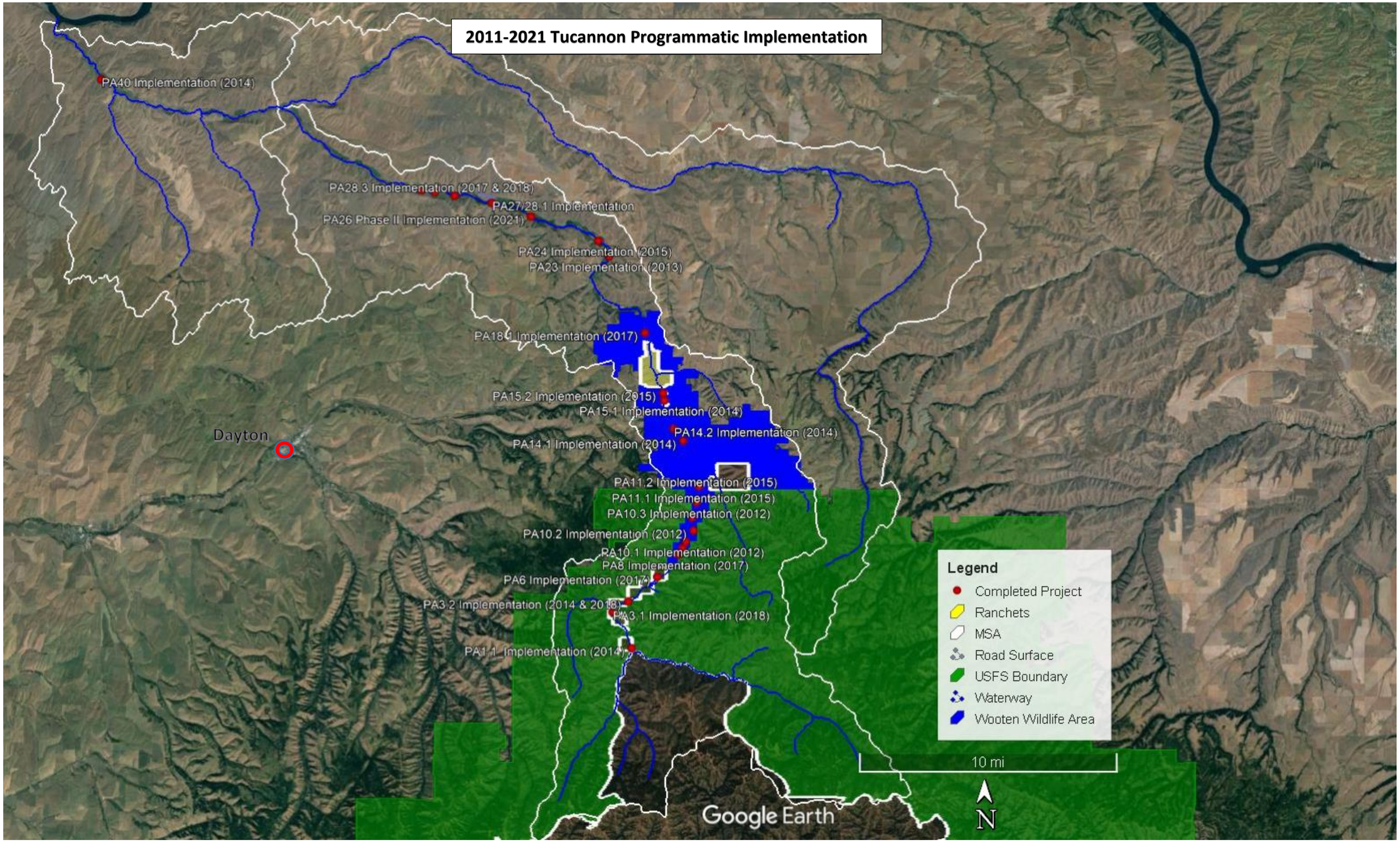


Figure 1: Distribution of habitat restoration project designed and implemented with support of the Tucannon Habitat Programmatic (2010-00-077) 2011-2021.

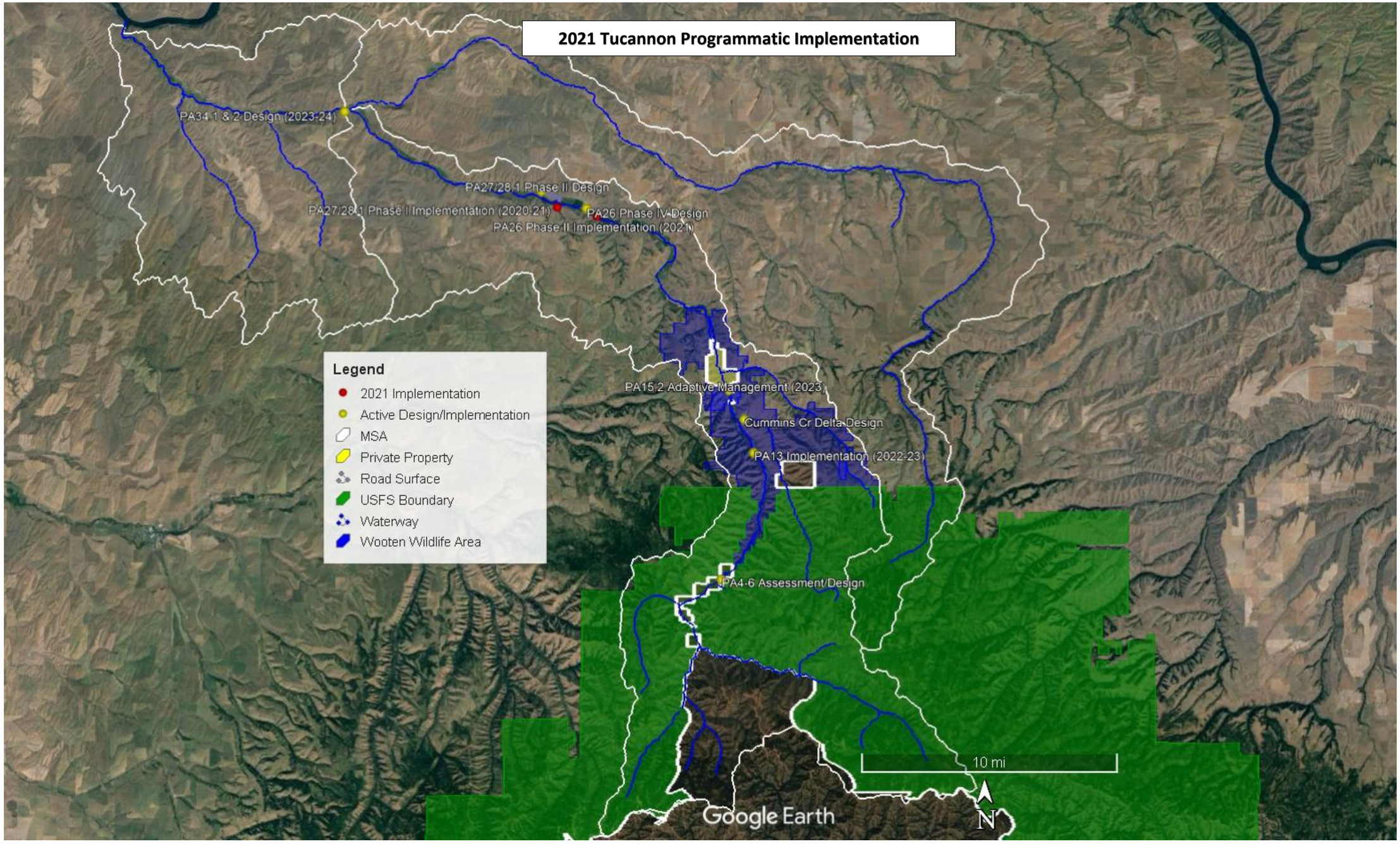


Figure 2: Google Map of the Tucannon basin, from the headwaters in the Blue Mts. (lower) downstream to the Snake River (upper) located in SE Washington east of the City of Dayton. The red dots indicate the approximate locations of the two Programmatic supported projects implemented, with the yellow dots indicating active and design projects in 2021.

Table 1. Active Members of the Snake River Salmon Recovery Board for the year of 2021.

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 3) 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 livestock and agricultural 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 following a number of flooding events in the Tucannon Valley, that led to a significant loss of property and infrastructure (Johnson 1995) the US Army Corps of Engineers (USACE) straightened and leveed the channel, increasing the conveyance capacity, and confining the river to a single channel at the valley margins. From 1937 through 1978, the length of the main channel of the Tucannon River had been reduced between 7- 20% depending on the reach, and possibly as much as 50% of the Tucannon' s total river perennial length was lost through channelization and further confinement (Hecht, 1982). Today much of the Tucannon River is stuck in a state of arrested degradation 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 less productive biologically because of lack of floodplain connectivity and increased stream velocities that require higher energy to forage in these channel types.

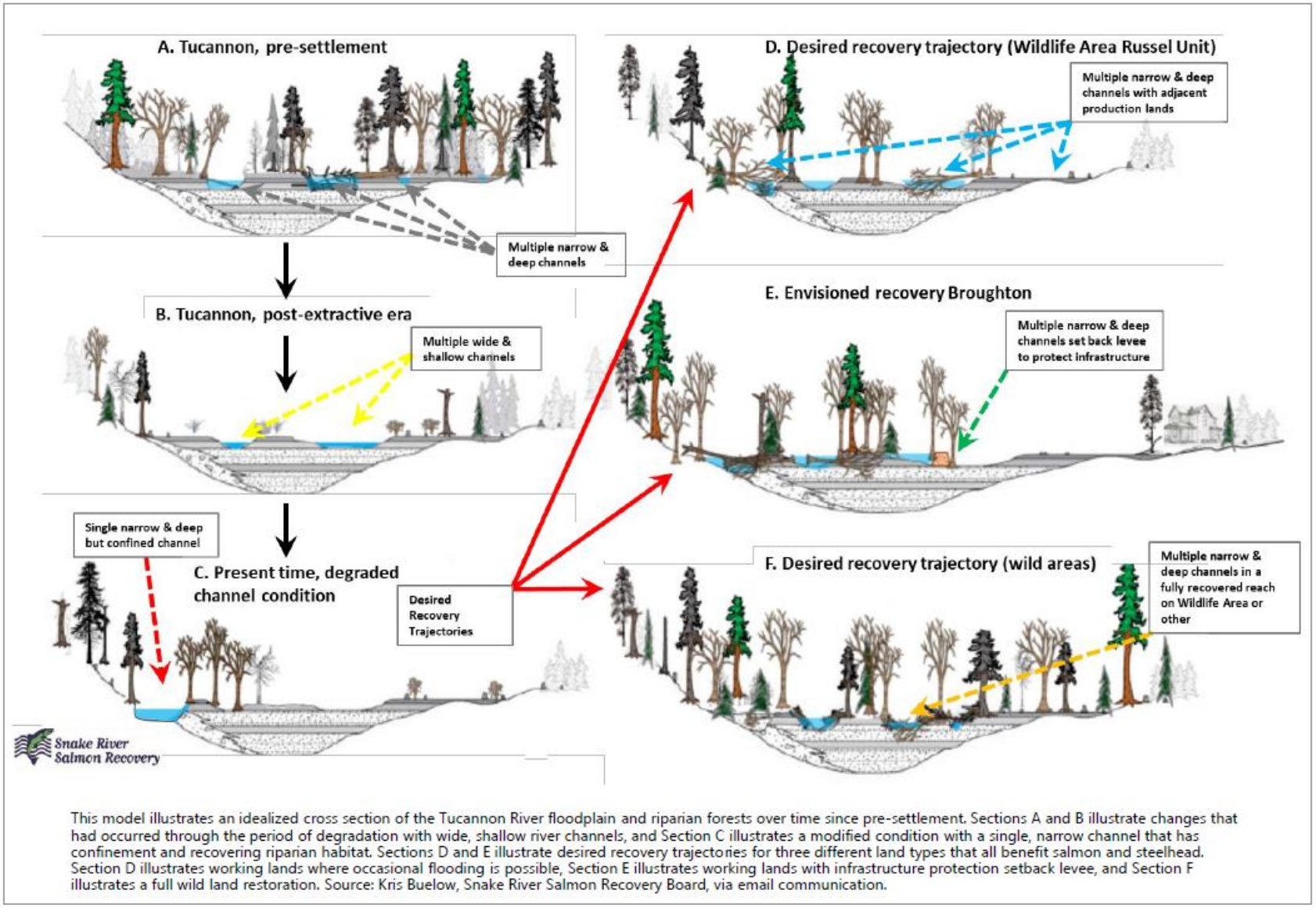


Figure 3. Tucannon Conceptual Stream Model

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 Tucannon Conceptual Restoration Plan (2021 Plan) (Anchor QEA 2021) evaluated habitat conditions, basin wide and identified flood plain 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.

Project Implementation Monitoring & Adaptive Management

Beginning in 2012, the SRSRB collected 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. The Tucannon Columbia Habitat Monitoring Protocol (CHaMP) and Asotin Intensively Monitored Watershed (IMW) program lead to the adoption of modified methods and protocols used currently in the Tucannon basin. The goal of the continued monitoring effort is 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 taken to limit the number of hours necessary to collect meaningful information on the primary key metrics 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 3).

Rapid-habitat metrics were derived from the 2011 Plan (Anchor QEA, 2011), and crafted to streamline measurement of the primary limiting factors; degraded channel complexity and limited floodplain connectivity, and focused on attributes that are easily measurable and repeatable in the field (Table 2).

In 2020, the Program began to formalize habitat monitoring protocols in the absence of an outside large scale monitoring effort (i.e. CHaMP). The drafting of a Tucannon Monitoring Plan (Camp 2020) and the identification of relatively quick field measurements that can be used to better track floodplain connectivity and channel complexity was adopted by the Program to utilize both RHS as well as develop methods for remote sensing.

Table 2: 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 , during the day of the survey at the upriver most real-time stream gage at Marengo (WDOE stream gage https://fortress.wa.gov/ecy/eap/flows/station.asp?sta=35b150). Each project funded or implemented under the Program has a survey for the entire project reach conducted pre & post-implementation, with an as-built survey completed in the late summer following construction (Table 3). Pre-project surveys are used in the development of project concepts and 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 while 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 warrant a follow up survey to capture unusual or interesting conditions that might require additional restoration/maintenance actions.

Table 3: Habitat and biological monitoring data collected at project area implemented between 2011 and 2021.

Implementation			Biological M&E							Rapid Habitat Surveys			LiDAR		
Project Name	Project Sponsor	Construction Year	Fish in Fish out	Salmonid Redd Surveys	AEM/ Biomonitoring	Mussel Presence Survey	Lamprey Presence Survey	Stream Temp	Stream Flow	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
PA3.1	CTUIR	2018	yes	yes						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	2010	2017 &2020	11 & 18 & 21
PA9	WDFW	2017	yes	yes						2017	2017	2019	2010	2017 &2020	11 & 18 & 21
PA10.1	WDFW	2012	yes	yes						2012	2015	2019	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						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
PA13	WDFW	not	yes	yes		yes	yes	Logger		2020 & 2021			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					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		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	2015 & 2019 & 2021	2021		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		2010	2017 &2020	11 & 18 & 21

In addition to the RHS, the program is using large 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 on the Tucannon River over the last decade. To replace the loss of CHaMP and AEM programs, the Program is collecting and using topo bathymetric LiDAR data (QSI, 2017 and QSI, 2020). These datasets use green lasers to penetrate the water surface at shallow depths to produce a high-resolution topographic map of the river channel and floodplain over the entire Tucannon River. 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/.

Collecting topo-bathymetric LiDAR data following significant flow events (>5yr return interval), allows continued assessment of geomorphic change in the Tucannon River. Using LiDAR instead of CHaMP and AEM, allows the Program to cover the whole basin at a much larger spatial scale and a fraction of the cost (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 4). Currently, CTUIR is working to conduct analysis of this change detection data set to better understand the distributions of habitat units and salmonid habitat suitability. 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 2021. Results of the updated analyses show that large portions of the Tucannon River remain below the desired targets for floodplain connectivity and channel complexity. These combined data also show 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.

In the fall of 2020, the Program supported CTUIR in the collection of a second topo-bathymetric LiDAR dataset which is currently undergoing analysis and is intended as a GCD comparison to the 2017 data set used in the 2021 Plan. As part of the 2021 Plan, methods to automate the development of habitat metrics for floodplain connectivity and channel complexity 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,

combined with rapid habitat surveys to fill in the interim periods between LiDAR surveys to inform progress towards Tucannon Basin goals and objectives.

Implementation:

The Program is focusing efforts and leveraging resources to complete the highest priority projects identified in the 2021 Plan. To date the Program implemented restoration actions on all or part of 24 (Figure 1) of the initial 60 project areas identified in the 2021 Plan. Key metrics collected during RHA survey pre-project and as-built are contrasted against surveys conducted post 2020 flood to reflect the impacts of higher than average flows on implementation project integrity (Table 4) for projects monitored over that time interval. In general, projects exhibit a positive trend for key metrics from pre-project to present, however there have been decrease in channel log structures following the large(~25 yr) flood event (Figure 4). This is largely attributed to the redistribution of mobile LWD as well and the formation of large channel spanning jams (Figure 5) as well as the slow decomposition of LWD materials in earliest project implemented in 2012. A larger and more complete analysis of project effectiveness and habitat trends is being conducted in 2022 and will be included in the January 2022 – December 2022 annual report.

Table 4: 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

2021 Implementation & Design:

The project area summaries outlined in the following section of this report describe the implementation related work conducted by the project partners in coordination and supported by the Program in 2021. The Program supports the partners in a number of ways including technical guidance and field support in development of project selection and prioritization, concept development and biological support during implementation. The program also provides support in project scope development, budgeting, and developing materials for permitting and reporting, including the development of this report.

The following sections summarizes the 2021 project portfolio, including project goals and objective, sponsor and budget information as well as a project summary and key metrics.

Project reach objectives are developed for each project area based on recommendation identified in the 2021 Plan (Anchor QEA, 2021), observation made in the field during design surveys and existing infrastructure and or landowner constraints. Project metric are collected for perennial and ephemeral side channel length and are reported as a change in length pre-project, post project as-built and in future follow up surveys. The number of LWD key pieces is a restoration target set at >2 key pieces per bankfull with in the 2011 Conceptual Restoration Plan, and was defined and a piece being >6m long and 0.3m dia. in the 2021 Plan. LWD abundance is one of the key driver in the development of channel complexity channel and floodplain connectivity in the basin, and is enumerated and classified into jams or other habitat forming features. Lastly, simple pool metrics are collected as they are a good indicator of channel complexity; including frequency, estimated area, maximum depth, forcing mechanism max tail out depth, substrate type, embeddedness ratio and pool complexity (pool cover).

Figure 5: 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.

