CTUIR GRANDE RONDE WATERSHED RESTORATION

LONGLEY MEADOWS FISH HABITAT ENHANCEMENT PROJECT COMPLETION REPORT

Report Prepared for:

Bonneville Power Administration-Grande Ronde Model Watershed
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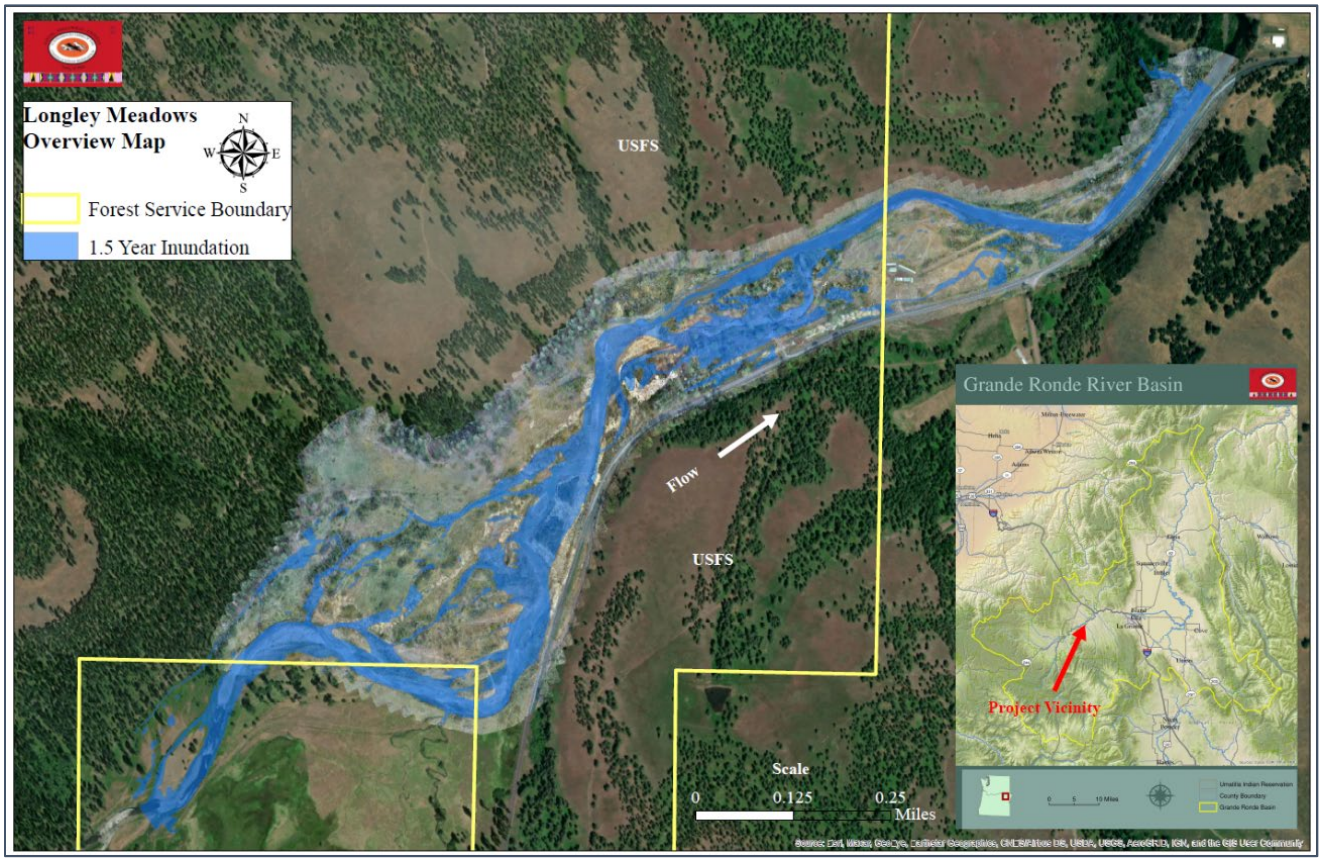
Introduction and Project Overview

From time immemorial, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) culture and traditions have been interconnected to natural resources. The CTUIR retains aboriginal and treaty-reserved rights for fishing, hunting, pasturing of livestock, and gathering plant food and medicine throughout its Aboriginal Use Areas. Traditional access and use of available resources continue to be threatened by land and water development, watershed degradation, and climate change.

The purpose of the Longley Meadows Project is to restore floodplain processes and fish habitat suitability and promote diversity, resiliency to address habitat limiting factors for all life stages of Snake River Spring Chinook salmon, summer steelhead, and native fishery resources. Key limiting factors include loss of historic floodplain function (attenuation of water and nutrients, riparian/wetlands, biodiversity), altered channel morphology and bedform dynamics, loss of historic pool and off-channel habitats, lack of complexity and diversity, poor riparian/wetland condition, and altered thermal regime with summer high temperatures exceeding conditions suitable for cold water fisheries.

Our Fisheries Habitat Program's hierarchical approach to restoration, project development, implementation, and monitoring is guided by the CTUIR Department of Natural Resources (DNR) "First Foods" Mission and Policy (Quaempts et al 2018). The Policy provides a framework for incorporating physical and ecological processes ("key touchstones") that are fundamental to restoring functional and dynamic watershed conditions that support water quality, natural resources, and First Foods integral for Tribal ceremonies and traditions (Umatilla River Vision, Jones et al. 2008; Upland Vision, Endress et al. 2019) (http://fisherieshabitat.ctuir.org/).

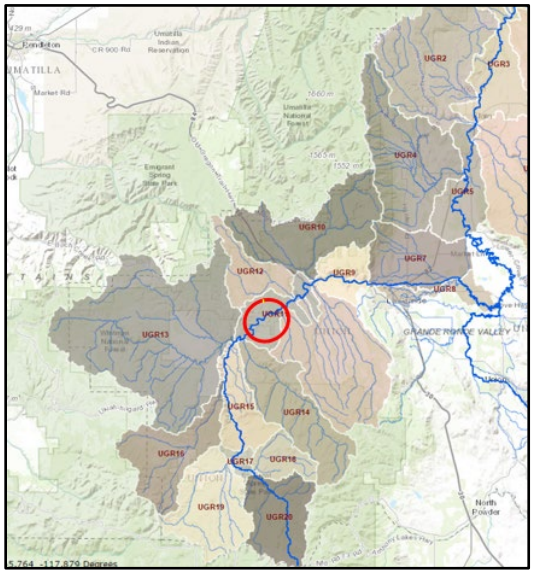
LONGLEY MEADOWS PROJECT VICINITY MAP



The CTUIR, in cooperation with Bureau of Reclamation (BOR), Wallowa-Whitman National Forest (WWNF) La Grande Ranger District, Grande Ronde Model Watershed (GRMW), and Bonneville Power Administration (BPA), partnered to plan, design, and implement the Longley Meadows Fish Habitat Enhancement Project. Funding for the Project included grants through the Grande Ronde Model Watershed (BPA funding) and Oregon Watershed Enhancement Board (OWEB) Focused Investment Program (FIP). Funding for planning, design, and construction administration was provided through CTUIR-BPA Accords and BOR Federal Columbia-Snake Recovery funds.

The Project was constructed in two phases with Phase 1 completed December, 2020 (approximately 30%) and Phase 2 completed December, 2021. The Project area encompasses about 1.5 miles of the Grande Ronde River between river miles (RM) 143.6 and RM 142.2, 10 miles SW of La Grande, Oregon on the WWNF. The Project is within the Upper Grande Ronde Atlas Biological Significant Reach (BSR) UGR11 *(below)*, an area that provides critical juvenile rearing habitat for spring Chinook salmon and summer steelhead and presents significant opportunity to increase habitat suitability and capacity.

UPPER RANDE RONDE BIOLOGICALLY SIGNIFICANT REACHES



Planning and Prioritization

Extensive habitat planning and prioritization in the Upper Grande Ronde (UGR) Subbasin guides basin partners in selecting and implementing habitat restoration, including *Grande Ronde Subbasin Plan* (Northwest Power and Conservation Council [NPCC] 2004), *Upper Grande Ronde River Tributary Assessment* (BOR 2014), and *Upper Grande Ronde River Atlas* (BPA 2015).

Longley Meadows is located in the highest ranked Tier 2 BSR with high geomorphic potential, poor to fair existing habitat conditions, and poor existing temperature rating. The project area, in its large, unconfined setting, provides significant opportunity for floodplain, channel morphology, riparian/wetland habitat, complexity, and potentially summer cold water and winter warm water refuge restoration for juvenile salmonid rearing, resident fish, lamprey, freshwater mussels and other native fish.