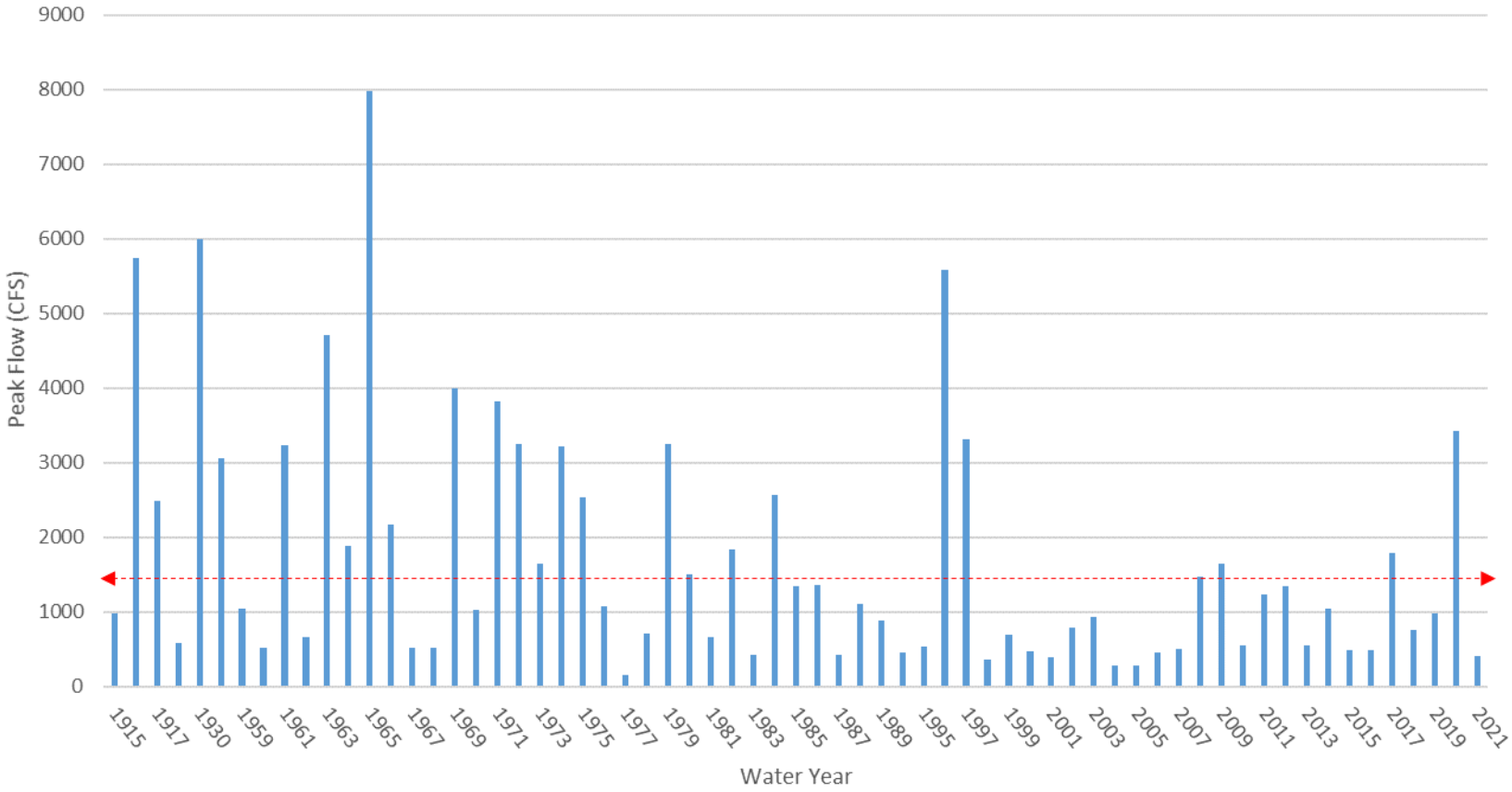


Figure 4: Peak stream flows recorded at the USGS Starbuck stream gage for the entire period of record 1914 to present. The dotted line indicated the approximate 2 yr flood return interval estimated for the basin at RM 8.8.

Partner – WDFW Projects

Project Title: PA13 Levee Removal and Channel Reconfiguration Implementation

Implementer: Washington Department of Fish & Wildlife

BPA Programmatic Funding (2010-077-00): In 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.

Project Timeline: Concept Development 2017, Design 60%-90% 2018, Final design funding site preparation and material sourcing 2019/20, Phase I started in 2019 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 was 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. Phase I work will resume in July 2022 to be followed by Phase II instream and riparian planting 2023-24.

Location: Tucannon River mile 39 to river mile 40; Start Lat/Long 46.319376 / -117.664189 End (Lat/Long) 46.309638 / -117.657055 (Figure 2).

Recovery Expectations: Due to the degraded nature of this project reach (Figure 6), 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 for Columbia River bull trout.

Potential Future Actions: Following implementation at this project efforts will be made to monitor gravel deposition, side channel connectivity and floodplain connectivity/riparian health. In the event monitoring efforts indicate a deficiency in meeting objectives additional gravel and LWD loading 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 in the 1 mile reach between the Tucannon Hatchery weir and the Hatchery Bridge.

Short Term Objectives: Increase channel roughness and LWD structure within the one mile reach, for the purpose of reducing stream power currently in excess (Anchor 2021).

- Construct 31 ELJs and supplement gravel and a cobble materials to raise bed elevation.
- 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 one mile reach. 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 acres of off channel wetland habitat.

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 Summary:

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 Salmon Recovery Board, in 2019. The project reach was characterized as being highly confined by river levees protecting Rainbow Lake and the Tucannon Fish Hatchery infrastructure. The river through the reach had been straightened and became incised below the hatchery fish trap reducing channel complexity (Figure 6). 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 based on high stream power (Anchor QEA 2020). Habitat complexity is also limiting, with few deep pools (RHA 2020-21 Data) for adult holding or secondary channels for juvenile rearing. Due to poor floodplain connectivity and low channel complexity the planned project will focus on expanding floodplain through a combination of removing confining levees, reducing channel incision and connecting

disconnected side channel. 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 rapid habitat design survey in 2020 and 2021, which identified >1,200 m (Table 5) 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 is currently meeting the restoration objective that value is a result of a couple very deep pools that formed in the 2020 with pool area and frequency remain below the objective for pools (Table 5).

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 ~925' of river levee until 2018 when the levee/dam was removed by WDFW (Figure 7) 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 2019, 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 8).

Table 5. PA13 reach objectives and pre-project rapid habitat survey metric results collected June 2021. 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)	Mean Depth Range (m)
Reach Obj.	N/A	800	800	>180	31	none	>14	2,646	1.0-1.5
Pre-project (2020) Phase I & II	1.26	220	268	28	3	8	8	874	1.0-1.5
Pre-project (2021) Phase I	1.26	71	307	36	7	7	8	882	1.0-1.5
Post-project (as-built) 2022 Phase I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

In early February of 2020, the upper Tucannon basin was impacted by a significant event flood (Figure 4) following a 5-9 inch rain on snow event which lead to significate 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 in 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 were formed (Figure 9). A pre-construction survey was conducted prior to the construction window during base flow in 2021 with metrics available for comparison indication very little change in 2020 following floods (Table 5).

In 2021, site access and material delivery was 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 passed over both the Tucannon and Asotin basins. By July 19th the fire which was named the Green Ridge Fire was expanding rapidly 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 over 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 to 2022.

Prior Efforts: In 2019, the Program coordinated with WDFW in the planting of the Rainbow Lake wet land as part of the reconstruction of the off channel impoundment seasonally used to supply water to the Tucannon Fish Hatchery. The reservoir was built through the Lower Snake River Compensation Program to mitigate for lost fisheries opportunities 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, funded by the State of WA as a capital project. The goals of this project were to reduce the impoundments encroachment on the floodplain, improve public fishery value and enhance water supply to the Tucannon Fish Hatchery. The objective that most aligned with the Tucannon Habitat Program was the removal of ~290 m of the original reservoir dam (Figure 7) and the creation of ~3.5 acre wetland on the previously inundated reservoir bed (Figure 6). 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 6) 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 8). The wetland planting 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 being implemented in 2022-23.

Project Summary: Project Area 13 was designed by WDFW in 2018-19 and updated in 2020, for the purpose of enhancing and restoring instream habitat in this project area through a variety of treatment actions in the main channel, along the banks, and within the floodplain. 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 to raise the river bed, the placement of LWD materials to provide channel roughness and habitat complexity, and riparian planting. The principal benefits of project implementation will be 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 increasing resiliency by naturally occurring flooding over the long term.

Implementation Actions (from restoration design): Reconnect >1.6 km isolated side channel (~50/50 perennial-ephemeral) habitat through the removal of ~200 m of river levee, and the placement of associated log jams and channel plugs(Figure 11). The removal of levees and placement of logjams will reconnect ~14.6 acres of low floodplain, and an additional 3.6 acres previously part of Rainbow Lake impoundment footprint (Figure 7). Install ~31 ELJs and other LWD structures in the main channel to increase channel complexity over a 1.26 km reach. Additional, unsecured mobile LWD will be placed in main channel, side channels and on the floodplain for complexity. Re-plant adjacent floodplain and riparian areas where disturbed to re-vegetate and restore disturbed construction access sites and staging areas. During planting, efforts will be made to increase pines and cottonwoods throughout the reach for the purpose of future LWD key piece recruitment. The 2022-23 removal of the addition 200 m of river levee is anticipated to reconnect the 3.6 ac wetland created in 2019 (Figure 10).

Current Emphasis:

Site access and material sourcing began in the spring of 2021 preparing the site for material delivery prior to July of 2021. As explained previously, instream work was delayed in 2021 and Phase I in planned for implementation in July 2022. This project remains a multi phased endeavor with the construction phases spanning two in water work windows and the riparian revegetation and plantings potentially spanning into a third year.

In 2020 and 2021, RHSs were completed to measure pre-project existing condition measuring main cannel length, length of existing perennial and ephemeral side channels and flood paths, number of LWD key pieces (> 6 m long & > 0.3 m dia.), the number of existing log jams, the number of single mobile logs, pool frequency, and estimate of pool area and maximum pool depth (Table 5). In 2021, the RHA survey included additional habitat attributes to better describe changes in habitat complexity caused by restoration including delineation of habitat unit, wetted area and floodplain and will be analyzed and reported at the time of the post implementation work in 2022. The existing condition for the project reach metric are displayed in (Table 5) with the reach objective for comparison. It is anticipated that an additional pre-project survey will be conducted during base flow conditions in the early summer of 2022 prior to implementation flowed by a post project survey conducted following 2022 implementation.

In 2023, an additional survey will be conducted prior and following implementation for the entire project reach both phases and results will be compared to the restoration objectives. The current monitoring strategy for project implementation will use the RHS monitoring protocol conducting a follow up post project survey after 2 freshets or one significant flood >2yr return whichever occurs first as described in the Tucannon Monitoring Plan (Camp 2021).

PA11.2 Implemented in 2015 illustrating large deep pools and extensive side channel complexes implemented just upstream of PA13.

Figure 6: Tucannon River Project Area 13 pre-project conditions in 2018. The upper left image is the Tucannon Fish Hatchery weir and fish trap located at the upper most end of the project area. The project reach is described as a combination of plain bed riffle and rapids (lower left and right images) caused and maintained by river levees and riprap. The upper right image shows one of the river levees being removed in 2022 as part of the restoration project design for this reach.

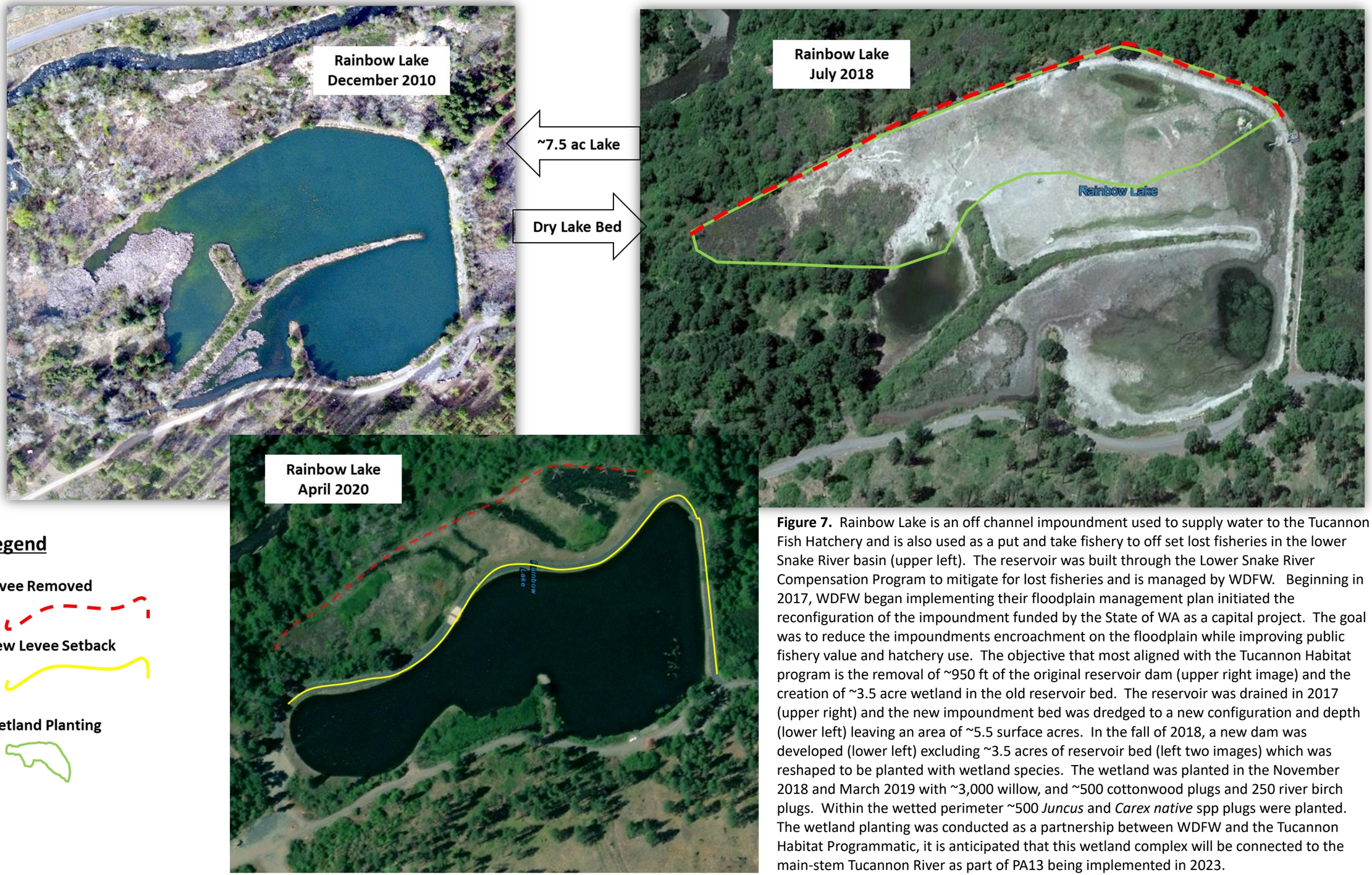


Figure 7. Rainbow Lake is an off channel impoundment used to supply water to the Tucannon Fish Hatchery and is also used as a put and take fishery to off set lost fisheries in the lower Snake River basin (upper left). The reservoir was built through the Lower Snake River Compensation Program to mitigate for lost fisheries and is managed by WDFW. Beginning in 2017, WDFW began implementing their floodplain management plan 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 ~950 ft 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 8: Project Area 13 off channel wetland created in 2018-19 by the removal and setting back of the Rainbow Lake dam and was planted in 2019 in cooperation between WDFW and the Program. In the spring 2020 the wetlands were fully inundated during a 25 yr. flood event and performed as intended.

Figure 9: Deep pool habitats formed in 2020 flood event as a result of disturbance to armored banks and the recruitment of LWD.

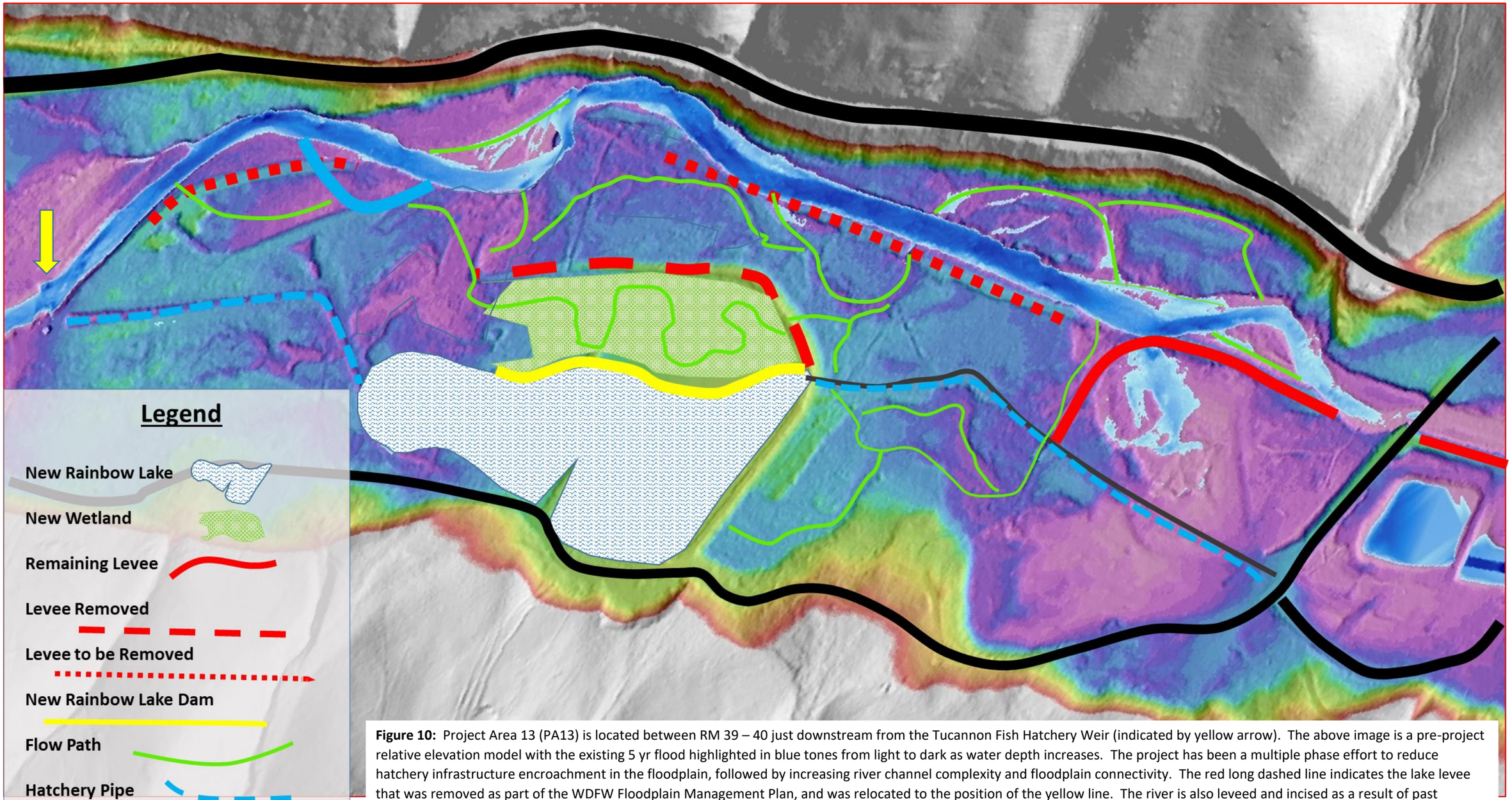


Figure 10: Project Area 13 (PA13) is located between RM 39 – 40 just downstream from the Tucannon Fish Hatchery Weir (indicated by yellow arrow). The above image is a pre-project relative elevation model with the existing 5 yr flood highlighted in blue tones from light to dark as water depth increases. The project has been a multiple phase effort to reduce hatchery infrastructure encroachment in the floodplain, followed by increasing river channel complexity and floodplain connectivity. The red long dashed line indicates the lake levee that was removed as part of the WDFW Floodplain Management Plan, and was relocated to the position of the yellow line. The river is also leveed and incised as a result of past management and manipulations to accommodate past lake management, which has significantly reduced connectivity to the floodplain. Beginning in 2021, WDFW will begin to remove the two main river levees (red short dashed lines) and initiate channel reconfiguration including LWD structure construction. The project is targeting side channel connection identified by the green lines. One river levee will remain disconnecting a spring well collector used by the Tucannon Fish Hatchery (red line).

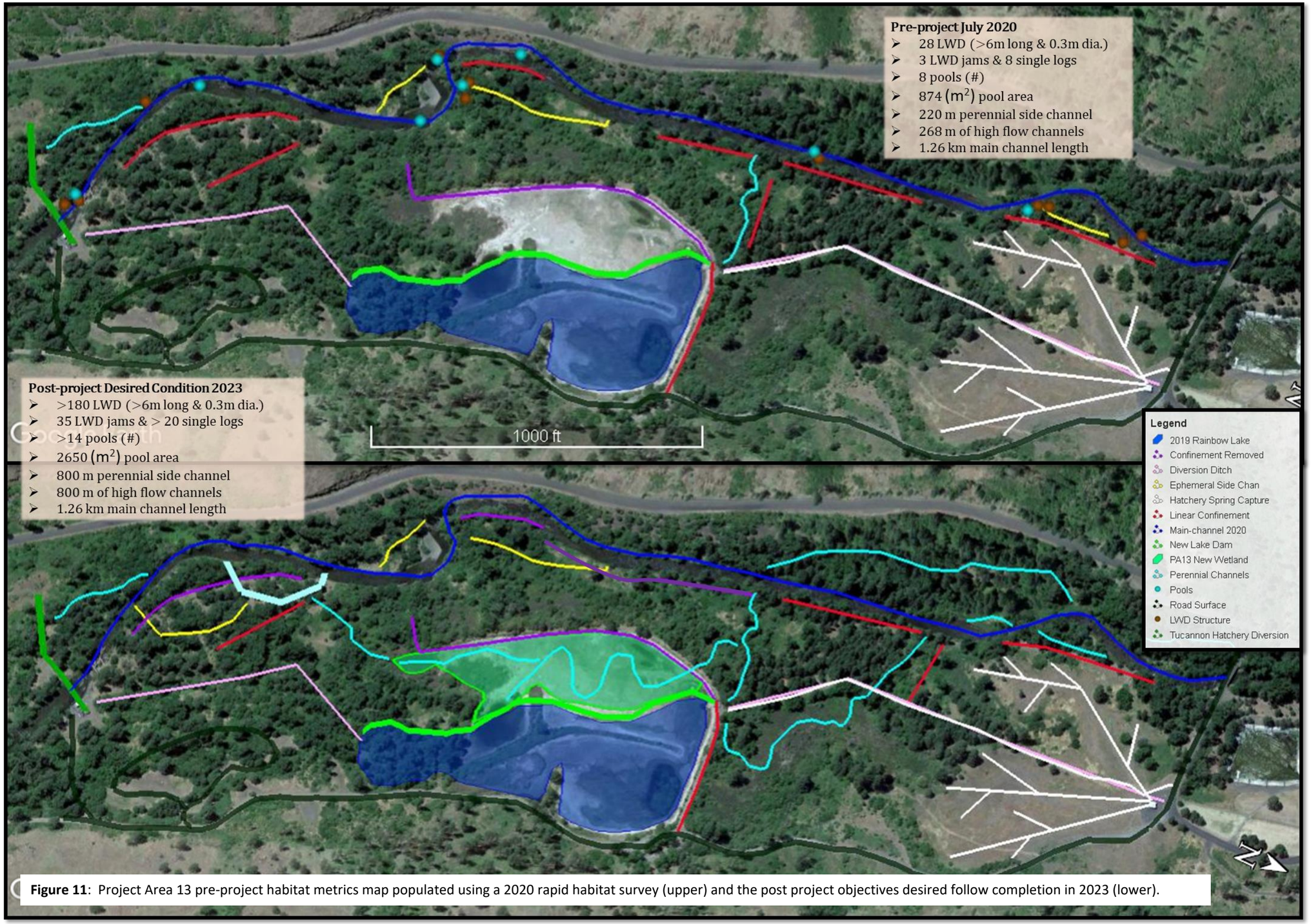


Figure 11: Project Area 13 pre-project habitat metrics map populated using a 2020 rapid habitat survey (upper) and the post project objectives desired follow completion in 2023 (lower).

Partner – CTUIR Projects

Project Title: PA15 Design Concept Development

Implementer: Confederated Tribes of the Umatilla Indian Reservation

BPA Programmatic Funding (2010-202-00): In 2021, $15,000 (73982 REL111) Final Design, in 2019 $5,000 (#84038) design support and in 2018 - $35,700 (#73982) design funds.

Other BPA Funds (2008-202-00): In 2020, $92,000 for design (73982 REL 100), in 2019 - $164,535 (#73982 REL 72)

Matching Funds: No other matching funds have been identified for this project area at the time.

Location: The project reach is located between RM 33.1 and 37.35. With a start Lat/Lon 46.343913 -117.681008 and end Lat/Lon 46.352667 -117.684059 (Figure 2)

Project Time Line: Coordinate and outreach 2021, concept development and build landowner support 2018-21, preliminary design 2020,near final design 2022. Construction in this project area is being delayed due to available funding in the FY 2023 Program Budget.

Priority Populations & Life Stages: Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened) and all life stages, Columbia River bull trout and other native species.

Project Goal & Objectives: The project goal will be to enhance the Primary Touchstones of CTUIR River Vision (Jones et. al. 2008) within PA15.1 & PA15.2, to the maximum extent possible. The goals of the Southeast Washington Salmon Recovery Plan included instream wood replenishment, increasing channel complexity, and reconnecting the river to its floodplain. Increase hydration of an inset floodplain through the construction of log jams, and the connection/creation of side channels. Specific project objectives will be developed during the design process in 2020-23.

Objectives: Note: The following objectives will be refined as the design nears completion.

1) Replenish instream wood to > 2 key pieces of wood per channel width.

2) Design large wood structures to:

- Raise the bed elevation, reconnecting the river and floodplain
- Decrease stream velocities and increase sediment deposition throughout the reach
- Increase connectivity using old side-channels throughout the reach
- Increase the local water table through hyporheic exchange with the alluvial aquifer

3) Replenish the floodplain forest with native tree plantings.

Background: The PA15 design has evolved out of the wide ranging ongoing effort initiated by CTUIR in 2017 at PA17/18, one of the most highly developed and impacted reaches within the priority spring Chinook domain of the Tucannon basin. There are multiple opportunities to working within the 1.1 km long reach to improve the impact of habitat degradation that have occurred over the past decades. In 2015, the CCD initiated worked on PA15 primarily focusing on the upper half of the stream reach located on WDFW and private properties. Those action focused on increasing channel length and placing LWD structures. Following the flooding in 2020 significant gains within the floodplain inset were realized opening more opportunities for gain left bank floodplain in the lower half of the project area. In working with landowners in the larger PA17/18 project area it was determined that the next step for CTUIR would be to work from the top down through the area where the most habitat gains could be realized quickest, building off habitat gains from recent project work completed by the CCD in 2015.

Summary: The primary goal of the project design concepts developed in 2020 focus on increasing floodplain connectivity and increasing channel complexity through side channel reconnection and strategic channel roughness elements (Figure 12). A combination of channel spanning and channel apex type structures will be placed to encourage increased flows onto the left bank floodplain where a number of long flow paths had developed (Figure 13) in past floods but were discouraged by prior (discontinued) land management approaches.

Current Emphasis: In 2021, CTUIR continued to work with private landowners within this high priority (Tier I) reach to identify and implement restoration objectives that have high fish benefit while working with the 22 property owners within this reach. In 2021, CTUIR had worked with a design engineer (using Tucannon Accord funding) to produce a preliminary designs for BPA technical EC review to complete a final design in early 2022. Due to current workload and available funds in FY22 and FY23 it is notanticipated this project will be completed in 2023 and may be postponed until 2024.

A site assessment was completed in 2020 in support of concept design development with the metrics from that survey provided below (Table 6). Project implementation would target a potential 50% increase in perennial side (Figure 13) channels, and an overall increase frequency of inundation into ephemeral flow paths from the 5yr to the winter flow to 1 yr return interval or less. The project concepts focus heavily in two reaches where existing condition has transformed to the where previously large floodplain flow paths on the left bank may be relatively easy to reconnect (Figure 14) at a more beneficial flow (<1 yr return interval). The floodplain channels will be roughened using a number of embedded logs to aid in channel formation over time. A full revegetation plan will be developed to initiate riparian vegetation over the length of the project. Prior to implementation a follow up pre and post -project survey would be completed to capture and document project implementation and support the as-built condition.

Table 6: Pre-project habitat metrics collected in floodplain expansion reach identified in PA15. 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)
Preliminary Reach Obj.	None	958	1,258	177	25	70	20	2,400	1.0-1.5
Pre-project (2020)	1.11	407	1,576	128	14	5	16	2,093	1.0-1.5

Example channel conditions being targeted for additional channel roughness undet the PA15 Phase II design.

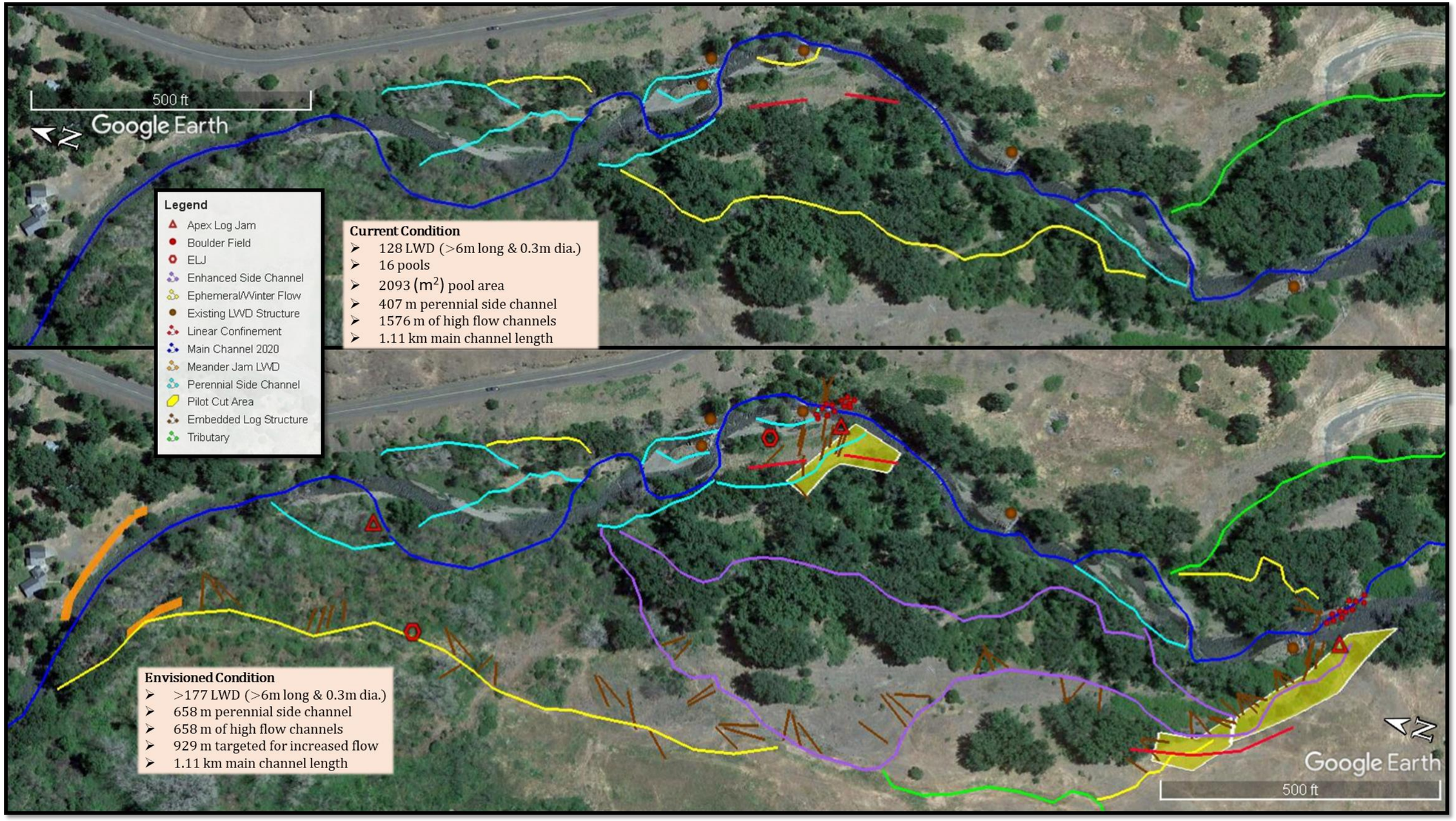


Figure 12: Project 15 Phase II project reach identified current design effort. In 2020, a rapid habitat survey was conducted of the entire project reach being designed (upper map) and is being compared to the desired condition developed for the design concept. The design concept will focus on removing remain confining features and increase connectivity to existing disconnected flow paths.

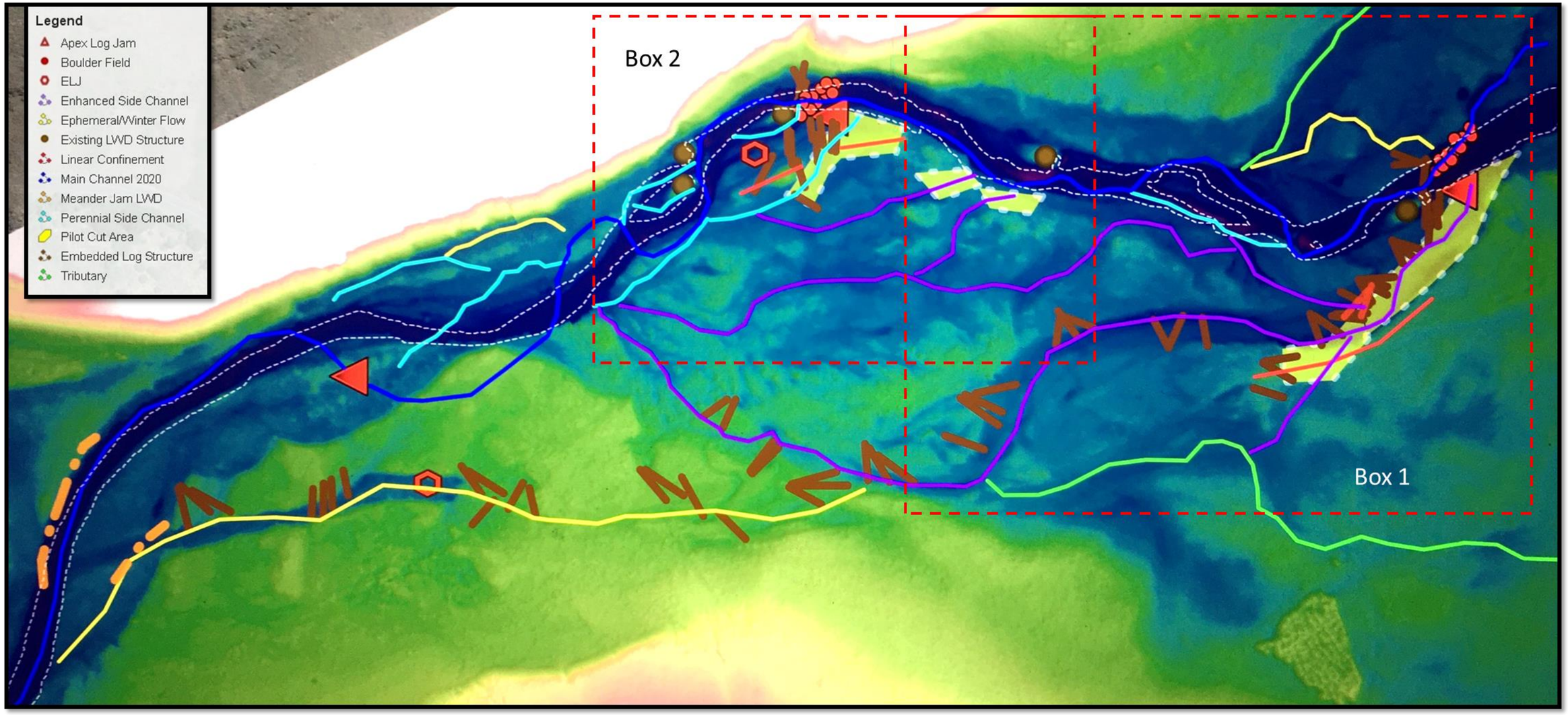


Figure 13: Relative elevation model developed using 2017 bathymetric LiDAR for the current design in Phase II of PA 15. The map illustrates the current position of the main channel following the 2020 flooding as well as existing LWD structures placed in 2015. The two dashed boxes indicate the location where significant LWD structures will be paired with side channel cuts to increase channel complexity and floodplain connectivity (Figure 14).