Existing Habitat Condition and Limiting Factors

Since the 1990s, restoring watershed processes has been widely accepted as the key to restoring watershed health and improving fish habitat (Roni et al. 2002). In the Upper Grande Ronde River Tributary Assessment (BOR 2014), four moderately confined to unconfined reaches were identified including the Bird Track Springs/Longley Reach. The reach was determined to be the only unconfined geomorphic reach (no bedrock confinement) with a high potential to improve the overall physical and ecological processes that support Endangered Species Act (ESA) listed species, including:

- Snake River spring/summer Chinook *(Oncorhynchus tshawytscha),* ESA listed as Threatened, January 5, 2006 and updated on April 14, 2014. (http://www.nwr.noaa.gov/publications/frn/2005/70fr37160.pdf)

- Snake River Basin steelhead *(Oncorhynchus mykiss),* ESA listed as Threatened, January 5, 2006 and updated on April 14, 2014. (http://www.nwr.noaa.gov/publications/frn/2006/71fr834.pdf)

- Columbia River bull trout *(Salvelinus confluentus)*, ESA listed as Threatened, June 10, 1998. (http://www.fws.gov/pacific/bulltrout/)

Two additional fish species are listed on the USFS Region 6 Regional Forester's Sensitive Species List:

- Redband trout *(Oncorhynchus mykiss gibbsi)* are present in the Upper Grande Ronde Subbasin and are listed as a sensitive species by the U.S. Fish and Wildlife Service, and NOAA Fisheries (NPCC 2004).

  Pacific lamprey *(Lampetra tridentate)* were reintroduced into the Grande Ronde River in 2014 and 2015 and have an unknown distribution. They are listed as a sensitive species by the U.S. Fish and Wildlife Service, and NOAA Fisheries (NPCC 2004).

Historic floodplain and stream channel alterations including systematic removal of beavers, channelization, logging and splash-dams, agriculture, railroad and road construction, livestock grazing, vegetation clearing, and placer mining have contributed to habitat degradation and loss of habitat suitability and capacity to support recovery of spring Chinook salmon, steelhead, and bull trout.

Sediment, water temperature, low stream flows, channel morphology, and large wood (habitat quality and quantity) are the most critical limiting factors for these salmonid populations.

The project site consists of a broad unconfined floodplain that has been disconnected as a result of legacy anthropogenic disturbances including splash damming, historic railroad and road construction, and channelization.

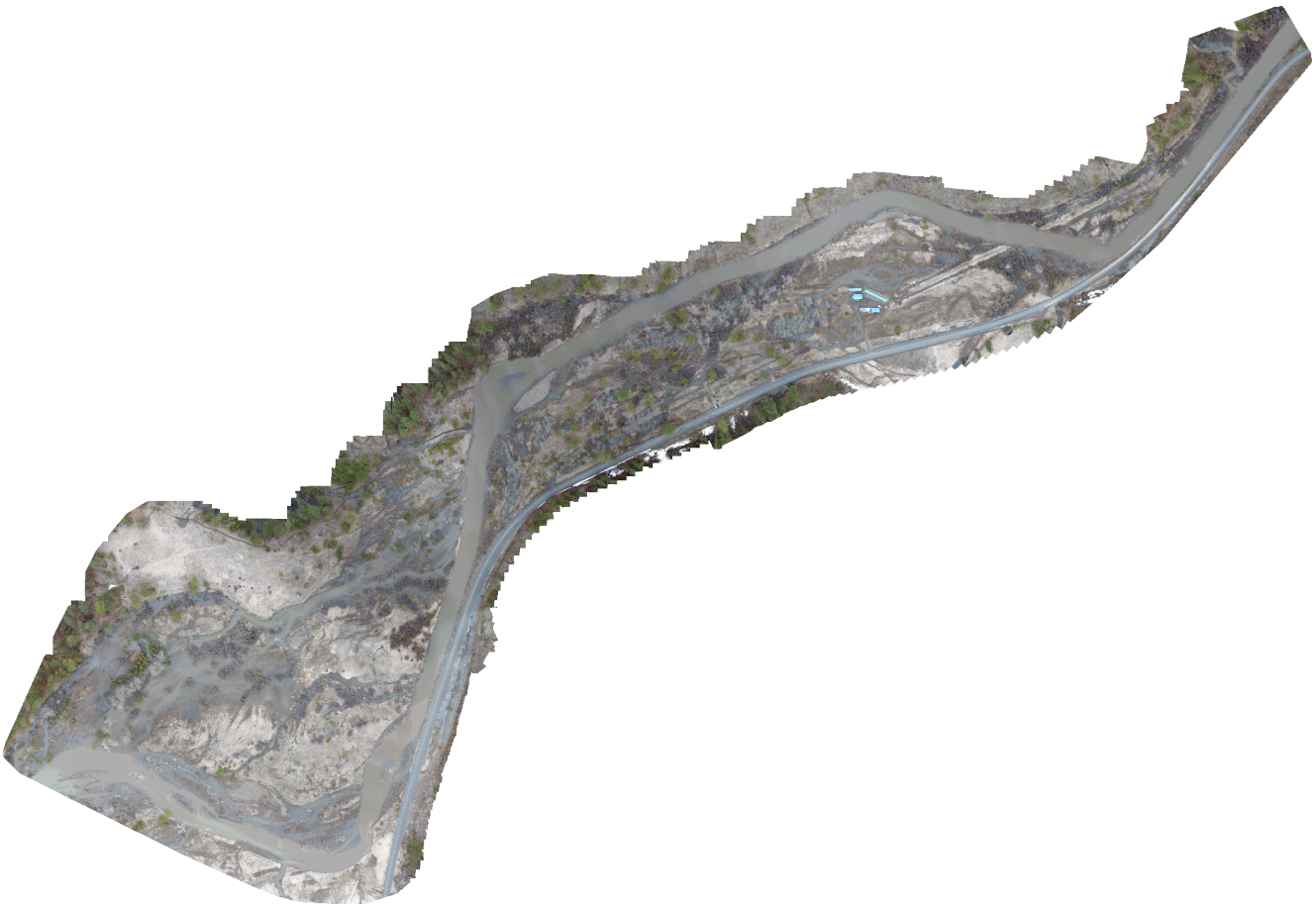
Existing condition includes a largely confined, mainstem Grande Ronde River that is over-widened, partially entrenched, and lacks diversity and complexity. Conditions include significant loss of historic large pool habitat and large wood, embedded and over-coarsened streambed lacking diversity, lack of sinuosity, and poor floodplain connectivity. The main channel fully engages the historic 35 acre floodplain during flows greater than a 2 year flow (~2,100 cfs).

Existing riparian vegetation condition includes patchy distribution of upland vegetation with riparian trees, shrubs, and wetland vegetation generally confined to streambanks and historic channel swales. Beaver are uncommon in the existing condition and play a limited role in forming and maintaining diverse habitat.

Large wood and debris play a significant role in habitat complexity, pool development, cover, contribution of detritus and nutrients, and macroinvertebrate production and are notably sparse in the existing condition, particularly large legacy wood. The most prevalent historical feature limiting floodplain engagement and habitat development are remnants of the Mount Emily Logging Company railroad grade. The grade has been breached and removed in several locations, but acts as a barrier to natural floodplain inundation within the reach.

Icing significantly affects habitat condition in the basin during winter low flows due to the wider, shallower channel geometry. Trees with ice scars have been identified within the Project area and provide an indication of longitudinal ice scour extent. These trees show height of scour occurring consistently above the 100-year water surface elevation. Surface ice accumulation can be significant during winter months, to the point of creating large ice dams. Salmonids overwintering in rivers such as the Grande Ronde are vulnerable to numerous threats to their survival as a result of highly variable environmental conditions due to fluctuations in water temperatures, discharge, and ice conditions (Brown et al. 2011).

PRE-PROJECT FLOODPLAIN CONDITIONS OF LONGLEY MEADOWS PROJECT REACH, APRIL 10, 2019



Anchor ice effects on salmonids include filling pools or other habitat and displacing fish, and creating high-velocity flow paths unsuitable for fish to maintain position (Brown et al. 2011). Research has shown that fish are forced to make larger numbers of movements when influenced by frazil or anchor ice, increasing demands on limited stores of energy in their bodies during the winter, and the probability of mortality (Brown et al. 2011). Studies have found that bull trout and cutthroat trout moved more often in streams affected by anchor ice than in streams with stationary ice cover (Jakober et al. 1998).

In addition, incubating embryos and alevins can experience direct mortality from frazil and anchor ice forms in streams and reduces water interchange between the stream and the redd (Bjornn and Reiser, 1991). Anchor ice normally forms in shallow water typical of spawning areas and may completely blanket the substrate. Ice dams may impede flow or even dewater spawning areas. When dams break, the water released can displace the streambed substrate and scour redds (Bjornn and Reiser, 1991). The formation of ice dams and their subsequent failure can also result in damage to stream banks and riparian vegetation.