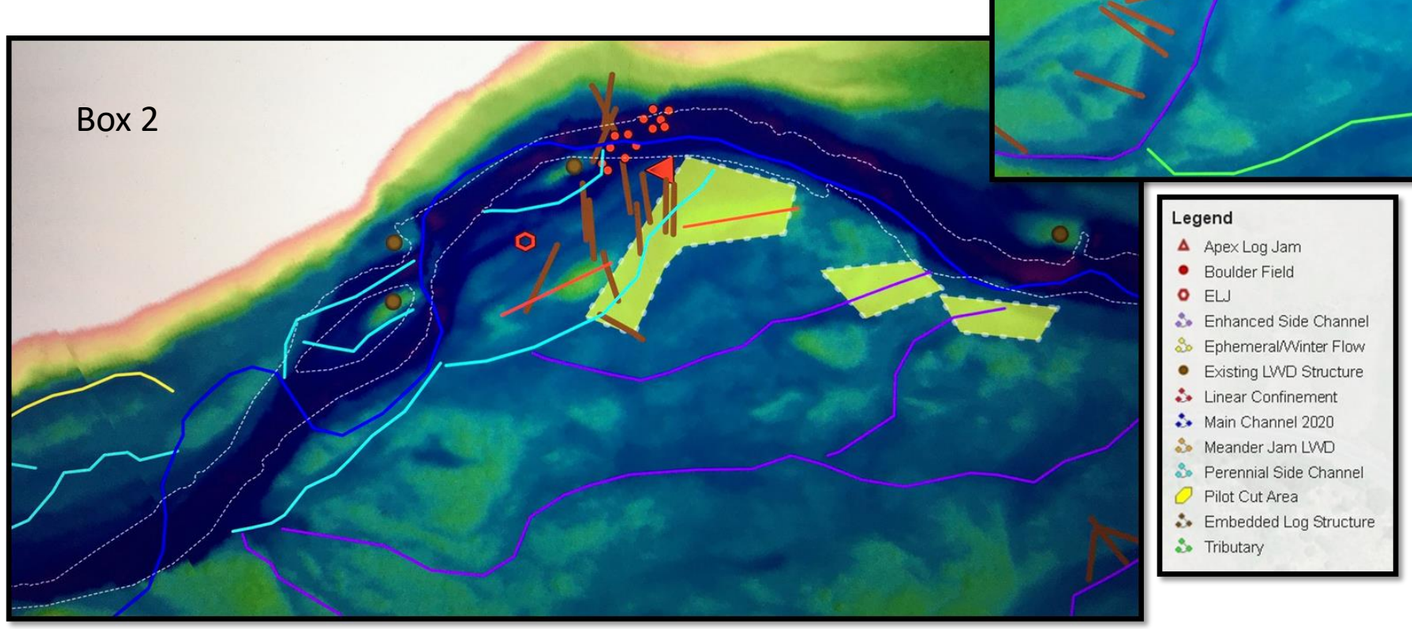


Figure 14: Design concept details for the two areas where significant instream structures will be constructed in association with side channel pilot cuts as illustrated in Figure 10. The callout labeled Box 1 is the upstream most pilot channel and Box 2 illustrates the lower pilot cut area.

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

Implementer: Confederated Tribes of the Umatilla Indian Reservation

BPA Programmatic Funding (2010-077-00): In 2021, $684,015 (73982 REL132), in 2020 $827,500 (#73982 REL 98) and in 2019, $73,112 (73982 REL 42).

Other BPA Funding (2008-202-00): In 2021, CTUIR ~$636,000 (73982 REL130), In 2020, CTUIR committed ~$151,000 (73982 REL100).

Matching Funds: Non-BPA matching funds have not been quantified for this project area, but could be in the donation of existing low lying agricultural lands for conversion to floodplain.

Location: Tucannon River mile 22.25 to 23.2.5. With a start Lat/Lon 46.453672 -117.816916 and end Lat/Lon 46.456387 -117.832140 (Figure 2).

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. This project was split into multiple phases to accommodate both available funding and permitting timelines in 2020-22. 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 is being designed in 2021-22 for implementation in 2022. Based on available funding Phase III is planned for design in 2022 and implementation in 2023-24.

Recovery Expectations: This project is 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 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. Additionally, the aggressive design approach will significantly alter habitat conditions within the reach. 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 7).

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).

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 the floodplain objective is being met. Revisit riparian planting and health over time as floodplain land scape evolves from shrub step or agriculture to a more functional riparian habitat.

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, increase fish habitat quality/quantity and 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: final objectives for this restoration project will be identified in early 2021 as part of the final Phase I Basis of Design Report.

- 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.
- Long Term Obj. (3-5 yrs):
    a. 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.
    b. 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.
    c. 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 RM-22.25 to RM-23.1. 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. 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 a > pool frequency and depth range..

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. 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 irrigation efficiency work is planned for implementation in 2022 following crop harvest and prior to the anticipated winter/spring planting. The summer of 2022 will 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 10 ac decommissioned field.

Implementation (FY21): In 2021, CTUIR completed implementation of Phase 1-b which involved the filling of incised channels to elevate the river bed, connecting side channels and floodplain habitat to improve riparian function and productivity. Construction on Phase I-b (lower half of Phase I) began in August and was completed in early September followed by riparian planting in the winter of 2021 (Figure 15). In total, the Phase I-b restoration efforts increased perennial side channel length by >950 m and more than1,400 m for the entire Phase I in both years, through channel connectivity measures and increased LWD jam frequency (Table 7). Pools were not directly developed during construction and are expected to develop following changes in channel geomorphology during high flow events, but as a result of reconnecting channels and LWD placement 28 additional pools were created. 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, large numbers of summer steelhead parr were observed during construction and salvage relocation activities.

Implementation (FY20): In 2020, CTUIR completed implementation management and supervision for: pre-construction site preparation, permitting, design finalization for Phase 0.5 implementation at PA-27/28.1. The Phase 0.5 design involved final design and construction of the floodplain connectivity and LWD placement for about half of the overall project elements planned in Phase I (Table 7).

The design focused on creating multiple habitat structure, floodplain connection, and improving stream function deficiencies associated with this reach of the Tucannon River (Figure 15). Enhancing and restoring instream habitat in this project area is being accomplished through a variety of treatment actions in the main channel, along the banks, and within the floodplain. In total, the Phase 0.5 restoration efforts in 2020 increased perennial side channel length by >500 m through channel connectivity measures and increased LWD jam frequency (Table 7). Pools were not directly developed during construction and are expected to develop following changes in channel geomorphology during high flow events, and will be reported in future reports (2022-2023).

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 projects. 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 3). 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:

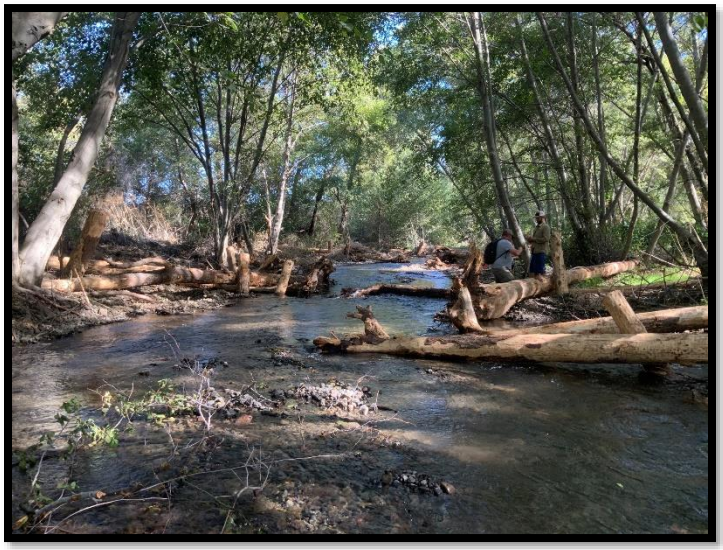
- Floodplain grading that targets removal of artificially high areas (such as berms and roads). Importantly, low areas such as those containing wetlands are avoided with floodplain excavations.
- Designs error on the side of more rather than less connectivity to allow the stream to find its natural multi-threaded 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.

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-b implementation (Figure 16). Overall, there was a 40% increase in the number of channel units, with about a 37% reduction in riffle habitats. Units were also delineated for the work completed in 2020 for Phase 0.5 for future comparison to other treated reaches (Figure 17).

Table 7: 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 II newly created side channel

PA28.1 Pre/post Photo Point 2021

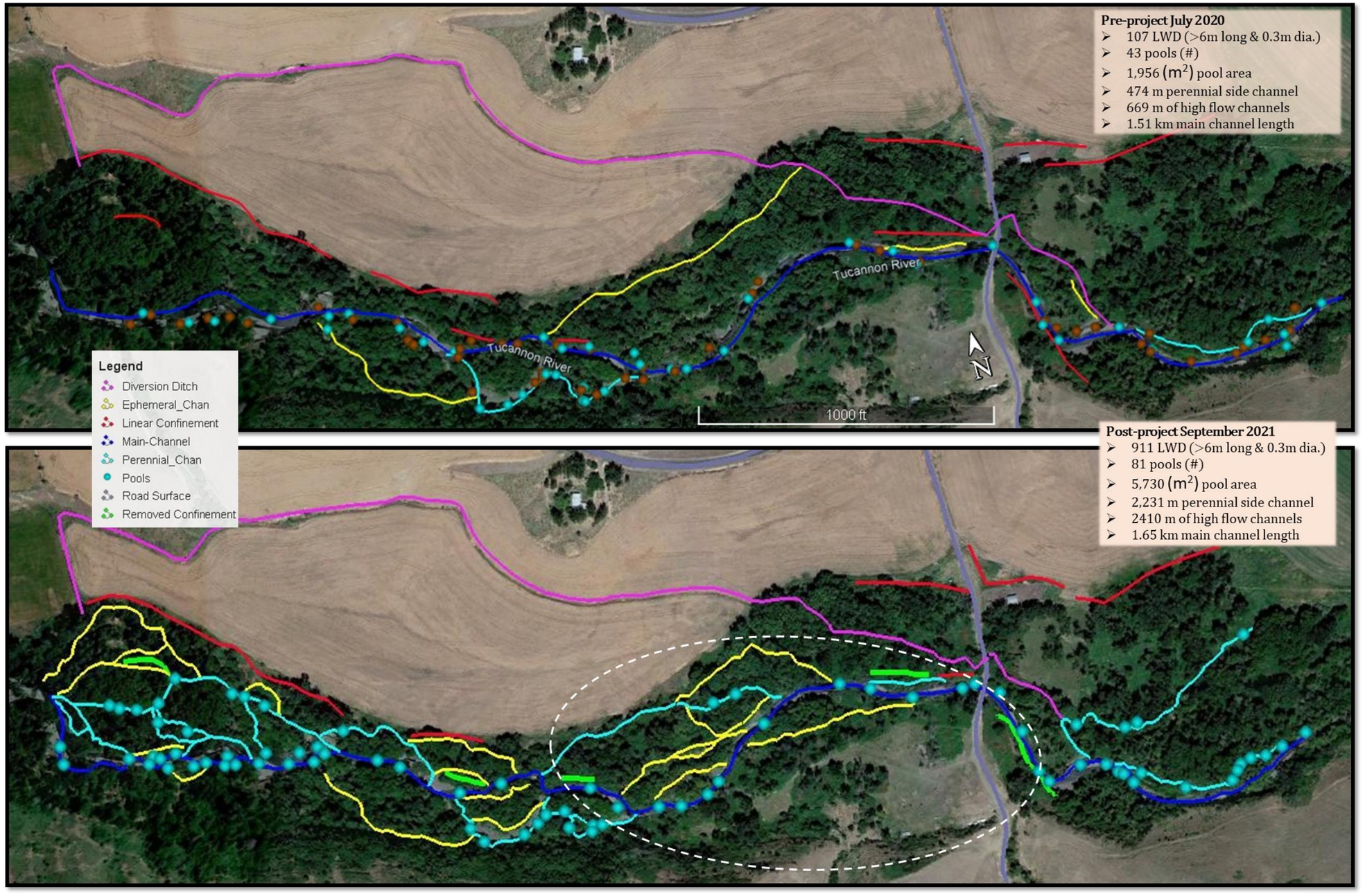


Figure 15: Project map illustrates pre and post project conditions within PA27/28.1 (Phase I-0.5) floodplain connection and LWD project implemented in 2020-2021. The dashed oval indicates the approximate area of work in 2020 Phase 0.5 reported in 2020 Annual Report.

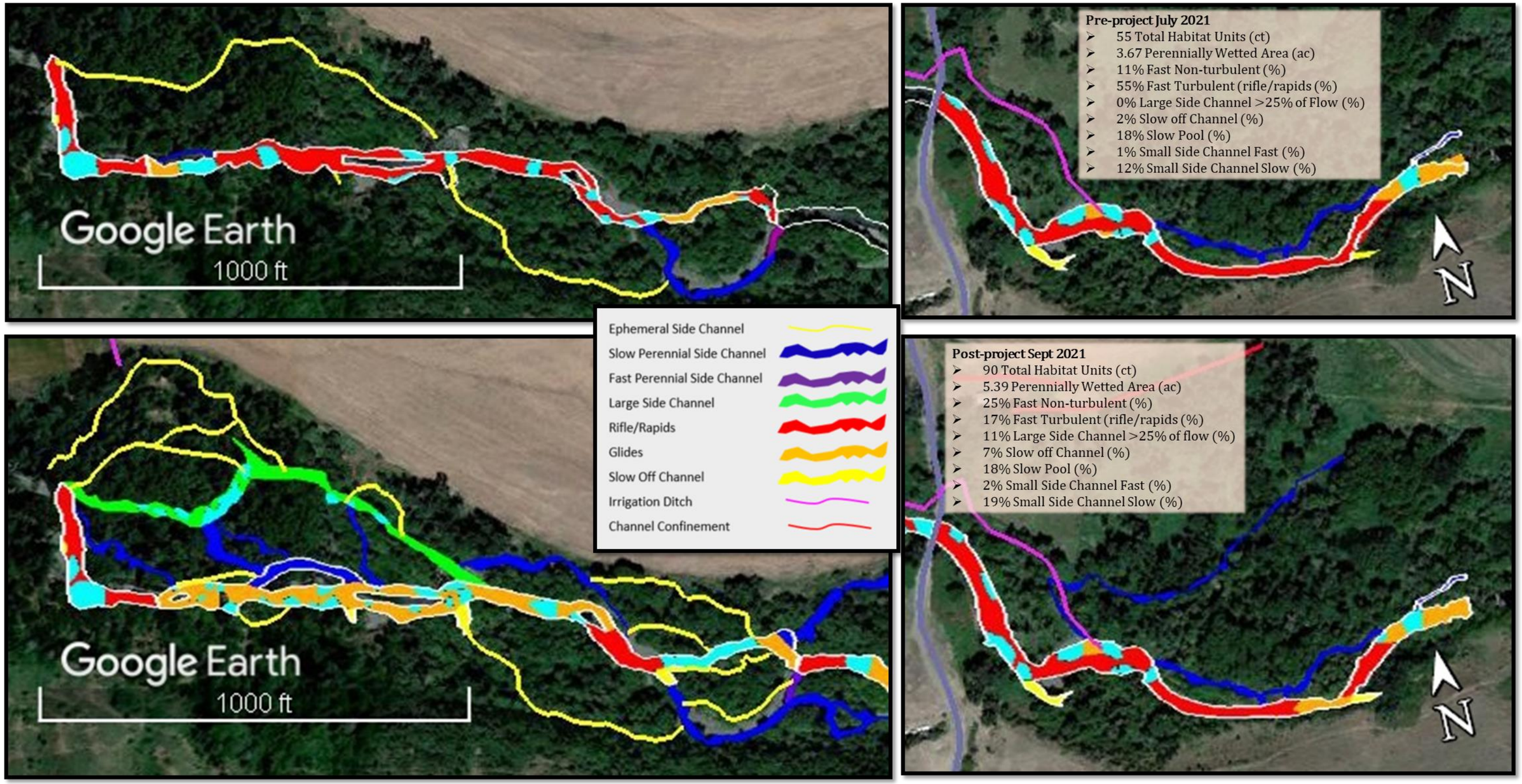


Figure 16: Project Area 27 & 28.1 Phase 1.b work completed in 2021 by CTUIR. The project reach runs from right to left under the King Grade Rd. The map above illustrate only the work focus in 2021. Habitat units were categorized in the field during the pre/post RHS. Note, the light blue shaded areas are slow pools in all maps above.

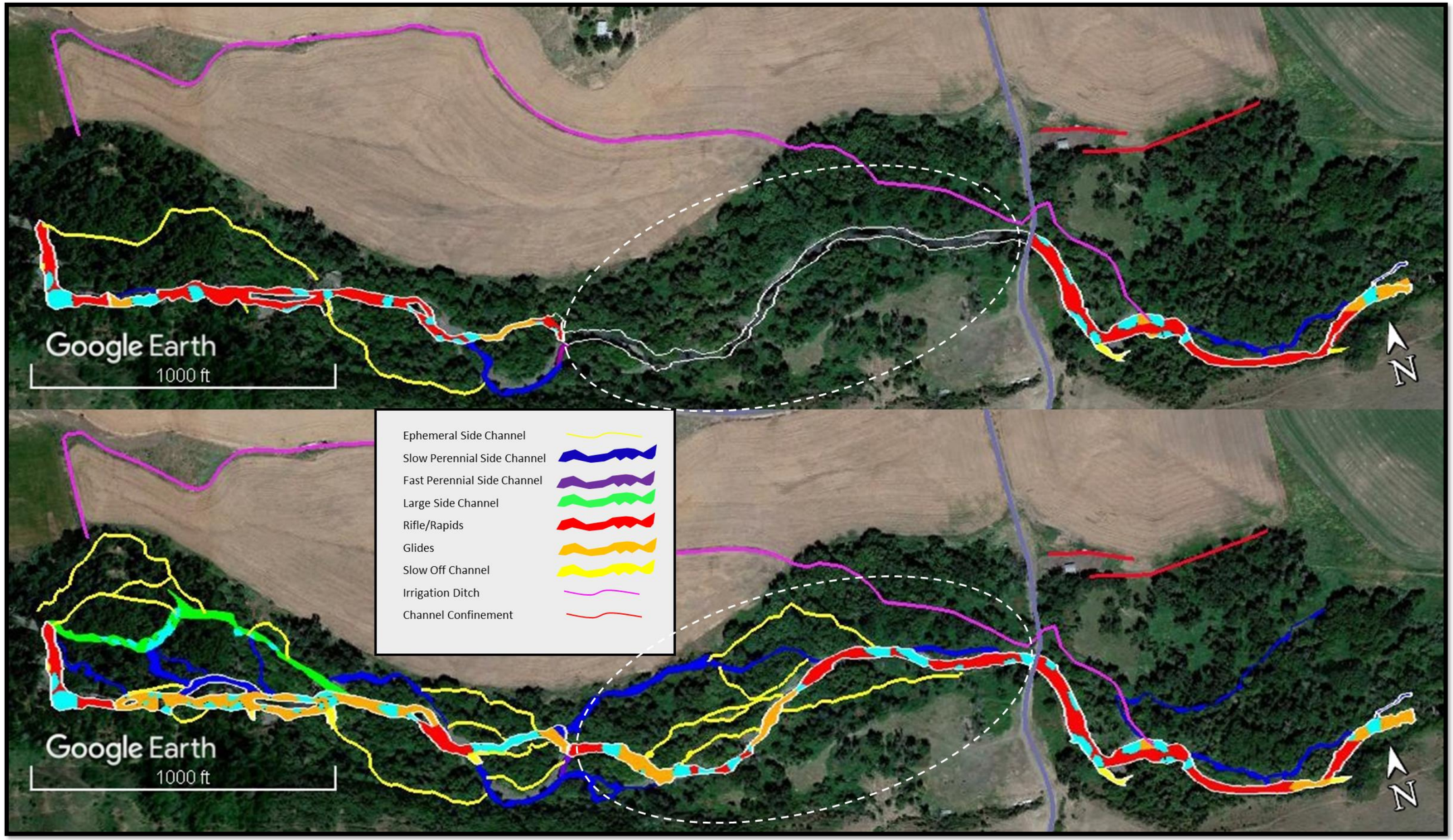


Figure 17: Project Area 27 & 28.1 Phase 1 all work completed in 2020 (highlighted by the dashed oval) and 2021 by CTUIR. The project reach runs from right to left under the King Grade Rd. The map above illustrates the whole of the project which was initiated in 2020 (Phase 0.5) highlighted by the white 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.

Project Title: PA27/28.1 Phase II Irrigation Efficiency

Implementer: Confederated Tribes of the Umatilla Indian Reservation

BPA Programmatic Funding (2010-077-00): In 2022 $315,525 in #73982 REL 132.

Other BPA Funding (2008-202-00): Funding is currently be determined and will be reported in 2022.

Matching Funds: Non-BPA matching funds have not been quantified for this project area, but could be in the donation of existing low lying agricultural lands for conversion to floodplain.

Location: Tucannon River mile 22.25 to 23.2.5. With a start Lat/Lon 46.453672 -117.816916 and end Lat/Lon 46.456387 -117.832140 (Figure 2).

Project Time Line: Project design was initiated late in 2021 (CR-73982 REL130) with planned design completion in 2022 and implementation in late 2022 (#73982 REL132). Project area 27-28.1 was split into multiple phases I III with Phase I spanning two years to accommodate both available funding and permitting timelines in 2020-22. PA27/28.1 Phase II planned to be designed in 2022 for implementation in 2022. Phase III floodplain connectivity will also been developed during 2022 for implementation in 2023.

Recovery Expectations: This project is located on the floodplain and valley margins of the project area in PA27 and PA28.1. It is expected that floodplain would be made available as soon as agricultural infrastructure can be relocated. Reclamation of agriculture field to riparian floodplain habitat will be a more gradual process initiated in Phase III.

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).

Priority Life Stages Targeted: All life stages

Potential Future Actions: Once Phase II is completed in 2022 operation and maintenance of the structure will be turned over to the landowner.

Project Goal & Objectives: The overall goal of Phase II is to minimize the overlap of agricultural production ground with low-lying floodplain (Figure 18) and convert ~10 ac of existing crop land to wet floodplain. Water savings would be held instream for fish. More descriptive objectives will be developed with the design in 2022.

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 RM-22.25 to RM-23.1. The project is identified as a priority for restoration in the 2021 Plan (Anchor QEA, 2021). The primary reach objectives are to increase floodplain connectivity through: removing channel confining features, the placement of LWD features and reconnecting perennial and ephemeral side channel features. It is predicted that restoration actions completed in Phase I (2020-21) will

lead to significant geomorphic change increase floodplain frequency/duration. It is also predicted that adjacent low-lying fields will inundate with greater frequency leading to the opportunity to conduct improvements to the existing agriculture approach. This action will work to improve the irrigation operations on a smaller footprint outside the modeled floodplain to minimize the loss to the operator.

Status (FY22): Phase II project concepts will be advanced and will include modification to existing irrigation access and efficiencies to aid in reducing the impacts of agricultural practices on the floodplain and waterway. Work on this project is anticipated to begin in the late summer to early fall to avoid field harvest or fall planting (Figure 18). Concurrent and following construction on Phase II the Program will work with CTUIR to develop design concepts for Phase III, floodplain and riparian wetland development for implementation in 2023. Phase III will involve a large riparian planning component and may take a number of years to implement through 2025.

Status (FY21): Phase II concept and design was initiated in 2021 with scope development and budgeting.

PA28.1 Phase 1 Floodplain Connectivity 2021

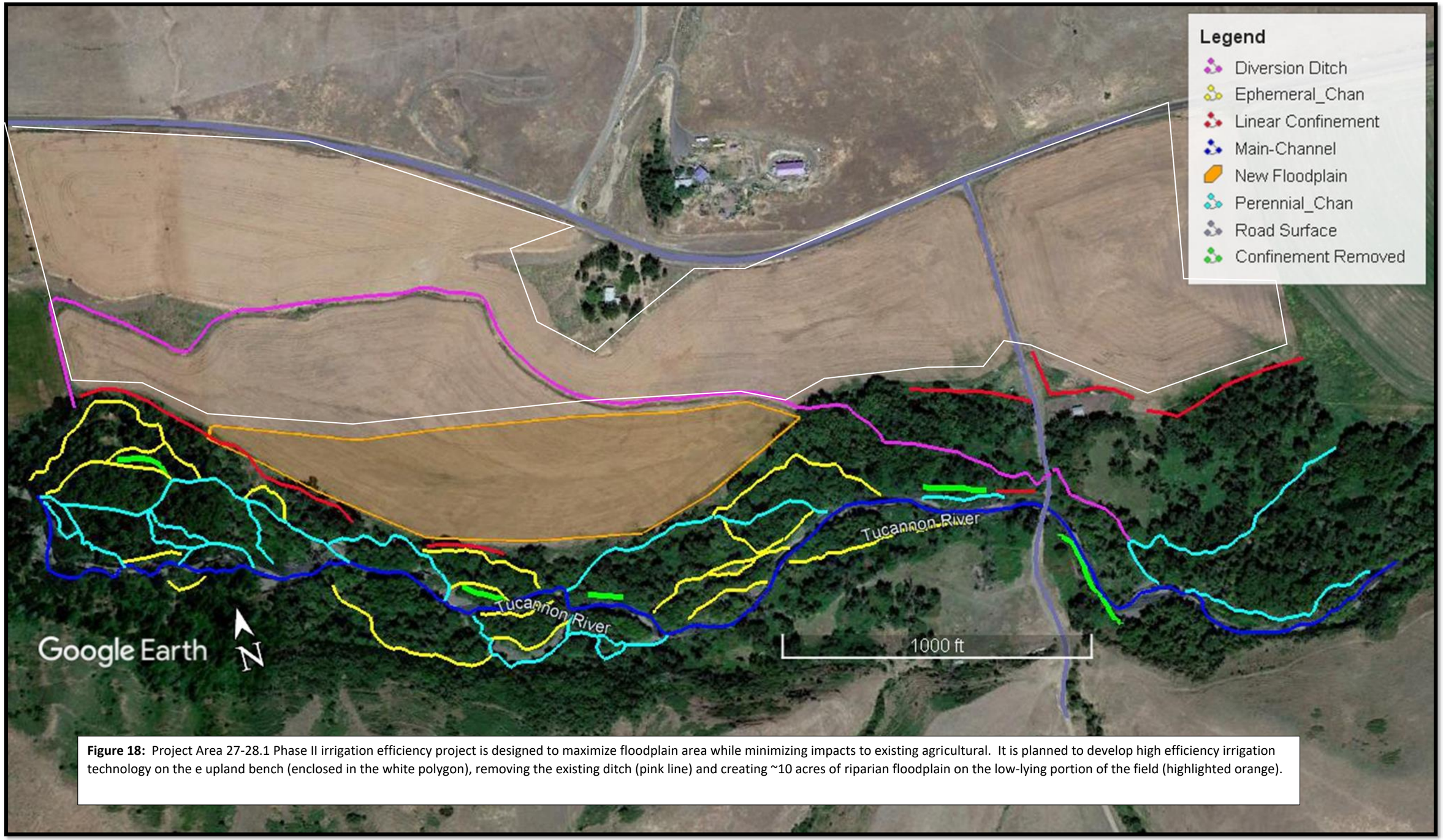


Figure 18: Project Area 27-28.1 Phase II irrigation efficiency project is designed to maximize floodplain area while minimizing impacts to existing agricultural. It is planned to develop high efficiency irrigation technology on the e upland bench (enclosed in the white polygon), removing the existing ditch (pink line) and creating ~10 acres of riparian floodplain on the low-lying portion of the field (highlighted orange).

Project Title: 2020 Tucannon River LiDAR Data Collection and Analysis

Implementer: Confederated Tribes of the Umatilla Reservation

BPA Programmatic Funding (2010-077-00): The Program supported the CTUIR in the 2020 Tucannon River Basin Terrestrial NIR LiDAR, Topo-bathymetric LiDAR, 4-Band Orthophotography Acquisition, Post-processing and Data Analysis. In 2020, $182,785 (86153)

Matching Funds: Matching funding toward this project come from the FY20 SRFB program funds, at a sum of $73,000 (IAA 20-2013).

Location: Entire 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 Topobathymetric Lidar Point cloud in November 2020 (Figure 19) 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

- Geomorphic Change Analysis
    - Geomorphic Change GIS Data: channel traces, lidar differencing, change locations shapefile (Figure 20)
    - 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 rasters 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 25yr 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 bathometric LiDAR data set prior to the flooding in February 2020 (Figure 4) which we bracketed with a follow up data acquisition in November 2020 prior to high water. The majority of the work conducted in this effort in 2021 was to process and analyze that dataset. 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 (Maret et al 2006) and the Geomorphic Unit Tool (GUT) for comparison of projects between pre and post flood impacts. 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.

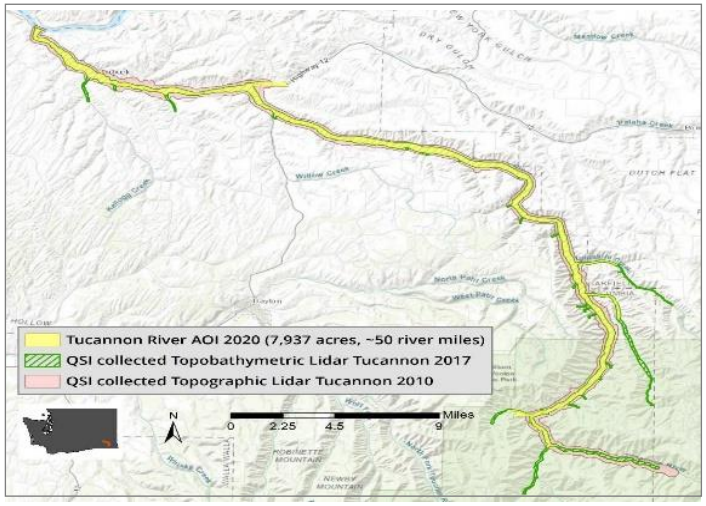


Figure 19: 2020 Tucannon River LiDAR coverage map.

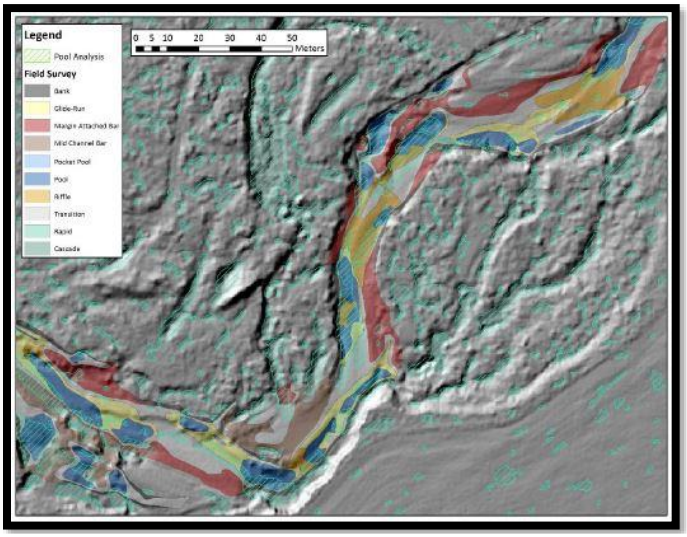


Figure 20: Example of the Tucannon LiDAR analysis classifying different habitat units using the bathymetric green LiDAR. The blue areas in the map are pools.

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, the Program is developing scope and budget $210,350 (CR-356074).

Matching Funds: Matching funding is be pursued in the current SRFB grant round at a rate of $150,000 (22-1021) in 2022.

Location: Tucannon Basin floodplain from RM 36.5 to RM 46.5.

Project Time Line: The Tucannon Floodplain Management Plan (WDFW 2012) was completed in 2012, with the implementation of two actions identified in the plan. The update to this effort would plan to begin in 2022 and wrap up in 2024 with 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 5-15 and (2) to create a conceptual design for the project reach based on the preferred alternative. The assessment will analyze the impacts of infrastructure on the floodplain and river channel to develop restoration alternatives that prioritize solutions to minimize or eliminate these impacts. The conceptual design 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. Specific assessment objectives include:

Objectives which support Goal 1 include:

1. Evaluate degree of floodplain confinement – 6 months

2. Assess impacts of infrastructure on floodplain functions, using the following physical habitat criteria: a. existing fisheries habitat availability (6 months) b. Existing stream power (6 months) c. Existing floodplain connectivity and channel complexity (6 months)

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) Objectives which support Goal 2 include: 1. Model potential future wetland conditions and work with ACOE to determine appropriate wetland mitigation plan for infrastructure modifications (1.5 years) 2. Create a report containing conceptual designs (1.5 years) The assessment and design process will identify metrics that ensure project implementation restore' s natural floodplain functions that support egg-fry, juvenile rearing and adult spawning life stages for spring Chinook, summer steelhead and bull trout throughout the project reach.

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, to help co-managers identify and prioritize multiple use management alternatives for each lake site. 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 21.1) 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 21.2), 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 21.1: River condition 2020 flooding looking upstream to Beaver Watson diversion point

Figure 21.2: 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 ½ of the available floodplain in this project area.

Partner – NPT Projects

Project Title: Tumalum 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 River mile ~32.7 and Lat/long 46.358986 -117.685199 (Figure 2).

Project Time Line: Initial preliminary design development began in 2019 (#74017 REL 45) to be completed by April, 2020. In 2020, NPT will work to finalize designs and (74017 REL 45) initiate implementation in 2022.

Recovery Expectations: This project is located in Tumalum 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 Tumalum 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 22). 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.

The removal of passage barrier will open complete access to more than 10.8 km of salmonid spawning and rearing habitat. The added benefit to habitat work in the immediate vicinity up and downstream from the barrier on adjacent properties will provide additional benefit to fish passage and rearing.

Figure 22: Tumalum 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 show the stream crossing with to 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-kind field survey completed in 2021

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

Matching Funds: Matching funding toward this project is being pursued 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 2).

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 will work to develop/finalize designs and (74017 REL 45) initiate implementation in 2022-23.

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.

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: 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: Detailed objectives will be developed during project development.

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 has been incised into its floodplain and remains relatively locked into its current degraded form (Figure 23) offering very little in quality salmonid habitat. The existing channel has relatively low habitat complexity (Table 8) 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 8).

Table 8: 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

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 2 km upstream from the main stem Tucannon. The design will be 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 23: Cummings Creek photo points established in November 2021 during a rapid habitat survey conducted for reach observation and concept design development. The upper three images indicate typical condition of channel habitat, which the lower (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 2021, NPT Staff in-kind

Matching Funds: Matching funding toward this project has not been pursued in 2021.

Location: Tucannon River mile ~46.0 and Lat/long 46.242 -117.687 (Figure 2).

Project Time Line: This project is in its early stages of development conducting early stakeholder involvement meeting to determine potential restoration alternatives which might be put forward in 2022 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 is working to bring stake holders together in support of leading toward a future design as early as 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: Snake River DPS Summer Steelhead (Threatened), for 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 24), as well as the numerous disconnected side channels (3,000 m). In 2021, 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 discuses/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

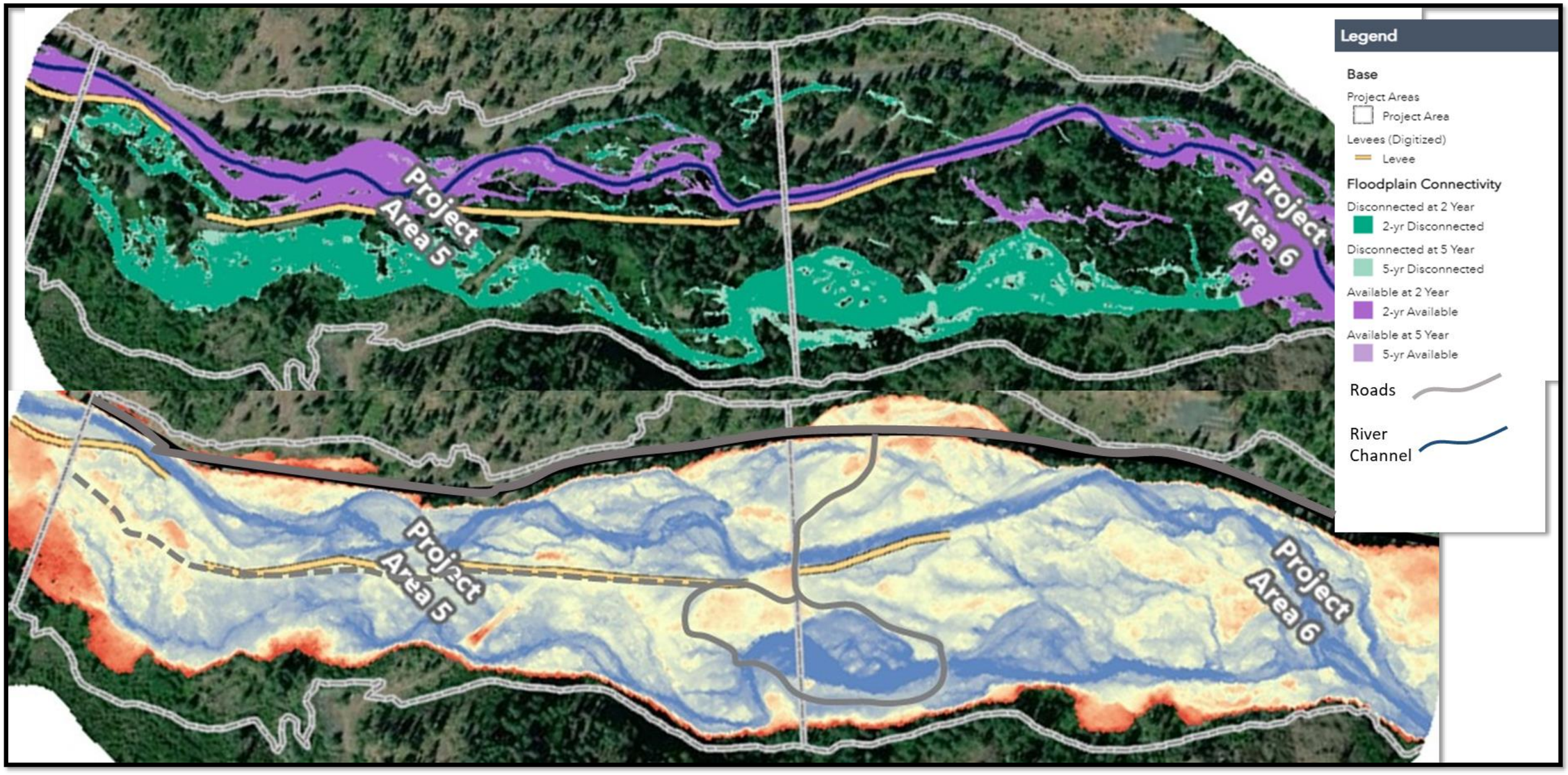


Figure 24: Project Area 5 & 6 just downstream from WA State Parks Camp Wooten. The upper map illustrates low-lying floodplain across both project areas with the lower map showing the relative elevation model based on 2017 LiDAR (https://ctuirgis.maps.arcgis.com/apps/MapSeries/index.html?appid=7961a9f233684f0daf87970b37d8dc1c). The upper map illustrated connected 5yr floodplain in purple with the disconnected floodplain in green. In total >19 acres of green shaded floodplain is disconnected by the road and associated gravel berms protecting the road.