PRE-PROJECT CONDITION DURING LARGE FLOOD EVENT ILLUSTRATING FLOODPLAIN POTENTIAL. PROJECT DESIGNED TO ACTIVATE FLOODPLAIN ON AN ANNUAL BASIS

Previous attempts at restoring this reach consisted of the placement of instream structures including rock weirs, rock barbs, and large wood buried in banks. These efforts have been marginally successful due in part to the scale of previous attempts, winter ice issues, and a lack of existing large streamside trees within the reach. Ice that forms tends to create jams, which then break and raft through the reach. Ice processes are naturally occurring, but have likely been exacerbated by loss of floodplain connectivity, lowered groundwater tables, and widening and shallowing of the channel. Furthermore, raft ice is currently confined within the channel, resulting in channel bed scour. Ice sorts channel bed materials, removing fine gravels and resulting in channel armoring.

Core habitat suitability limiting factors affecting juvenile summer and winter rearing, and adult holding and migration include: water quality (temperature), channel and bed form complexity (limited low velocity and large pool habitat), riparian conditions, large wood recruitment, and sediment. Restoration objectives for salmonids include increasing habitat complexity and diversity, improving water temperature conditions, improving riparian vegetation diversity, and reconnecting the floodplain.

The following table illustrates factors limiting productivity and recovery of native fishery resources. Limiting factors provide the framework to develop and prioritize goals and objectives through an iterative interdisciplinary design team process.

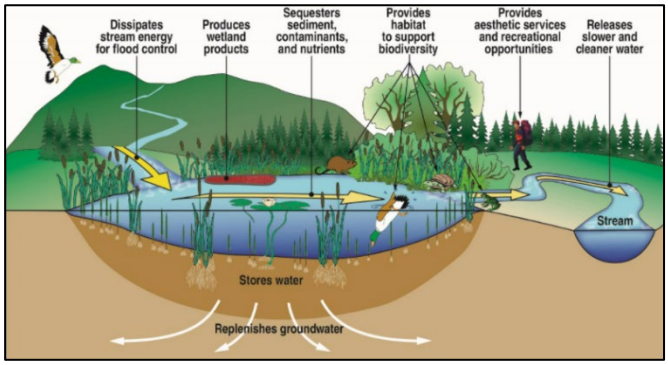
HABITAT LIMITING FACTORS

Description	Atlas H-M-L Scoring		
	Chinook	**Steelhead**	**Bull Trout**
Habitat Quantity: Anthropogenic Barrier	L	L	L
Riparian Condition: Riparian Condition	H	H	H
Riparian Condition: LWD Recruitment	H	H	H
Channel Structure and Form: Bed and Channel Form	H	H	H
Channel Structure and Form: Instream Structural Complexity	H	H	H
Sediment Condition: Increased Sediment Quantity	M	M	M
Water Quality: Temperature	H	H	H
Water Quantity: Decreased Water Quantity	L	L	L
Periperal and Transitional Habitats: Side Channel and Weltand Condtions	H	H	H
Periperal and Transitional Habitats: Floodplain Condition	H	H	H

Historically, the Longley Meadows Project area supported spawning and rearing habitat for salmon, steelhead, and other aquatic species, but the highly degraded pre-project condition provided limited habitat diversity and complexity, and exhibited severe thermal conditions. While summer juvenile salmonid rearing is currently limited due to habitat and thermal degradation, the Project can potentially function over time to provide summer rearing and important over-winter habitat for juvenile salmonids. This could be an important aspect of improving juvenile Chinook winter survival by restoring habitat that can hold fish higher in the watershed prior to migration through the Grande Ronde Valley where research indicates significant over-winter juvenile Chinook mortality. Additionally, the Project provides habitat for other native species including Pacific lamprey, native trout, and freshwater mussels.

Project Goals and Objectives

The long-term restoration vision (CTUIR's River Vision) for Longley Meadows is a dynamic, diverse, and interconnected floodplain and anastomosing channel-swale complexes supported by hydrological processes and functions. Dynamic floodplains and rivers form and maintain complex habitat, support riparian/wetland plant communities, and provide habitat capacity for all life stages of native fish and wildlife resources. In our vision, the Project reach is annually inundated during spring high flows with increased open-water habitat during summer base flow periods that support critical summer/winter parr and adult life history requirements. Connected floodplains are the foundation for supporting ecological processes and biodiversity with the ability to attenuate water, sediment and nutrients, dissipate energy, and promote food web and biological diversity (*below)*.



Interconnected floodplains and rivers attenuate floods, and decrease erosive damage to streambanks and infrastructure, filter surface water pollutants, recharge groundwater supply, and support healthy riparian and wetland plant communities. Increased annual floodplain inundation contributes to water storage, increased groundwater storage, and hyporheic processes that contributes to summer cold water refuge and increased base flow. Habitat uplift includes deep, complex pools, off channel habitat, wetlands, beaver complexes, and velocity refuge with an overall increase in habitat suitability and capacity for native fishery and wildlife resources.

Overall project goal is to restore watershed processes and fish habitat to address habitat limiting factors including a disconnected floodplain, altered channel morphology, loss of historic large pools, poor habitat complexity and diversity, lack of large wood, low stream flows, poor riparian-wetland conditions, and an altered thermal regime. Restoration objectives were developed to restore floodplain processes and habitat capacity to improve productivity of spring Chinook salmon, summer steelhead, bull trout, and resident native fish. Project-specific restoration objectives for the Longley Meadows reach include promoting instream structural diversity and complexity by reconnecting historic floodplain and side channel networks, promoting natural channel function and form, installation of large wood complexes that increase roughness, scour, sorting and storage of sediment, and development of riffle, pool, glide, side channel, and alcove habitats. Additional objectives included increasing beaver habitat suitability and recolonization to complement restoration activities and accelerate natural habitat forming processes that create floodplain wetlands, pools, and diverse riparian-wetland plant communities. Project actions included main and side channel construction, boulder placement, large wood additions, and floodplain plantings. Anticipated project responses include annual activation of island braid morphology, restoration of large pool habitat and morphological complexity, increased groundwater elevations and water storage, and riparian vegetation establishment.

Project background information, hydraulic/hydrologic analyses, project design, and design report can be viewed in the following link. *Longley Meadows*

Goals

1. Increase habitat diversity and complexity for salmonids;
2. Improve water temperature conditions for salmonids;
3. Improve riparian and floodplain vegetative diversity and health within the Project area;
4. Reconnect the Grande Ronde River with its floodplain and expand quality floodplain habitat availability for all salmonid life history requirements.

Objectives

The following objectives were derived using the Grande Ronde Atlas, specifically developed to address habitat limiting factors, and detailed interdisciplinary team planning and design.

Objective 1 – Floodplain Reconnection - Restore connectivity to promote hydrologic processes that develop and maintain complex and resilient habitats able to hydrate/store, attenuate floods, and buffer temperature. A functioning floodplain recognizes that the river is the floodplain. Connected floodplain ecosystems contain morphologic and hydraulic diversity supporting ecological processes that create and maintain diverse habitat and floral/faunal communities. Floodplain connectivity and diversity is the foundation for sustaining aquatic food-webs, improving thermal diversity through hyporheic exchange, and supporting development of suitable conditions to restore a keystone species, the American Beaver. Floodplain habitat includes peripheral and transitional habitat such a side channels, wetlands, and alcoves. The floodplain objective is to connect the historic floodplain as much as feasible. Based on hydraulic modeling, we expect floodplain connection uplift to increase by 67% from existing (from 15 to 35 acres).

Objective 2 - Channel Morphology Restoration - Enhance in-stream structural diversity and complexity by reconnecting historic floodplain and side channel networks, promoting natural channel function and form, increasing stream lengths and wetted habitat area, increasing large pools, and developing diverse assemblages of riffle, run, pool, glide, side channel, and alcove habitats. The intent of the project is to maximize and promote ephemeral and perennial side channels and improve instream channel diversity, changing the predominate plane-bed channel conditions associated with homogenous particle size retention to a pool-riffle channel with greater particle size diversity. Channel morphology

objective is to increase main channel sinuosity from 1.25 to 1.4, develop/enhance 12 mainstem complex pools per mile, develop 8+ side channel pools, and increase the river complexity index from 3.75 to 14.

Objective 3 – Instream Habitat Structure and Complexity - Increase instream habitat structure, complexity, and floodplain structural diversity through large wood complex additions that promote roughness, scour, sorting, and storage of sediment commensurate with reference condition wood loading. The instream complexity objective is to meet or exceed wood loading of 18 large pieces/100 meters (290 pieces/mile).