Partner – CCD Projects

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), in 2013, $152,000 (#59663). In 2011, $64,000 (#50146)

Matching Funds: In 2019, the CCD was awarded a SRFB grant for $304,775 (19-2094), 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 River mile 26.2 to 26.7 (Figure 2) Center Point Lat: 46.442 Long: -117.760.

Project Time Line: The initial project including levee removal and setback, was completed in 2012. Phase I of the LWD structure placement was implemented in 2013 (#59663 - #50146), Implementation of Phase II took place in 2021-22 on the upper 1.28 km of the overall PA26 reach. Phase III_IV designs are being developed in 2022-23, and are discussed in the next section.

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, 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 revisited pilot channel cuts and associated LWD structures to ensure side channel objective and floodplain objectives are being met. Additional floodplain structures may also be desired once

the floodplain objective 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 2012.

Project Goals and Objectives

Goal: Return a 1.29 km reach (Phase II) of the 5.95 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 2011, river levees and gravel berms were removed or breached throughout the entire reach (Figure 27) as part of the 5.95 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 which is illustrated from pre-project through 2020 (Figure 27). 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, seventeen log jams were placed within the 5.95 km reach as a pilot effort in accordance with landowner's wishes at the time. Five log jams

were placed within the upper 1.29 km reach designed in Phase II (#87504) to provide fish cover while observations of river conditions were ongoing. 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 ~14 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 II work (#87504) was located on the upper 1.29 km of the project reach on which restoration actions were performed in 2011 & 2013 Phase I and is the first significant log jam project to be proposed for implementation following the CHaMP recommendations.

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 and riparian condition and elevated summer water temperatures, all key habitat limiting factors for Chinook and steelhead (Anchor QEA 2011a).

Table 9: 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)
Phase II Reach Obj.2023	none	>800	>800	>175	36	5	18	~2,400	1.0-1.5
Pre-project Phase II (2015)	1.44	062.8	0.0	63	17	7	14	293	0.5-1.0
Pre-project Phase II Design (2020)	1.44	181	0	25	8	7	11	646	0.5-1.0
Phase II As-built (2021)	1.44	611	126	247	47	6	19	4610	0.5-1.0

Summary: The PA26 Phase II LWD Structure placement focused on developing better connection of the winter flood flow (>~140cfs or <1yr), with adjacent floodplain, where previously the levee and gravel berms were removed in 2012. The design used 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. In total, within the upper 1.29 km long reach 29 log structures were constructed in channel (Figure 25) and 15 were constructed on the floodplain in likely flow paths to aid in the shaping of future side channels as they develop (Figure 26). The stream work will provide increased inundation both in frequency and duration of ~ 14 acres of floodplain (Figure 26). As part of project habitat monitoring in 2021 channel habitat units were delineated in the field for pre-project followed up by the as-built condition (Figure 28) using field protocol identified in the Tucannon Monitoring Plan (Camp 2020). 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.

Future work in PA 26 is being designed and named Phase III-IV and is discussed in the next section.

PA26 2021 Post-project Bank and Apex Structure Combo

Figure 25: Pre (upper) / post (lower) project images in a plain bed -reach treated with LWD structure to increase channel complexity and floodplain connectivity at PA26 in 2021.

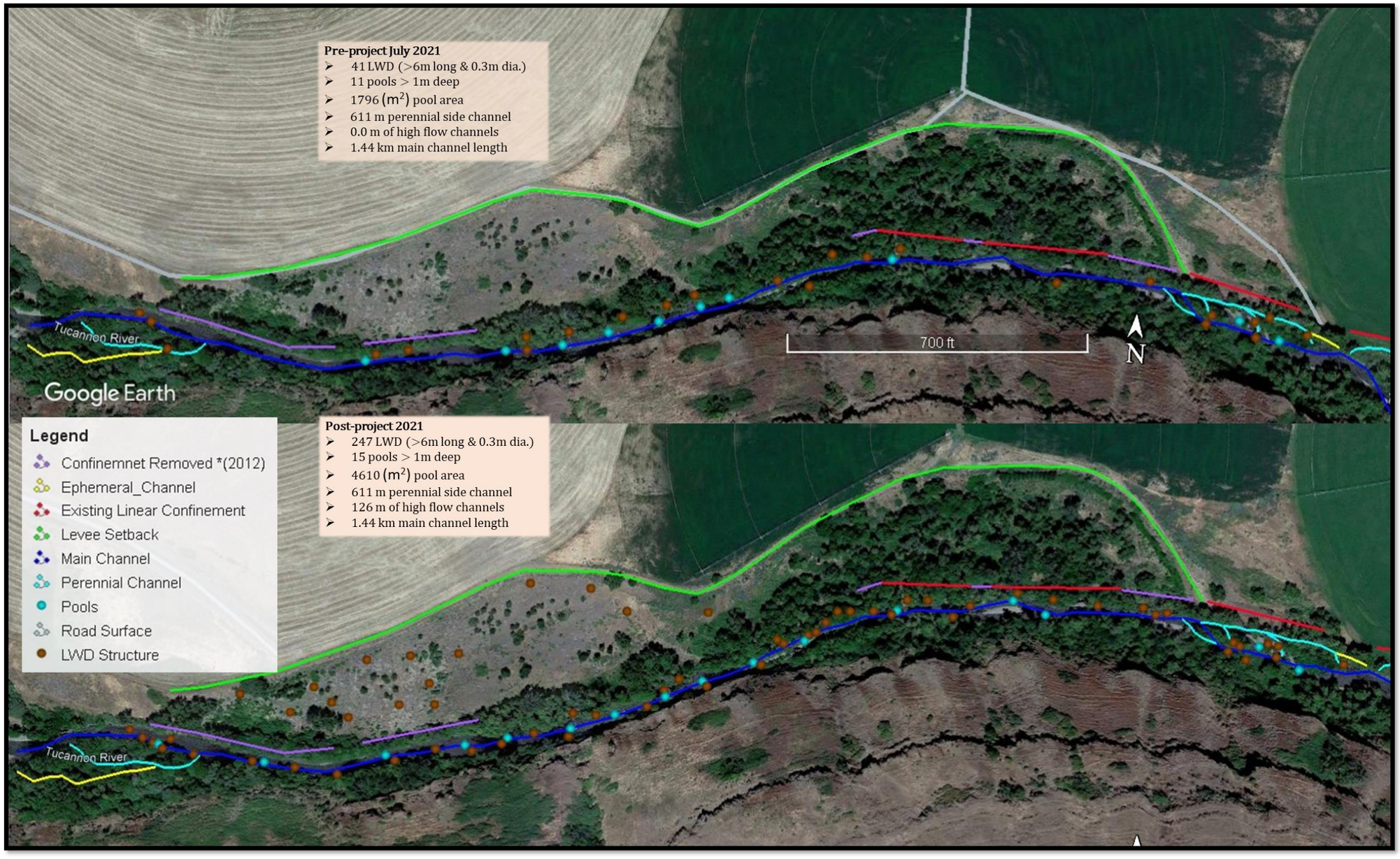


Figure 26: Project Area 26 Phase II pre/post project condition for side channel, pools and LWD structures. The upper map image illustrating the 2021 pre-project and the lower one the as-built in Sept 2021.

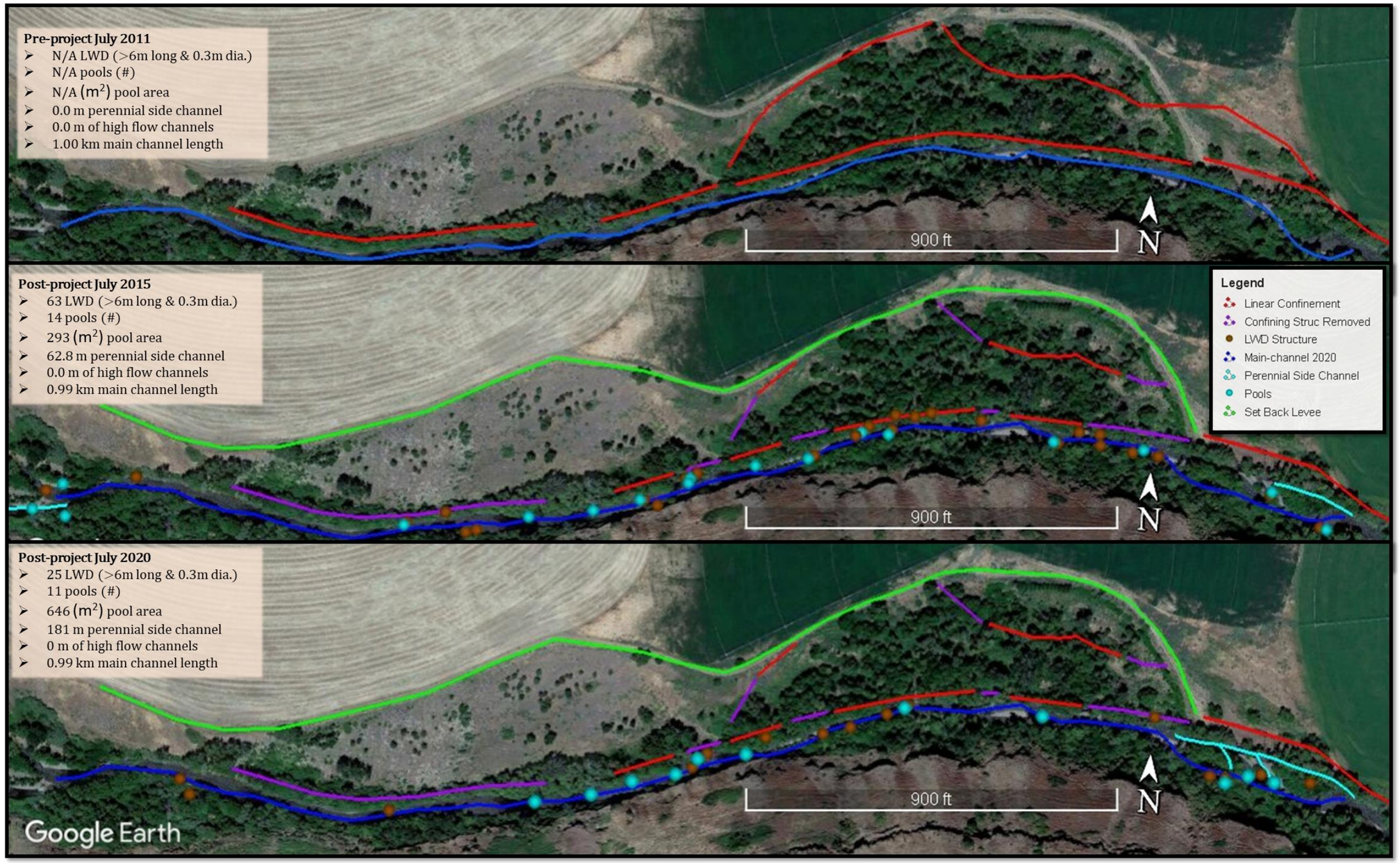


Figure 27: Project area 26 Phase II habitat metrics displayed for rapid habitat surveys conducted in 2011, 2015 and 2020. The 2011 survey was only completed on channels and does not include pools or LWD. The maps illustrate the previous levee removal and setback work completed in 2012.

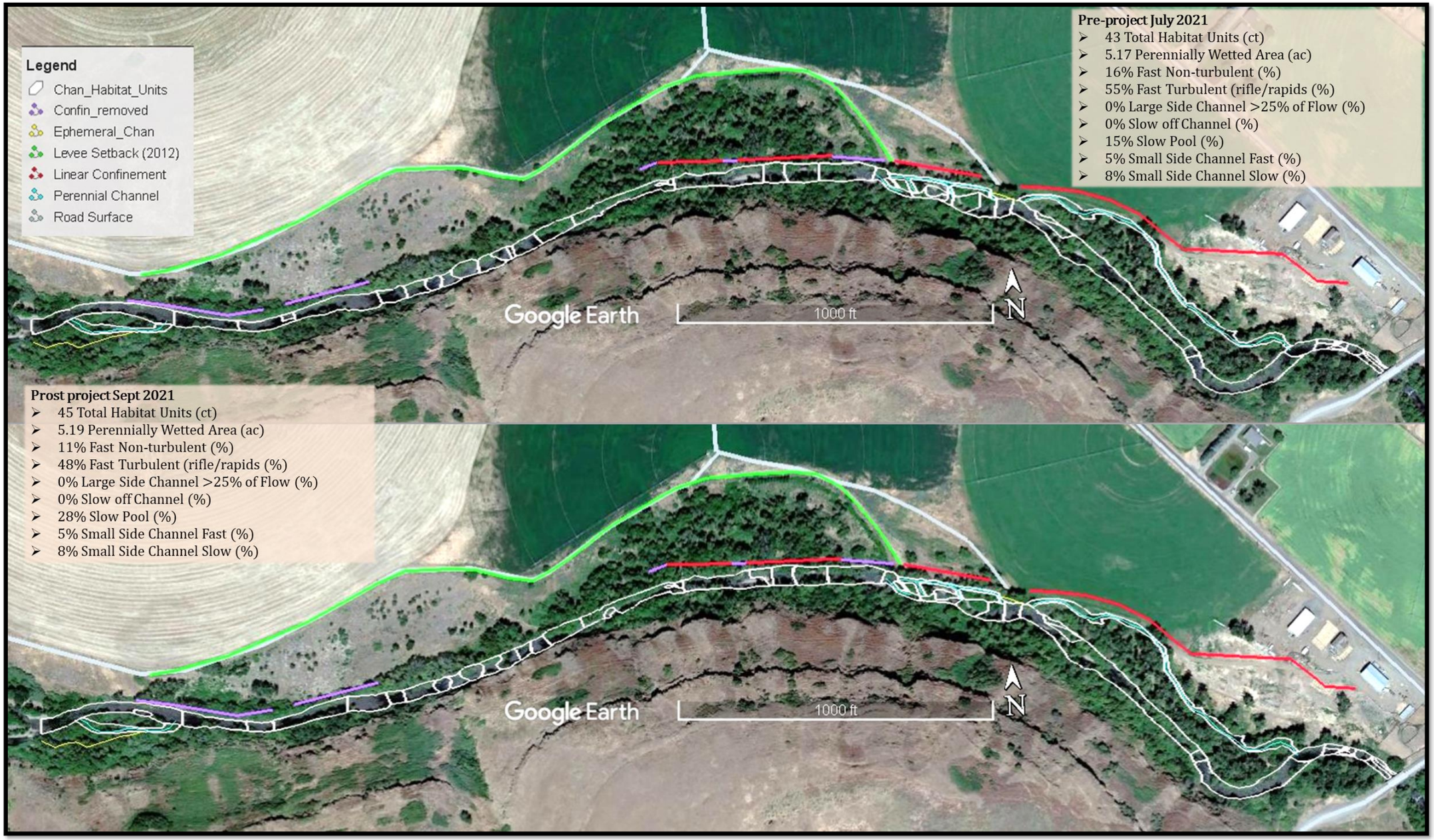


Figure 28: Project Area 26 (Phase II) channel habitats units delineated during the pre-project survey in July 2021 and the as-built survey September 2021. The greatest immediate changes in habitat units were in conversion of riffle/rapid units to slow water pools and non-turbulent glides.

Project Title: TUCANNON (PA-26) PHASE III-IV: ADD Floodplain Connectivity & COMPLEX

Implementer: Columbia Conservation District

BPA Programmatic Funding (2010-077-00): 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 is pursuing a 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 River mile 26.2 to 26.7 (Figure 2).

Project Time Line: The initial project including levee removal and setback was completed in 2012. 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 are being developed in 2022-23 and are under review through BPA and the SRFB application process.

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, 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 29). 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 revisited pilot channel cuts and associated LWD structures to ensure side channel objective and floodplain objectives are being met. Additional floodplain structures may also be desired once the floodplain objective 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 2012.

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:

Detailed objectives would be developed during the alternative analysis and conceptual design review.

- 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.
- Short Term Obj. (3 yrs): Remove channel confining features and conduct side channel pilot cuts to connect and initiate floodplain connectivity.
- Phase III Long Term Obj. (3-5 yrs): Increase floodplain connectivity and channel complexity.
- Planting to restore a floodplain and upland terrace forest

Background & Project Summary

Background: The 2011, river levees and gravel berms work describe for PA26 Phase II, levees and berms were removed breached throughout the entire reach (Figure 29) as part of the 5.95 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 29) particularly along the 730 m levee removal, with the hope that floodplain inundation and side channels would develop during flood events. In 2011, levee removal was a relatively new and innovative restoration technique for SE Washington State, resulting in a conservative approach being implemented 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 in accordance with landowner's wishes at the time. 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 on the middle 2.68 km of the project reach with the remaining lower 0.75 km of the project area not currently under review.

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 and riparian condition and elevated summer water temperatures, all key habitat limiting factors for Chinook and steelhead (Anchor QEA 2011a).

Table 10: 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)
Phase III-IV Reach Obj.2023	none	>3000	>200	>335	~100	N/A	67	~4000	1.0-1.5
Pre-project Phase III-IV (2021)	2.68	581	1078	134	47	23	36	2550	0.5-1.0

Summary: The PA26 Phase III-IV design is focused on developing better connection of the winter flood flow (>~140cfs or <1yr), with adjacent floodplain, where previously the levee and gravel berms were removed in 2012. 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 10). The design (currently 15%) 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 ~56 LWD structures of various purposes including channel spanning, apex and other cover forming jams. To aid in the reconnection floodplain numerous pilot cuts will be used to lower the river bank and remove gravel fill to reduce confining feature throughout the 2.68 km reach (Figure 29). The stream work will provide increased inundation both in frequency and duration of ~ 31 acres of floodplain (Figure 29) reconnecting > 4,000 m of disconnected or poorly connect existing side channels identified during the 2021 RHS. Habitat monitoring will be conducted using field protocol identified in the Tucannon Monitoring Plan (Camp 2020). 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.

PA26 example of degraded habitat being targeted for increased complexity and connectivity in Phase III-IV.

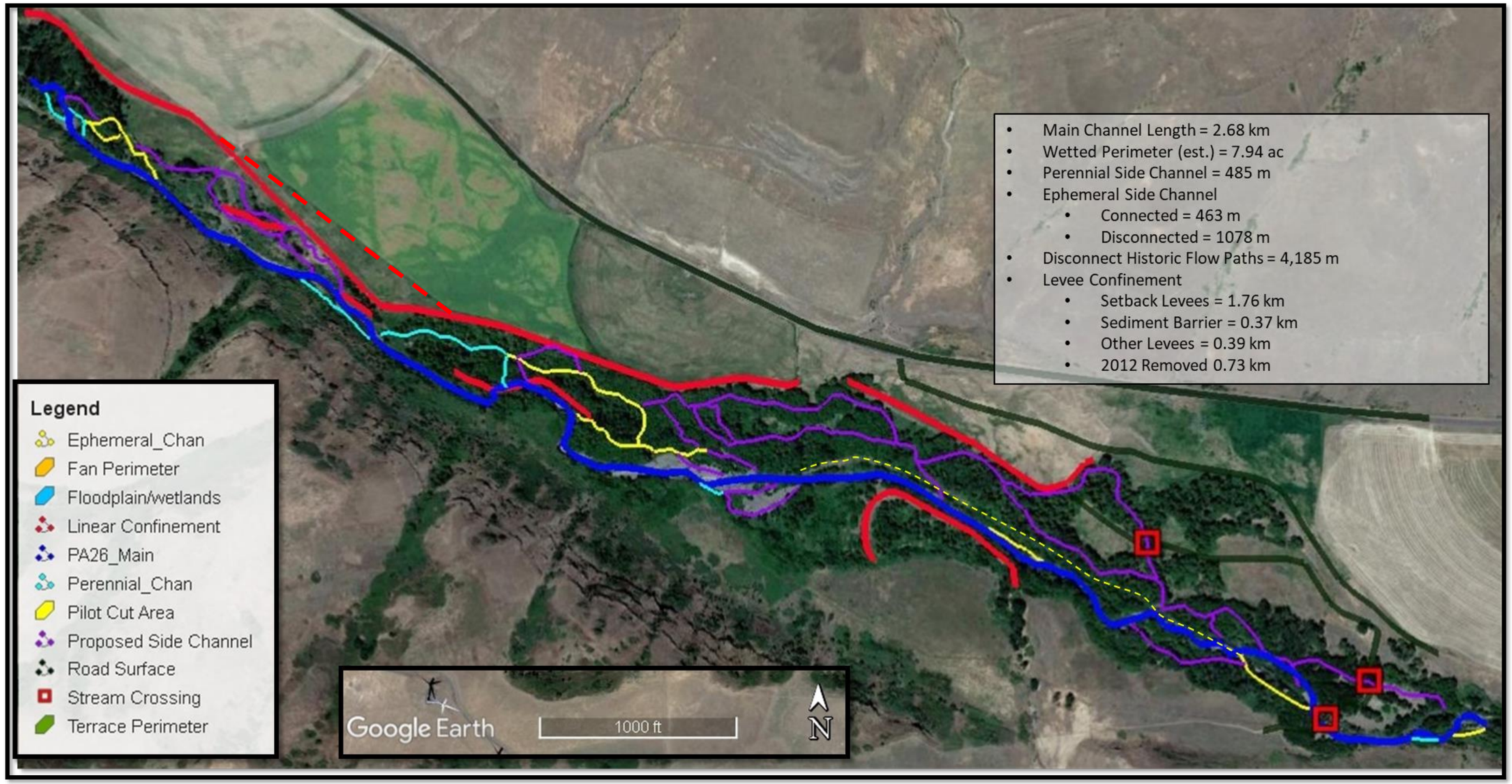


Figure 29: PA 26 Phase III-IV: The project reach being targeted during Phase III-IV design in 2022. The purple lines indicated disconnected side channels that have potential for reconnection and perennial flow. The red dashed line indicated an opportunity to add additional floodplain inside the setback levee highlight by the solid red line. The dashed yellow line highlights the location of the 730 m levee removed in 2011.

Project Title: Tucannon River Habitat Restoration (PA34.1 & 34.2)

Implementer: Columbia Conservation District

BPA Programmatic Funding (210-202-00): FY20 $2,000 (#84836)

Other BPA Funds (1994-018-06): FY21 engineering ~$20,500

Matching Funds: In FY20 the CCD received a SRFB grant for $81,066 (# 20-1052) to complete construction designs, engineering and modeling.

Project Time Line: In 2020, the CCD and the programmatic worked to complete a project reach assessment and concept development. Initiate concept prioritization, selection and design development including permits for future implementation in 2023-2025. This project effort is trying to complete the entire in water work interval into one season in agreement with the landowner.

Location: PA34.1 Start Lat/lon 46.505962/-117.988847, End Lat/lon 46.508280/-117.996584 and PA34.2 4 Start Lat/lon 46.506280/ -117.996584, End Lat/lon 46.506293/ -118.010482 (Figure 2).

Priority Populations: Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened) and Snake River ESU Fall Chinook (Threatened)

Priority Life Stages: All life stages for, Snake River DPS Summer Steelhead and Snake River ESU Fall Chinook. This project would have benefits to winter rearing and migration of Snake River ESU Spring/Summer Chinook and Columbia River bull trout.

Project Goal: The anticipated goals of the design would be to improve floodplain connectivity, increase channel complexity and reduce excessive stream power to support natural river process and habitat abundance and resiliency.

Objectives: Detailed project objectives will be identified during project development and design phases in 2021-22 prior to implementation in 2022.

Project Back Ground & Summary:

Background: The Program provided the CCD, field assessment and technical support toward the development of design concepts for project area PA 34.1 and PA34.2 in 2020, including a pre-design rapid habitat survey (Table 11) and initial concepts and objectives to aid in securing funds for design development in 2021. These projects were prioritized in the 2021 Plan as priorities for restoration actions based on potential for connecting floodplain and potential to have significant habitat gains for winter rearing salmonid habitats.

The Columbia Conservation District has received a SRFB grant to initiate project design on one or both the project areas beginning in 2021 for construction in 2023-25.

Summary: The projects are both located on an active private farm (Figure 2) and the current active river and riparian habitats are adjacent to active irrigated farm fields that are protected by channel confining features like levees, riprap, gravel berms and a bridge (Figure 21). The design concepts are currently investigating opportunities to remove some of the river confining features, adding LWD and reconnecting floodplain. It is anticipated enacting this goal will lead to significant increases in channel complexity, particularly in channel complexity more than doubling perennial side channel length (Table 11).

In 2021, the Program will work with the CCD to continue to develop design concepts and work with the land owner to determine the potential needs for the development of a setback levee to accommodate the conversion of disconnected floodplains to low-lying floodplain. The current existing condition and potential restoration objectives are provided in an illustration which show the existing condition as well as restoration potential (Figure 30).

Table 11: Project area 34.1 and 34.2 rapid habitat survey results from 2020 project reach assessments for design concept development. 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)
PA34.1 Pre-project (2020)	1.11	329	982	22	12	5	14	447	0.5-1.0
PA34.1 Project Reach obj.	None	1,000	500	>111	>28	5	30	3,330	>1.0-1.5
PA34.2 pre-project (2020)	1.27	1,500	1,000	69	35	8	N/A	N/A	N/A
PA34.2 Project Reach obj.	None	N/A	N/A	121	50	12	31	4,000	>1.0-1.5

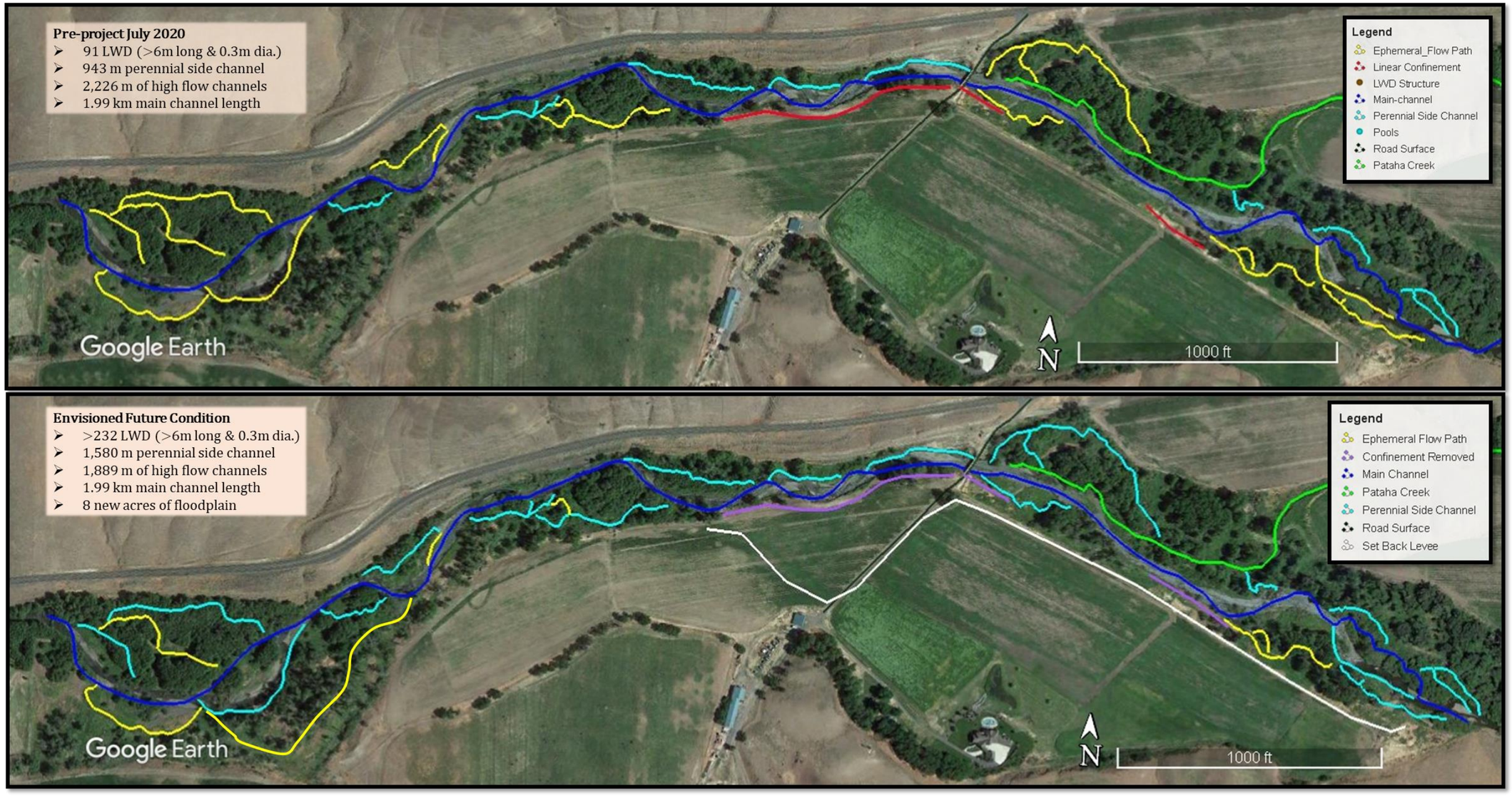


Figure 30: Project area 34.1 and 34.2 illustrated from left to right respectively. The upper map was developed from current field conditions observed in 2020 during the pre-project rapid habitat surveys. The lower map is developed based on 2020 field conditions and observations made in the field and existing relative elevation models provided in the 2020 Tucannon Conceptual Restoration Plan (Anchor 2021).

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 implementation using these funds being completed in 2022.

Location: Tucannon River mile 39 to river mile 40; Lat/Long 46.069 / -118.333

Recovery Expectations: The Mill Creek fish passage effort is an ongoing effort to reconnect >40km 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 12) 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 31).

Table 12: 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 project being implemented to date bring this effort closer to completion.

Current Status 2021: 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 31). 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 2022 construction work window.

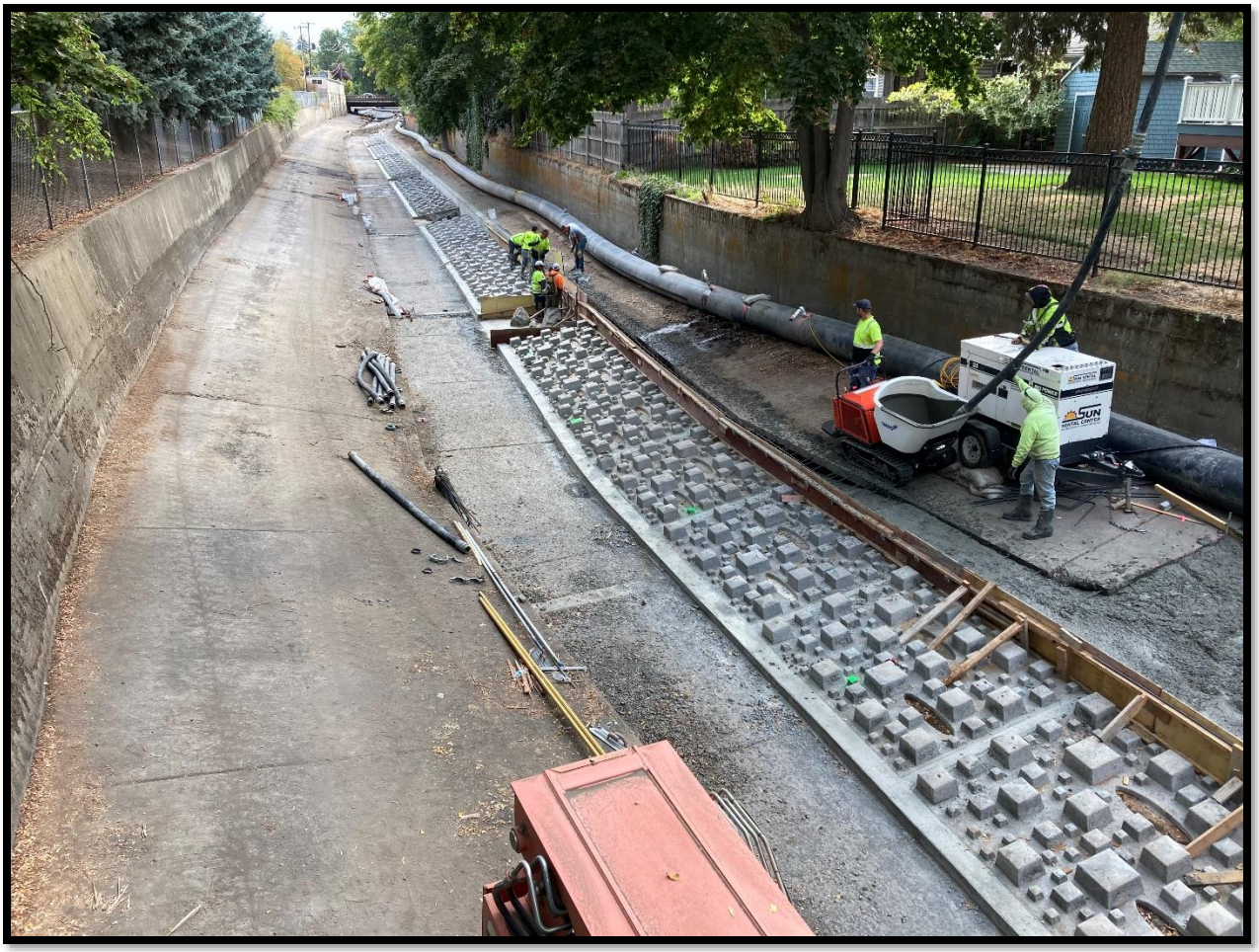


Figure 31: Mill Creek floodway fish passage construction showing the concrete roughness panels while flows are diverted.

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 2021, the Program and its partners continued to address the priority work outlined in 2021 Plan, as identified in the 5 year work plan (Table 13). 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 13: Tucannon Programmatic Habitat 5yr Work Plan 2021-2026.

Project Title	Priority Population	Limiting Habitat Condition(s)	Prioritized Habitat Action Types	Proponent Organization	Proposed Year of Implementation
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
Project Area 17/18	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 I -2024 Phase II - 2025
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
Tucannon LiDAR	All	Floodplain connectivity, channel complexity, excessive stream power, and pools	Assessment	CTUIR	2022
Tumalum Fish Passage	Tucannon DPS Summer Steelhead	Passage Barrier	Fish Passage under Tumalum	NPT	2022
Project Area 26 Phase II	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Riparian enhancement	CCD	-2022
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
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
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
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
Project Area 14.1&2	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	2023-2024
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 13 (continued): Tucannon Programmatic Habitat 5yr Work Plan 2021-2026.

Project Title	Priority Population	Limiting Habitat Condition(s)	Prioritized Habitat Action Types	Proponent Organization	Proposed Year of Implementation
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
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
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
Tucannon PA 44 Floodplain	Tucannon DPS Summer Steelhead, Fall Chinook	Floodplain connectivity, channel complexity, excessive stream power, and pools	Channel reconfiguration, addition of large wood, channel modification, side channel reconnection, and riparian enhancement	CCD	2022
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
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

Northwest Power & ISRP review in 2021

The SRSRB, in coordination with BPA, began work in 2021 to update the Tucannon Programmatic Habitat proposal (2010-077-00) for planned work of the time period 2021- 2026 illustrated in the 5 Year Work Plan (Table 13). The Program coordinated with CTUIR, NPT, WDFW and CCD to develop the proposals and a coordinated presentation to the ISRP panel.

We continued in 2021 to be committed to making positive changes in our umbrella project in response to ISRP's review and recommendations. To initiate these changes, the Program updated the 2011 Plan (Anchor QEA 2011) in the 2021 Plan (Anchor QEA 2021) which focused on reinforcing restoration actions which target the key limiting factors and formalized an adaptive management plan. To better articulate and streamline physical habitat monitoring within the Tucannon basin for implementation and effectiveness monitoring the SRSRB worked with Cramer Fish Sciences to develop the Tucannon Habitat Monitoring Plan (Camp 2020), which incorporates data that is being collected as part of existing and ongoing programs.

The Program has little input in regards to biological monitoring and as a result choose not to include actions that are not under the purview of the Program, or the partners. This lead to a miss understanding in the ISRP review that the Program works in isolation from those collecting biological monitoring data. This was not an observation isolated to the Tucannon projects but at a broader scale which lead to a requested response in the form of developing a monitoring map (Figure 32) and matrix (Table 14) to illustrate the extent of monitoring infrastructure the Program has to draw from. The Program works closely with the fish managers and in 2021 initiated an annual meeting update with the co-manager to share information leading into the field season. The co-managers also regular present information and data at the SRSRB Regional Technical Team meeting which are attended by all the Program staff and partners. Additionally the completion of RHS continue for evaluation of project implementation and effectiveness over time which conducted > 100 surveys of projects to date (Table 15) with the footprint illustrated in an accompanying map (Figure 33).

In 2022, the Program anticipates preparing four design products for implementation in 2023 and the implementation of one fish passage project and one habitat instream project with funding allocated through the program.

Table 14: Tucannon River sub-basin M&E matrix pre-paired in 2021 by the Programmatic in response to the ISRP's request.