Objective 4 - Riparian Restoration and Management – Connect the floodplain to increase hydration and restoration of hydrophytic plant communities which support long term development of diverse and resilient native plant communities and seral stages. Healthy riparian and wetland vegetation supports structure and diversity, detritus and food web, wood recruitment, shade, and beaver habitat suitability (woody material for dam/lodge/winter food and herbaceous food sources). In conjunction with natural channel and floodplain objectives, a combination of riparian/wetland habitat protection, planting, seeding, and natural recruitment will result in increased tree, shrub, and herbaceous plant communities that are resilient and self-sustaining, contributing to shade, structure, terrestrial food web, streambank stability, and future large wood recruitment. Objective includes restoring approximately 35 acres of floodplain that supports riparian and wetland vegetation.

Objective 5 - Water Quality-Temperature - Increase diversity and function of hydrodynamics that decrease summer maximum water temperatures, increase winter water temperatures, and moderate and buffer diurnal water temperature fluctuations during both summer and winter rearing periods. Apply restoration techniques that maximize the interaction and function of hyporheic and groundwater exchange, increase channel sinuosity, and promote channel bed diversity, sediment retention and vertical gradients to create dynamic depositional features with increased and improved hyporheic connectivity, decrease solar input and temperature loading within the reach. At project completion, have no net increase in thermal loading in as-built base flow main channel wetted surface area through decreasing width/depth ratio during base flow condition. Provide long term decrease in base flow water surface exposed to solar radiation within project area through increased shading from native riparian plans**.**

LONGLEY MEADOWS FISH HABITAT ENHANCEMENT PROJECT METRICS

Metrics					
Floodplain reconnection (acreage inundated) (Existing/Restored)		Channel morphology (Existing/Post)		Instream habitat structure and complexity LWM: *key members	Riparian restoration (plants installed)
15 acres	35 acres	Main channel: 1 mi Side channel: NA # of pools: 2 Sinuosity: 1.25 RCI: 3.75	Main channel: 0.75 mi Side channel: 2 mi # of pools: 20 Sinuosity: 1.4 RCI: 14	616 pieces/mile	10,000

Project features included:

- Sections of main channel realignment and fill of existing main channel alignment;
- Construction of riffles that mimic natural features;
- Construction of gravel bar features;
- Construction of channel banks;
- Placement and compaction of native fill material;
- Construction and connection of side channels and floodplain swales;
- ELJs (e.g., meander jams, channel-spanning jams, apex jams, small wood placement acting similarly to beaver dams, channel margin jams, and deflector jams);
- Individual large wood habitat pieces (e.g., sweepers, floodplain roughness);

- Bioengineered bank treatments; and
- Creation and enhancement of alcoves and oxbows.

Project performance will be monitored over time in relation to project goals and objectives. Anticipated habitat uplift includes:

- Increasing habitat capacity (main channels, side channels, alcoves, wetted areas, etc.).
- Enhancing existing pools and creating new large pools (~%1000 increase).
- Increasing bedform diversity.
- Increasing habitat complexity (wood, bank roughness, overhead cover).
- Floodplain activation, active inundation, increased wetted habitat area at base flow and early winter periods.
- Creating velocity refuge and winter rearing habitat for juvenile salmonids.
- Creating deeper water habitat, cover, sediment diversity for adult salmonid holding/spawning.
- Restoring hydrological process that support wetland riparian vegetation.
- Improving thermal diversity (summer cold water, winter warm water).

Project Planning and Design

The Project was designed by an interdisciplinary team of engineers, fluvial geomorphologists, and fishery biologists representing the CTUIR, BOR, and USFS with Cardno and Anderson Perry Associates providing design and survey support under contract with the BOR. Project design included baseline data collection, geomorphic assessment, historic and existing conditions, development of digital topographic surfaces, hydrologic and hydraulic analyses and modeling, evaluation of fish habitat suitability models and criteria, development of project design criteria and integration of project goals and objectives, development of project feature design (channel grading, riffles, large wood, bank treatments), and development of project construction drawings and specifications.

Project engineering and design was led by the BOR Columbia-Snake-Salmon Recovery Office (CSRO) River Systems Restoration Program. The BOR and BPA contribute to the implementation of salmonid habitat improvement projects in the Grande Ronde Subbasin to help meet commitments contained in the 2008 Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) (National Oceanic and Atmospheric Administration [NOAA] Fisheries 2008) and the 2010 and 2014 Supplemental BiOps (NOAA Fisheries 2010, 2014). BOR's contributions to habitat improvement are all meant to be within the framework of the FCRPS RPA or related commitments and follow the requirements of the NOAA and U.S. Fish and Wildlife Service [USFWS] BiOp as outlined under BPA's Habitat Improvement Program III (HIP III, version 4.0).

This Project was designed utilizing a three-dimensional grading surface with the anticipated use of GPS equipment for construction. Project survey, layout, staking, construction, and inspection was performed using GPS equipment. The Project engineering team developed and provided all electronic files of alignments, surfaces, and other design elements in AutoCad Civil 3D 2019 file formats. Survey control was established throughout the Project area to support construction as well as baseline and future monitoring using drone imagery flights and development of ortho-imagery, typically provided by the GRMW.

Channel and Floodplain Morphology

Project planning and design was driven by objectives to restore floodplain and fluvial processes. The fundamental planform vision is a multi-threaded, island braided channel network interconnected to the historic floodplain.

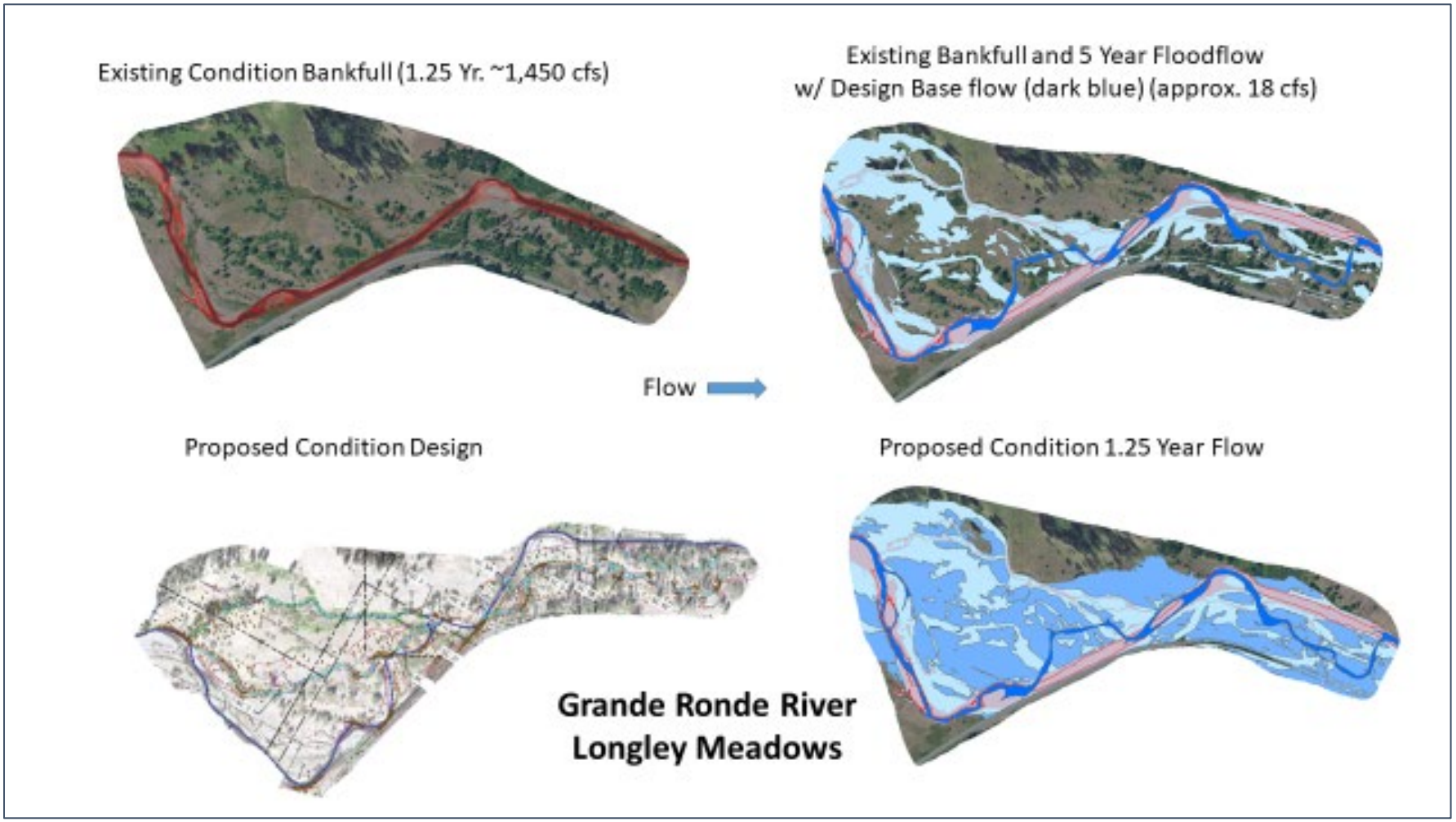
The project included constructed main and side channel and connecting existing channels. Channel planform and morpholgy design was guided by hydraulic modeling and river complexity index (RCI) which is a measure of diversity (channel junctures, connections and nodes).

Project design included realignment of channelized mainstem reaches to increase channel length, increase sinuosity, decrease slope, decrease width/depth ratio, increase large pool habitat and bedform diversity, and enhance habitat complexity using large wood material. Image above illustrates planform design and construction in the middle of the project reach.

The existing channelized mainstem Grande Ronde River segment in the project area located against Highway 244 was re-aligned to a meandering geometry to create and maintain large pools, decrease slope, and vertically adjust the reach to improve connection with the floodplain as illustrated in image to left. Two existing pools along the mainstem were excavated to increase pool length, depth and large wood complexity.

In the existing condition, much of the valley left historic floodplain would be active only during large flood events. Surface water typically disconnected from floodplain by late spring/early summer with lower reaches remaining perennial throughout the year. Picture to left illustrates middle segment of side channel 2 channel/wetland complex, reconnected by grading side channel entrances from the Grande Ronde River.

In combination with realignment of sections of the mainstem, a network of side channels, alcoves, off-channel rearing ponds, and remnant floodplain swales were connected by constructing upstream entrances from the mainstem Grande Ronde to River to increase frequency of activation and inundation during early winter and spring high flow periods.


Existing Condition Bankfull (1.25 Yr. ~1,450 cfs)
Existing Bankfull and 5 Year Floodflow
w/ Design Base flow (dark blue) (approx. 18 cfs)
Flow
Proposed Condition Design
Proposed Condition 1.25 Year Flow
Grande Ronde River
Longley Meadows

Constructed Riffles

Constructed riffles were incorporated into design to provide vertical stability, floodplain connection, and habitat diversity. Riffle construction included excavation of riffle footprints two feet below design grade, and import of a specified alluvial gravel mix consisting of fines, small gravel, and larger cobble in one foot compacted lifts. Each layer was washed using high pressure water pumps to distribute fines into the riffle matrix. Riffles were graded and contoured to design elevations followed by the installation of small to large boulders which were embedded >70% for structural stability. Constructed riffles were intended to be at least as stable as those found upstream of the Project to allow for dynamic adjustments while providing vertical stability. In general, constructed riffles crests will be stable for discharges at and below the 10-year return interval flood, and most riffle faces will be stable through the 2-year return interval. At discharges exceeding the 2-year peak, it is expected that channel substrate at riffle locations may adjust within the Project area similar to natural stream reaches in this setting. To determine the required gradation for the riffle matrix, the GeoHECRAS 2D modeling outputs for the 2 and 10-year shear stress were evaluated at each of the riffle locations. The maximum shear stress was recorded for each riffle for the evaluated design flows which was then used to determine the gradation required for the riffle matrix.

Wood Design – Large Wood Structures

LWM structures were designed and strategically placed to create habitat complexity, overhead cover, velocity refuge, and as hydraulic forcing agents to create and maintain pools, split flows, and/or to provide bank stability. The locations and structure types vary in size and complexity. Types of large wood structures include apex (mid-channel), meander bend, channel margin, floodplain roughness, and reinforced habitat structures, as well as sweeper logs and cover logs. Structures were designed to be overtopped by raft ice at key locations to promote sustainability and longevity. Pool structures were designed to encourage energy dissipation, abrupt forcing scour to maintain pool depths, and submergence of LWM during low flow conditions. Design of all wood structures attempted to mimic natural large wood accumulations using locally sourced large wood.

Streambank Bioengineering

Constructed sections of the mainstem and side channels were reinforced with woody bioengineering to provide bank stability and facilitate establishment of native riparian vegetation. Bank treatments incorporated native vegetation and large wood to mimic natural channel banks. They were designed to provide energy dissipation and erosion resistance to allow natural vegetation to become established for long-term riparian development, shading, large wood

recruitment, and to promote natural rates of channel migration. Placement was determined based on hydraulic modeling to ensure that those areas with high shear stress were treated appropriately.

Riparian and Floodplain Vegetation

Riparian and wetland vegetation in the project reach has been affected by channelization and associated altered hydrology. Riparian and wetland vegetation is generally limited to bands along stream channels and swales in a patchy distribution likely associated with availability of water. Ponderosa pine on higher terraces, and black hawthorn in association with wild rose and snowberry predominates in the historic floodplain indicating more xeric condition while cottonwood, willow, sedge/rush communities occupy narrow bands along streambanks and side channel swales.

Hydrology, lack of a natural disturbance regime and ungulate browse limit the distribution, diversity, and seral condition of riparian and wetland vegetation within the project area. A fundamental tenant of the restoration project is to restore hydrological processes that support natural recolonization of riparian and wetland vegetation.

To facilitate vegetation establishment in the near term, construction emphasized avoiding existing vegetation to the extent feasible, salvaging and replanting willows and sedge/rush mats, bioengineered streambanks as noted above, and seeding all disturbed areas with custom native seed mixes. See additional detail in environmental compliance section below. Additionally, the WWNF will implement a planting effort beginning in spring 2022 to install approximately 20,000 riparian trees and shrubs throughout the project area to further jumpstart vegetation establishment.

Project Construction

The CTUIR administered a construction subcontract with Steve Lindley Contracting, LLC for construction services, which included the following general work tasks.

1. Prepare the site for construction including placement, management, removal, and rehabilitation of erosion and sediment control measures, establishing and stabilizing access roads, temporary bridge crossing, and staging areas.
2. Salvage, stockpile, maintain and place herbaceous sod mats and riparian shrub clumps.
3. Excavate and grade main channel, side channels, alcoves, blind channels, floodplain, and floodplain ponds.
4. Install, manage, and remove cofferdams and temporary channel diversion structures, and manage water at multiple sites. Coordinate work area isolation, water management, and fish salvage operations with project sponsor.
5. Import and generate onsite, specified rock materials and screen/sort/stockpile/haul for constructing riffles, glides, and point bars.
6. Import, sort, stockpile and haul specified large wood materials.
7. Install large wood habitat structures.
8. Construct riffle, glide, and point bar features.
9. Install brush bank (live cuttings supplied by Contracting Agency).
10. Restore areas disturbed by construction activities in preparation for revegetation.
11. Furnish, stage, and place straw mulch onsite.
12. Seed disturbed areas outside proposed channel (seed provided by Contracting Agency).

Project construction was initiated in September, 2020 and completed in December, 2021. Project accomplishments include the construction of approximately 2,850 feet of main channel containing 20 large pools, 7,250 feet of side channels, and 525 feet of alcove habitat resulting in the reconnection of 35 acres of historic floodplain. The Project was constructed with GPS controlled equipment using digital design.

Approximately 138 large wood structures and 299 floodplain wood structures were installed, with placement of 280 cover logs and 63 whole trees.

Other constructed floodplain roughness features include the installation of 270 feet of live floodplain fence and 3,150 feet of live brush trenches. Approximately 4,400 feet of bioengineered bank treatments were installed along the main channel and side channels. A total of 7,500 willow cuttings were harvested throughout the Project over the two-year timespan for installation into large wood structures, bank treatments, and floodplain roughness elements.

Project earthwork resulted in the excavation of approximately 42,050 cubic yards of cut/fill material and the sorting and screening of 17,000 cubic yards of excavated material. Approximately 30 riffles were constructed using approximately 10,500 cubic yards of mined and sorted riverbed cobble and included the installation of 305 boulders. One blind channel was constructed that will allow main channel surface water to trickle underground and feed an off-channel wetland swale network.

The following table illustrates summary of project element descriptions and quantities included in the construction subcontract.