What		Who	When		Where	Additional Comments
Name	**Description of Actions**		**Data Set Time Span**	**Annual Recurrence**	**Specific Location**	
Kelt Reconditioning and Reproductive Success Evaluation Research Project (2007-401-00)	Steelhead kelt reconditioning including: fish culture techniques, performance of reconditioned kelts including survival, abundance, distribution, and genetic diversity; homing fidelity; reproductive success; and physiological metrics.	Columbia River Inter-Tribal Fish Commission, Nez Perce Tribe		Kelt collection occurs from May-June. Fish that are collected are reconditioned at the Dworshak National Fish Hatchery for 6-18 months before released in October.	Steelhead Kelts are collected from the juvenile bypass screens located Lower Granite and Little Goose Dams. Reconditioned fish are released below Lower Granite Dam in Little Goose pool.	It has been noted that to date no Tucannon Kelt has been captured as part of this program. This is likely due to the fact that the capture sites are located above Little Goose Dam.
Tucannon River Steelhead Supplementation M&E (2010-050-00)	Evaluate performance new "endemic" hatchery stock, estimate escapement and spatial distribution of NOR and HOR steelhead from PIT tags and PIT arrays on the Tucannon River. Estimate "overshoot" and fallback of Tucannon origin steelhead (NOR and HOR). Maintenance/operation of PIT Tag arrays. Assist in adult trapping/broodstock spawning, monitoring in-hatchery and post-hatchery release timing and survival, and estimation of residual SSH. Includes tagging (CWT/PIT) of juvenile SH (NOR and HOR) for program evaluations.	WDFW	2010 – Present (early years of program (2000-2009) were funded under LSRCP	PIT tag queries and maintenance of PIT arrays occur throughout the year. SSH broodstock trapping / spawning occurs from March-May. Juvenile releases and outmigration timing and survival evaluation occurs from late-March through the summer. Residualism surveys will occur in late June/early July (post the normal SSH migration period). SSH HOR juveniles are tagged at Lyons Ferry in the fall (CWT) and spring (PIT) prior to release, and NOR SSH are tagged at the Tucannon smolt trap during trapping operations (see LSRCP).	Lyons Ferry Hatchery, Tucannon Fish Hatchery, specific sites in the Tucannon River at the PIT tag arrays, and spatially distributed sites for residua lism surveys, PIT tag data queries from PTAGIS/DART (See Map Figure 1).	Some of the M&E activities and/or hatchery production actions are linked directly with LSRCP funded activities.
Lower Snake River Compensation Plan (Direct Funding Agreement with BPA)	Hatchery Mitigation program for Lower Snake River Dams. Hatchery and natural production monitoring areas of SE Washington, including the Tucannon River. Releases of hatchery SSH and SPCH in Tucannon. Broodstock collection of SPCH and SH @ Tucannon FH, redd counts for SPCH, SH (historical-but partial coverage) and FCH, smolt trapping for all salmonids. Historical data (1985-2006) on natural juvenile production from E-Fishing/Snorkel surveys and habitat surveys.	WDFW	1983-present	Current Annual Activities: - Smolt Trapping (Oct-July, 24/7) - SPCH Broodstock Trapping, Redd counts, Juvenile releases - SH Broodstock Trapping, Juvenile releases - FCH Redd counts	Current Annual Activities: - Smolt Trapping (see map) - SPCH Broodstock Trapping (see map), Redd counts (entire basin), Juvenile releases (Tucannon FH/Curl Lake) - SH Broodstock Trapping (see map), Juvenile releases (Tucannon FH/Curl Lake, Marengo Bridge) FCH Redd counts (lower basin – generally from HWY12 Bridge downstream to mouth (See Map Figure 1).	Overlap with some SSH activities from BPA project 2010-050-00 (e.g. NOR SSH PIT tagging at smolt trap).
WDFW Fish Management	Bull Trout spawning ground surveys	WDFW	1994-2014	Multiple surveys conducted during September-October	Upper Tucannon River basin including tributaries (Sheep, Bear, Cold, Panjab, Meadow, Turkey, and Turkey Tail)	USFWS funding was pulled from the area for other areas of Washington.

What		Who	When		Where	Additional Comments
Name	**Description of Actions**		**Data Set Time Span**	**Annual Recurrence**	**Specific Location**	
WDFW Fish Management	Steelhead Creel Surveys	WDFW	1985-present	Annual Steelhead Season (Sept-April)	Tucannon FH downstream to mouth	All creel surveys in the Tucannon for steelhead prior to 2017 were conducted by Snake River Lab evaluation staff with a combination of LSRCP and WDFW Endorsement funds.
Life Cycle Monitoring	Determine survival of juveniles (SPCH and SSH) from early fall PIT tagging to subsequent out-migration as determined by in-stream PIT tag arrays (See Map Figure 1) and Snake River Dams (Lower Monumental)	WDFW	2013-2014, 2016-2017	Capture/PIT tagging of juvenile SPCH and STHD from Electro-fishing surveys in late September into October.	Throughout Tucannon River basin (mainstem) – Last two years capture data were directly linked to CHAMP habitat sites (See Map Figure 4) for CHaMP site distribution.	Natural SPCH and STHD were captured and tagged between ~RM 20 and 50 in 2013-2016.
Lower Snake River Steelhead VSP Monitoring (2002-053-00)	Fish-In/Fish-Out steelhead monitoring of Asotin Creek. Adult steelhead escapement monitoring and estimation in George, Tenmile, Alpowa, Penawawa, and Deadman. Status and trend monitoring	WDFW	2004-Present	Annual trap operations in Asotin, George, Tenmile, Alpowa. Annual smolt trapping occurs in two seasons on Asotin Creek; October-freeze, spring trapping begins as soon as conditions warrant and continue to late-May/June.	Monitoring occurs at the following location for Tucannon summer steelhead including the following; Deadman Creek, Penawawa Creek, Almota Creek, Alkali Flat Creek and Pataha Creek. The Asotin summer steelhead population is monitored at the following locations including; Asotin Creek Smolt Trap, Asotin Creek Adult Weir, George Creek Adult Weir, Tenmile Creek Adult Weir, Asotin Creek Smolt Trap, and Alpowa Creek Adult Weir (See Map Figure 1).	Project is moving toward PIT array monitoring in small streams downstream of LGD, and possible some of the streams considered part of the Asotin population. Adult trapping and smolt trap operations will continue on Asotin and George Creeks. Adult steelhead are trapped, sexed, counted, and implanted with Passive Integrated Transponder (PIT) tags as they migrate upstream to spawn
Asotin Intensively Monitored Watershed (IMW)	The IMW is working to determine the effectiveness of stream restoration at increasing the abundance of salmon and steelhead. The monitoring of physical and biological parameters in a pre/post habitat restoration context.	Eco Logical Research, Inc. is the project implementer supported by the SRSRB and the Regional Technical Team.	Pre-project monitoring 2008-2010. Restoration implementation and monitoring 2011-2015. Post restoration monitoring 2016-present.	Annual in basin juvenile monitoring occurs with summer seasonal PIT tagging within the restoration treatment reaches. Migration is captured on an annual basin continuously at PIT tag arrays located throughout the basin (see map 1).	The experimental design of the Asotin IMW study includes the lower 7.46 miles (12 kilometers) of Charley Creek, North Fork, and South Fork of Asotin Creek.	Juvenile steelhead are captured and PIT tagged during the summer and fall surveys in sections where restoration was completed (treatments) and sections with no restoration (controls).

What		Who	When		Where	Additional Comments
Name	**Description of Actions**		**Data Set Time Span**	**Annual Recurrence**	**Specific Location**	
CTUIR Lamprey (1994-026-00)	Supplement Pacific Lamprey in the Tucannon River basin, monitor success through larval electrofishing surveys, rotary trap operations (WDFW) and eDNA collection.	CTUIR	2020-present	Juvenile releases: May-June annually; Larval E-fishing: Aug-Sept annually, eDNA collection: May-July annually	<u>Electrofishing Locations</u> Site Name — UTM Coordinate TUC-01 — 11T 409708.00 m N, 5155563.00 m E TUC-02 — 11T 415627.00 m N, 5151173.00 m E TUC -03 — 11T 418384.00 m N, 5150729.00 m E TUC-04 — 11T 418989.00 m N, 5150596.00 m E TUC -05 — 11T 426265.00 m N, 5148793.00 m E TUC -06 — 11T 436982.00 m N, 5144821.00 m E TUC-07 — 11T 444317.00 m N, 5119202.00 m E TUC-08 — 11T 444350.00 m N, 5119281.00 m E TUC-09 — 11T 448088.00 m N, 5131170.00 m E <u>Juvenile Release Sites</u> Site Name — UTM Coordinate CTUIR-TUAP1 — 11T 448349.00 m E, 5130577.00 m N CTUIR-TUAP2 — 11T 449651.00 m E, 5126711.00 m N <u>eDNA Collection Locations</u> Targeted at 10m, 100m, 500m and 1000m downstream and 100m upstream of release sites	Electrofishing surveys occurred (Fall 2020) prior to juvenile lamprey releases (May-June 2021). Approx. 400k pro-larvae were released at the two releases sites combined.
CTUIR Biomonitoring (2009-014-00)	This Project has worked in coordination with the CHaMP project and now the AEM project and has been focused on the PA18 project implemented by CTUIR in 2017. This project is also part of the AEM project (2016-001-00) in monitoring the site at Hartsock.	CTUIR	2010 -present		PA18.1 (Hartsock) CBW0583-079743 (See Map Figure 1).	
CTUIR Mussel Project (2002-037-00)	Assess status and distribution of mussels in the Tucannon subbasin. Evaluate pre-construction restoration sites for salvage and relocation needs, and post-construction sites for future population restoration potential.	CTUIR	2010-present	One annually monitored site in Russell Springs Creek in June-July. Other sites monitored or surveyed as needed between April-September.	One long term monitoring site in Russell Springs Creek Several locations in the mainstem Tucannon R have been surveyed	Mussels are present in low numbers in many locations, associated with stable substrate and low/high flow refugia, in <3% gradient reaches. Mainly Western Pearlshell (Margaritifera falcata) but floater mussels (Anodonta spp.) and Western Ridged Mussel (Gonidea angulata) could be present in low numbers in mid to low elevation.
Action Effectiveness Monitoring (2016-001-00)	MBACI Floodplain monitoring at PA18.1 (Hartsock) and PA24. Habitat surveys consist of comparison between control and treatment for LWD, particle size distribution, pool tail fines. Biological data is collected using two person snorkel surveys during low summer flows. Fish numbers, sizes, species, and micro-habitat associations (e.g., slow or fast water, off-channel or side channel habitat, LWD or boulder association) are recorded and compared to control sites. Also recorded prior to snorkel survey, stream temperature, flow and visibility are measured.	Cramer Fish Science	PA24 2014, 15, 16 18 & 20. PA18.1 2016, 17, 18, 20 & 22	Sampling occurs two pre project yrs one as-built sample and +1, +3 & +5 yrs. Final year of sampling is scheduled in 2022 and would take place at PA18.1 only.	Monitoring occurs at the project site level for both project treatment site as well as control surveys. Project Area 24 CHaMP database treatment name CBW05583-170443 with its control located at CBW05583-276351. PA18.1 (Hartsock) CBW0583-079743 treatment with the control shared CBW0583-0276351 (See Map Figure 1) for locations.	Metrics Calculated include: 1. Bankfull width to depth ratio 2. Sinuosity 3. Pool-riffle ration 4. Slow water habitat (%) 5. Residual pol depth 6. Side Channel Ration 7. # of side-channel junctions 8. Habitat diversity index 9. RCI 10. Floodplain inundation index 11. Ration of floodplain area to main channel area 12. LWD volume 13. % fines 14. Substrate 15. Juvenile Fish Density

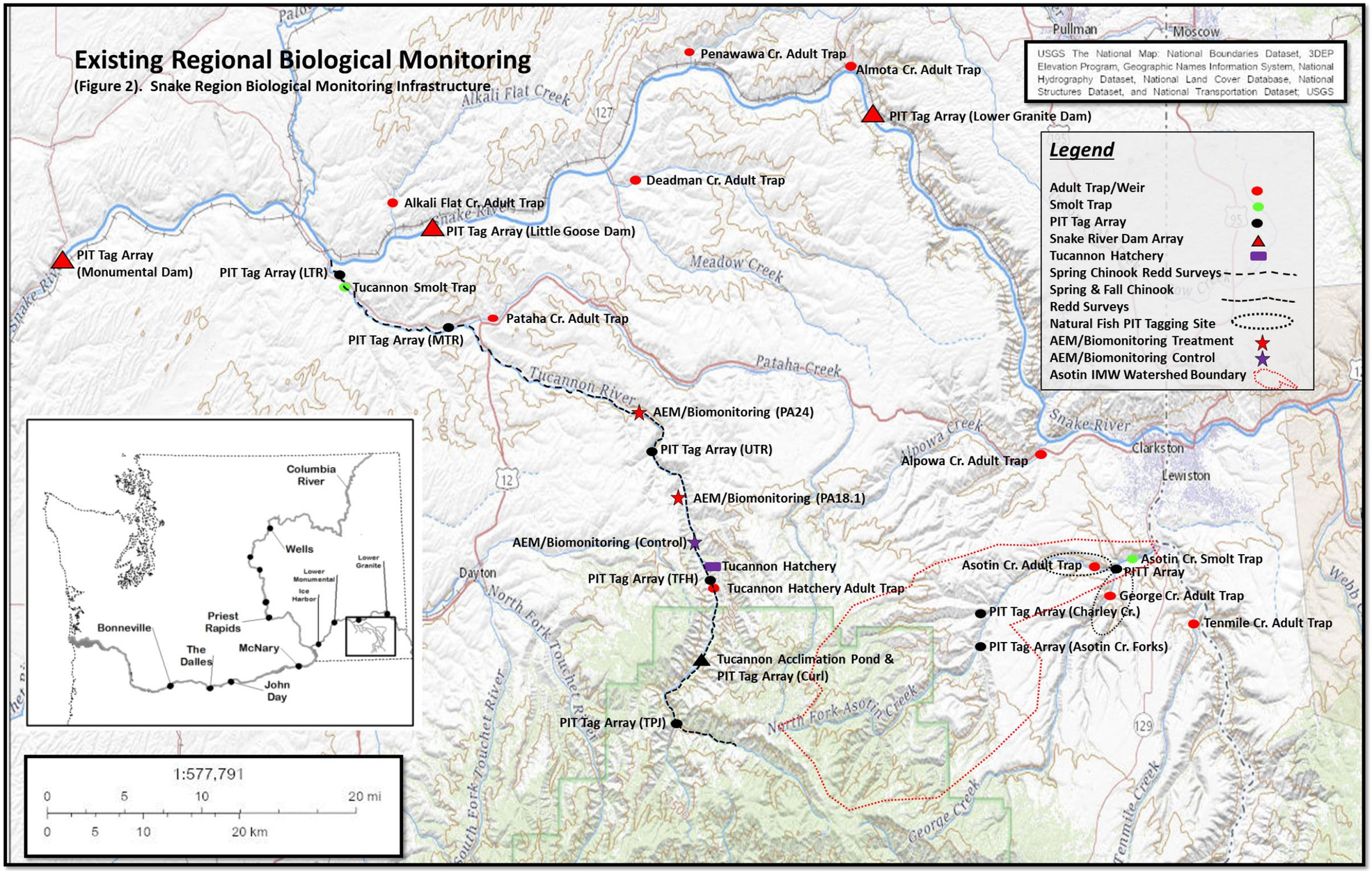


Figure 32: Lower Snake River tributaries biological monitoring infrastructure locations map.

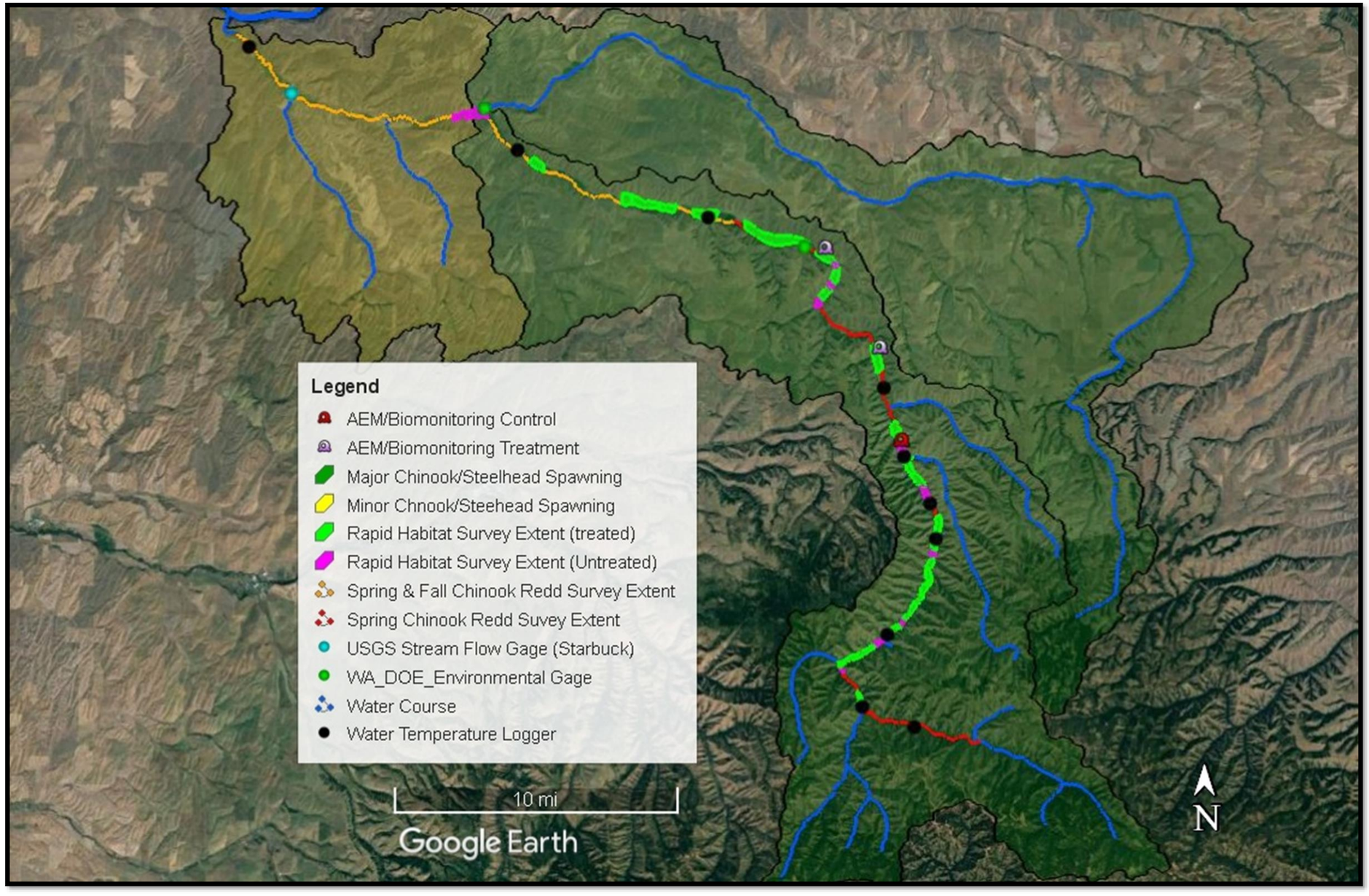


Figure 33: Distribution and coverage of rapid habitat surveys through 2021.

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