PROJECT WORK ELEMENTS AND QUANTITIES

Item	Description	Quantity	Unit
1	Mobilization and Demobilization	1	Lump Sum
2	Temporary Traffic Control	1	Lump Sum
3	Environmental Controls (SWPPP, ESC, Etc.)	1	Lump Sum
4	Temporary Access Routes and Staging	1	Lump Sum
5	Work Area Isolation, Channel Diversion, and Water Management	1	Lump Sum
6	Construction Surveying	1	Lump Sum
7	Provide Temporary Channel Crossings	1	Lump Sum
8	Transport Channel Materials Bird Track Springs	1	Lump Sum
9	General Site Clearing	13	AC
10	Sod Salvage, Store, Maintain, and Place	5080	SQYD
11	Salvage, Maintain, and Transplant Riparian Clumps	385	SQYD
12	Earthwork - Excavate, Haul, Segregate, Store, and Place	42050	CY
13	Channel Materials Mining/Replacement	1000	CY
14	Channel Materials Screening	17000	CY
15	Furnish Large Cobble	865	CY
16	Constructed Riffles Class 1	5815	CY
17	Constructed Riffles Class 2	4670	CY
18	Constructed Point Bars	5291	CY
19	Constructed Glides	900	CY
20	Furnish Boulders	390	Each
21	Boulder Placement	695	Each
22	Blind Channel	115	LF

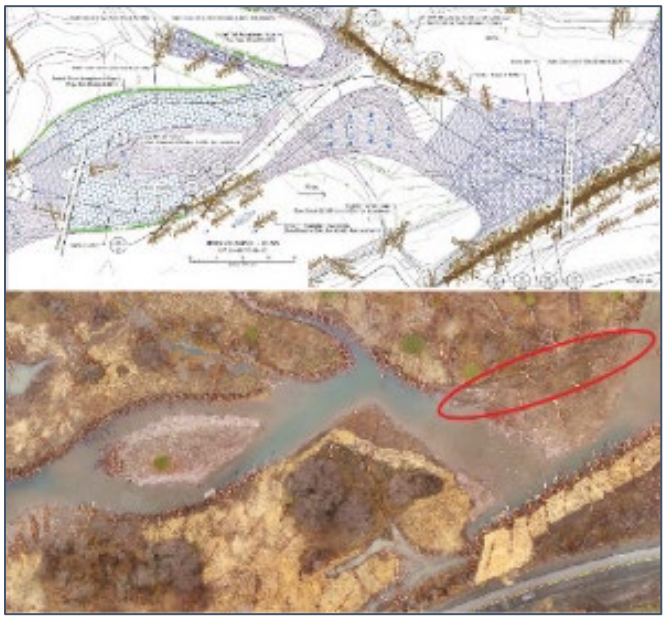
Item	Description	Quantity	Unit
23	Type A - Apex Jam Small	11	Each
24	Type B - Meander Jam - Mallet Jam	9	Each
25	Type C3 - 3 Log Angled Channel Margin Jam	13	Each
26	Type C6 - 6 Log Angled Channel Margin Jam	17	Each
27	Type C9 - 9 Log Angled Channel Margin Jam	16	Each
28	Type C12 - 12 Log Angled Channel Margin Jam	15	Each
29	Type D - Single Log Sweeper Jam	55	Each
30	Type E - Cover Logs	56	Each
31	Type F - Floodplain Roughness	299	Each
32	Type G - Reinforced Habitat Structure	2	Each
33	Short Roughened Edge Bank Treatment	3600	LF
34	Tall Roughened Edge Bank Treatment	800	LF
35	Flood Fence	270	LF
36	Live Brush Trench	3150	LF
37	Large Full Tree	55	Each
38	Large w/ RW	126	Each
39	Medium w/ RW	251	Each
40	Medium w/o RW	184	Each
41	Small Tree w/ RW	520	Each
42	Small Tree w/o RW	2634	Each
43	Tree Top	598	Each
44	Slash	6695	CY
45	Apply Seed to Disturbed Areas Outside of Channel Bank Limits	16	AC
46	Furnish and Place Straw Mulch	16	AC
47	Medium Track Hoe (i.e. CAT 330 or similar)	80	Hours
48	Small Track Hoe (i.e. CAT 318 or similar)	80	Hours
49	Off-Road Dump Truck (i.e. CAT 735 or similar)	60	Hours
50	Dozer (i.e. CAT D6 or similar)	60	Hours

Design Modifications and Field Adjustments

The project was largely implemented as designed and no changes orders were required with the construction subcontractor. Minor field adjustments included adjusting bank lines to minimize impact to existing vegetation, adjusting locations and quantities of permanent fill to capitalize on opportunities to increase floodplain connection and/or of channel habitat, and taking advantage of using bypass channels as off channel habitat in lieu of filling as designed.

Generation of onsite gravel meeting specifications for riffle gradation was problematic as anticipated from the geo-technical samples collected during project planning and design. Anticipating there could be issues, based on data from onsite sampling and experience with a similar issue on the upstream Bird Track Springs Project, the project team intentionally incorporated contingency in the construction budget for riffle gravel import to augment material mined onsite from suitable locations.

Examples of field changes are presented in the following. To right, main channel reclamation grading was adjusted in specific locations to increase off-channel alcove habitat (shown in red) and to minimize impacts to existing riparian vegetation while maintaining deep and complex off channel habitat with existing vegetation providing shade and bank structure.



Bypass channel between Sta. MC 41+00 downstream to entrance of MC-B. Before reclaiming this particular bypass channel the decision was made to establish the fill elevation slightly lower than original design. The reasoning was to increase channel capacity at high flows, resulting in lower velocities and sheer stress at the entrance to Side Channel (SC) 5 directly across channel from the adjusted bypass reclamation.

Above image illustrates the side channel in red polygon that had previously been used as a temporary bypass channel during construction. Bypass was channel was filled with compacted fill, graded, and completed with large roughness to provide velocity refuge and cover for juvenile fish fishing.

In addition to expanding channel capacity adjacent to the entrance to side channel 5 to relieve velocities and sheer stress at high flows, a bleeder log jam, spanning approximately 80 feet from the entrance to the side channel was installed to limit the risk of high water and potential ice flow from capturing the entire mainstem Grande Ronde River. The bleeder jam is illustrated in the image to the right, circled in red. Large logs were installed into both right and left banks of SC5 and spanned to the opposite bank in a crisscross configuration. The purpose of this adjustment from the original design was to reinforce SC5 and control high flow into side channel 5, helping decrease potential that more MC flows would be captured than intended during high water events.

Environmental Compliance and Permitting

Best management practices (BMP's) regarding erosion, turbidity, and impacts to water and natural resources were employed throughout the duration of project construction, and post construction stabilization measures were employed as required to facilitate riparian and wetland vegetation establishment. Additional details are provided in the following sections.

Work Area Isolation

Prior to in-water work activities, construction contractor was required to isolate work areas in preparation for removal of fish. Water that was pumped by the contractor was either free of fish to begin with or de-fished before pumping (see fish salvage data below). During uncommon occasions when water was pumped from fish-bearing areas the contractor was equipped with a fish screen consisting of mesh openings not exceeding 3/32 inch.

WORK AREA ISOLATION AND FISH SALVAGE

Fish Salvage Overview 2020 – 2021 (Year 1 & 2)

Year 1 fish salvage efforts began on October 20, 2020 and concluded on November 3, 2020. A total of two bypass channels were constructed in conjunction with placed sandbags in order to isolate Year 1 work areas within the main channel Grande Ronde River.

Bypass 1, located in the upper-most reach of the Project area was excavated through an existing point bar on river right from approximately MC Sta. 1 + 00 downstream to Sta. 7 + 00. Main stem flows were directed into the bypass channel which allowed the fish salvage crew (CTUIR) to begin relocating fish from the isolated section of main channel. The salvage crew made several initial passes using seine nets to coax the majority of fish out of the isolated unit before using electro-fishing methods to capture the remaining fish and relocating them to areas outside project disturbance.

Upon completion of in-stream work elements within the upper reach bypass flows were redirected back into the main channel alignment.
A summary of the catch from this main channel reach and Bypass 1 is below:

- (4) age-1, (1) age-2 *O.mykiss* and (1) age-0 Chinook were captured
- (30) Pacific lamprey ammocoetes
- The majority of the biomass salvaged (903 fish) was a healthy assemblage of freshwater cyprinids (dace, sculpin, shiner and suckers)

Bypass 2 was constructed with similar methods and intentions as Bypass 1, and was located downstream of the confluence with Jordan Creek from approximately MC Sta. 19+75 to 22+25. Main stem flows were directed into Bypass 2 to allow salvage crews to begin removing fish from the main channel isolation area. Sein nets and electro-fisher techniques were utilized to remove fish from the work area isolation and then relocate them outside project area disturbance.

Bypass 2 was similarly de-fished and decommissioned upon conclusion of Year 1 construction activities in this reach. The following is a summary of the catch from the main channel reach below Jordan Creek confluence and Bypass 2:

- (4) age-0, (13) age-1, (3) age-2, (7) age-3 *O.mykiss* were captured
- (289) Pacific lamprey ammocoetes
- The majority of the biomass salvaged (12,254 fish) were red-sided shiners, with a variety of other freshwater cyprinids (dace, sculpin, sucker).

Two smaller work area isolation units were established using placed sand bags surrounding the entrances to Side Channels 5 and 6. Salvage crew successfully removed a total of (17) non-salmonid fish from these two sites in preparation for in-stream construction activities.

Year 2 fish salvage efforts were accomplished by project partner staff from CTUIR, BOR, GRMW, Oregon Dept. of Fish and Wildlife (ODFW), and USWCD. Phase 2 Salvage activities began on July 6, 2021 and concluded on September 14, 2021. A total of three bypass channels were constructed in conjunction with placed sand bags to divert water away from Year 2 project construction areas which occurred primarily along the approximately 400 meter long reach of the main channel adjacent to the highway between MC Sta. 23+00 and 47+00. Salvage efforts followed the construction sequencing plan which generally moved from upstream to downstream sites.

Fish salvage efforts were made whenever a section of live water was to be diverted away from construction sites, or after work site isolation when bypass channels were to be reclaimed and live water

turned back into the main channel. The following is a summary of the catch from primarily main channel and bypass reaches between MC Sta. 23+00 and 47+00:

- (39) age-0, (15) age-1, (8) age-2, (1) age-3 *O.mykiss* were captured.
- (8) age-0 chinook were captured.
- (345) Pacific lamprey ammocoetes.

The majority of the biomass salvaged from Year 2 project areas was a mix of red-sided shiners, dace, sculpin, suckers, pike minnow, and freshwater mussels. Several non-native bluegill and catfish were observed during salvage efforts.

Riparian and Wetland Vegetation

Protection of existing riparian and wetland vegetation during construction was emphasized to minimize the disturbance footprint and to protect plant communities and seed sources important to future natural recolonization. Special provisions in the construction contract specifications included salvage and transplant of riparian shrub and native herbaceous sedges and rushes. BMP's included adjusting access routes and disturbance zones to protect and/or minimize disturbance to existing native vegetation, and carefully grubbing and either appropriately stockpiling salvaged plant material in shaded or wet areas for future transplant, or re-installation of grubbed material along available completed channel or floodplain grading segments. Willow and shrubs located within construction zones were excavated whole and temporarily stored in water or planted in an excavated hole and back-filled in strategic locations to optimize survival. Sedge/rush mats/sod were typically grubbed by dozer and stockpiled for future use as a top dressing along completed floodplain/channel segments. Additionally, a special provision for removal and stockpiling of topsoil was made to separate soil from coarser gravels and later used to top dress final grading zones in preparation for installation of sedge/rush mats and seeding/mulching operations.

Following completion of each construction phase, all disturbed areas were treated with native grass seed and covered with straw mulch. Cleared native vegetation, including sedge mats and willow clumps were salvaged and replanted, or used in the construction of wood structures. Native grass seed was distributed over approximately 10 acres of disturbed ground. Straw mulch was used on seeded and planted areas to retain moisture for better grass seed establishment and to suppress competitive weeds.

In spring 2022, the USFS will implement a revegetation plan to plant all areas of ground disturbance (approximately 20 acres). Species planted will consist of native conifer and deciduous seedlings. There will be a total of 25,000 seedlings planted in the Project area.

Planting will occur on all disturbed areas within the project. There will be 10,000 deciduous gallon potted seedlings, 10,000 conifer plug seedlings and 5,000 deciduous plug seedlings planted within these areas.

All species planted will be native. Species planted will consist of willow (misc. species) (6,000), cottonwood (3,000), aspen (1,000), alder (1,000), hawthorn (1,000), red osier dogwood (1,000), golden current (500), serviceberry (1,000), choke cherry (500) and ponderosa pine (10,000).

The gallon potted seedlings will have the holes predrilled with augers. The gallon-potted seedlings will be planted by contract crews, and plugs will be hand planted by USFS crews. Seedlings will be planted at appropriate locations within the project. Species that require wetter or drier conditions will be planted according to the plant's ecological needs and water availability.

Upland areas, access roads, and disturbed areas will be planted with locally-adapted grass species which include Idaho fescue, bluebunch wheatgrass, basin wildrye, and tufted hairgrass. Swale complexes and side channels will be planted with sedges which include Nebraska sedge and Beaked sedge. Areas within swale and channel excavation limits were grubbed to salvage sedge mats and quality topsoil for use during planting activities.

With restored floodplain activation, increased groundwater elevations, and sediment sorting and routing expected from the project, native hydric plant communities are expected to flourish over time, supporting floodplain and channel resilience, future shade, food web processes, and beaver recolonization.

Department of State Lands (DSL)/ Corps of Engineers (COE) Joint Permit

Removal/Fill permit issued for construction period ending in July 2022 authorized 30,450 cubic yards of removal and 16,645 cubic yards of fill within the project area. CTUIR fish biologists worked closely with project construction contractor to ensure compliance with DSL/COE permit terms, including work area isolation (*right*), storm water management, turbidity, erosion control methods, operation of equipment in and around water, fuel and chemical spill prevention, maintaining fish passage, and restoring temporary ground disturbances.

Oregon Department of Environmental Quality (ODEQ)

In addition to maintaining compliance with DSL/COE Removal/Fill permit, project contractor was issued Oregon's 1200-C permit pertaining to the management of storm water runoff before access road and staging area clearing could begin. BMP'S were implemented during project construction to comply with permit requirements as noted above. Special provisions in the ODEQ permit required additional measures to minimize disturbance and stabilize disturbed areas through seeding and mulching, installation of sediment control measures, and management of turbidity within and downstream of the project.

It was the responsibility of the Contractor to implement and comply with all permit requirements associated with fish salvage, water management, water quality, and turbidity mitigation. Contractor was responsible for constructing, maintaining, monitoring, and adaptively managing water and turbidity during project construction including installing temporary diversions, work area isolations, pumping and managing water, and installing and maintaining sediment control measures necessary to implement the

project. Silt curtains, eco-blocks, block nets, and other appropriate methods (e.g. coffer dam, sand bags) were installed as needed to isolate the work area from the main water body. All de-watering activities were completed in cooperation with the CTUIR fish salvage operations and were carried out in a manner that minimized impacts to ESA listed fish species.

Heritage Resources and State Historic Preservation Office (SHPO) - Section 106
Prior to initiation of construction, CTUIR and BPA staff developed a detailed plan to protect and avoid sensitive heritage resources consistent with Section 106 permitting requirements. Pre-construction activities included mandatory training for all construction personnel which was provided by BPA and CTUIR archeologists.

Pre-construction and onsite training included a review of the permitting process, identification of sensitive areas requiring avoidance, and procedures and requirements for implementing an inadvertent discovery plan. Prior to initiation of construction activities, avoidance area boundaries were delineated in the field using survey stakes and flagging which were maintained by CTUIR and contractor staff during project construction. CTUIR and contractor staff also scheduled and maintained regular communication with CTUIR and BPA cultural resource staff to schedule cultural observers as required and to provide updates on project construction status. CTUIR cultural staff provided the majority of onsite observation with BPA and BOR cultural staff providing oversight, partner coordination, and monitoring for permit compliance.

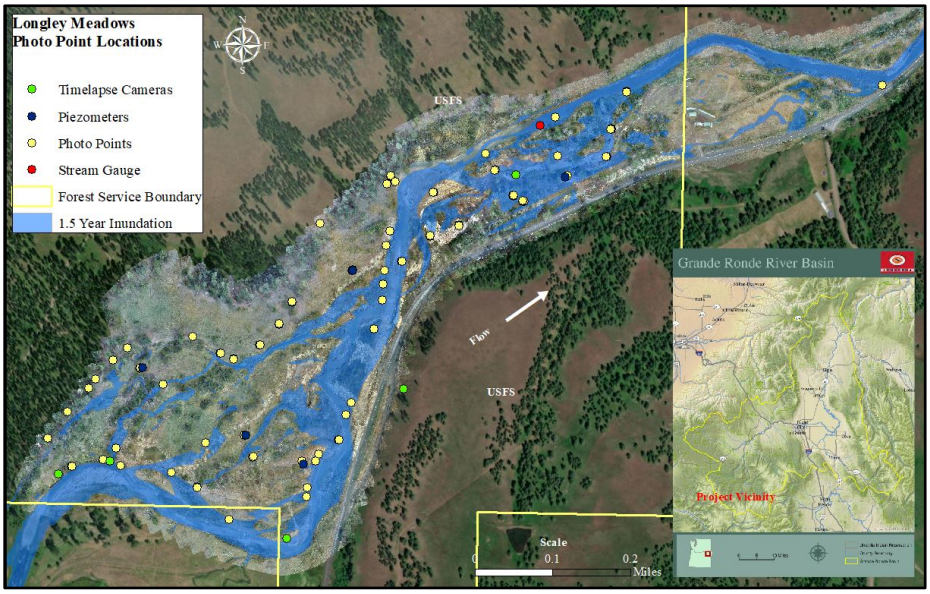
Despite efforts to educate construction crews and staff on the complexities associated with the project area, several unfortunate events occurred during construction which were inconsistent with permit requirements, and should have been avoided. Lessons learned are discussed later in this report.

In-Water Work Period
The designated ODFW in-water work window for the project reach is July 1 to October 15. Year 1 construction was delayed due to the Covid-19 pandemic. A request was issued to extend the in-water work window so Year 1 construction activities could continue and be completed as planned, while ensuring final Year 2 project activities would be completed by November, 2021. Year 1 instream work was completed by November 15, 2020 and included installation of two temporary bypass channels, de-watering, fish salvage, installing large wood structures at Stations 5+00 and 20+00 along the mainstem Grande Ronde River, and temporary bridge removal.

Due to project complexities associated with managing bypass channels along the mainstem Grande Ronde River and unanticipated challenges associated with onsite mining for suitable riffle material, Year 2 work also required an extension of the in-water work window until mid-November, 2022. With the support of the ODFW District Fish Biologist and Oregon DSL staff, the project was successfully completed with minimal impacts to fishery resources and water quality.

Project Monitoring and Evaluation

An intensive monitoring and evaluation effort is underway on the adjacent Bird Track Springs Project and will expand to include the downstream Longley Meadows Project area to evaluate physical and biological response to large scale floodplain and riverine habitat restoration (*below*). Aspects of the monitoring plan include remote sensing of geomorphic and vegetation response using UAVs (geo-rectified ortho-mosaic imagery and video fly-through), flow measurements, groundwater elevations, groundwater and surface water temperature, cross sections, development/restoration of hyporheic response, and biological monitoring (spawning and juvenile snorkel surveys during summer and fall/winter periods). Additionally, a study developed by the University of Idaho is underway to monitor and evaluate hyporheic cold water floodplain/channel connectivity throughout the Bird Track Springs and Longley Meadows Project areas.



Fish response to habitat actions for the Longley Meadows Project are monitored by the CTUIR Grande Ronde RM&E Project (#2009-014-00). Biological objectives related to Grande Ronde Watershed habitat projects were developed to assess the biological response to habitat actions. Physical habitat objectives were developed based on fish life histories, limiting factors and actions.

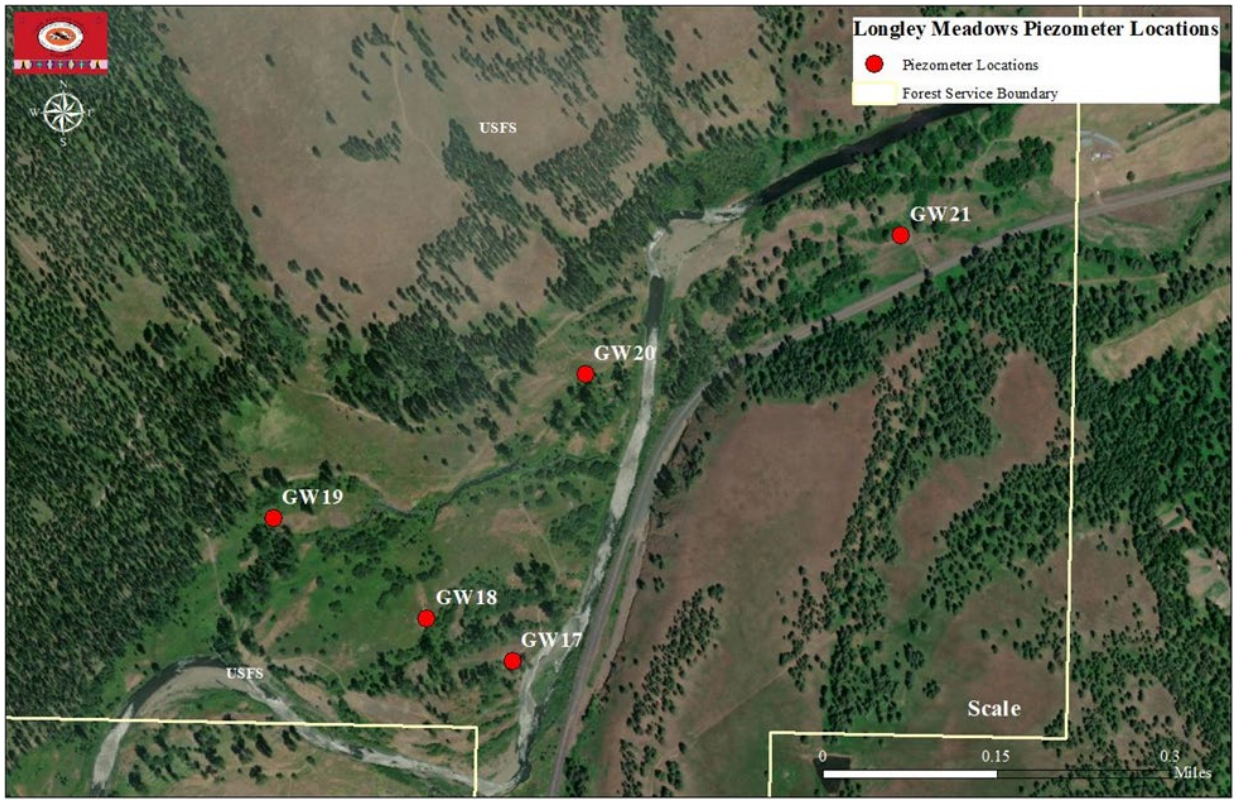
BIOLOGICAL OBJECTIVES AIM TO ASSESS RESTORATION PROJECT EFFECTIVENESS

Biological Objectives	Measureable Criteria	Monitoring Technique	Effectiveness/Statistical Criteria	Notes
1. Salmon/steelhead abundance	• Adult abundance by species • Juvenile abundance	• Electrofishing (**see notes**) • Snorkel Surveys • Minnow traps	• t-test for pre vs. post project mean, alpha = 0.05 • 25% Increase over baseline with data	• Adult abundance monitoring contingent on permit
2. Salmon/steelhead productivity	• Pre-spawn survival • Trib survival of seasonal parr • Smolt-to-adult return (SAR)	• Adult weir (**see notes**)	• t-test for pre vs. post project mean, alpha = 0.05 • 25% Increase over baseline with data	• Only implemented on Lookingglass Creek • ODFW collects adult data within Grande Ronde basin.
3. Holding/spawning/ incubation/emergence	• Redd density by species (**see notes**) • Spatial arrangement of redds	• Spawning surveys (**see notes**)	• t-test for pre vs. post project mean, alpha = 0.05 • 25% Increase over baseline with data	• Gallagher et al. 2007

Standardized snorkel surveys are conducted annually in July and September to quantify salmonid abundance and distribution on the Longley Meadows Project. Recorded habitat metrics include channel type (main channel or side channel), habitat type, mean depth, maximum depth, length, ambient temperature, and coldest temperature.

Groundwater Monitoring

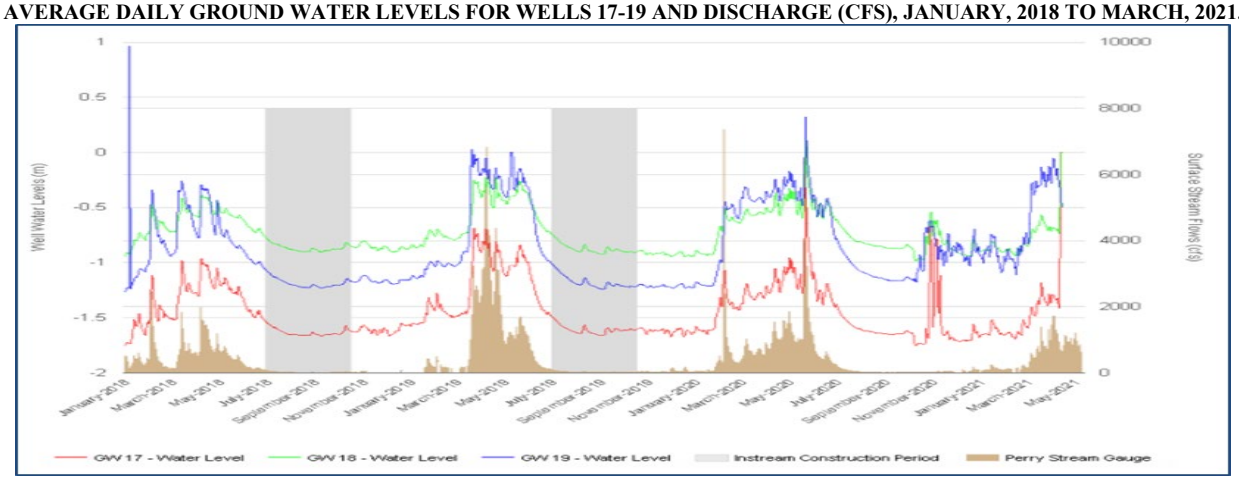
Groundwater wells (piezometers) were installed on Forest Service and private property in November 2017 in the Bird Track Springs and Longley Meadows Project areas, following direction from BOR geologists. The objective was to install permanent, small-diameter groundwater monitoring wells that can be used to conduct hydrologic analysis, and record temperature measurements of groundwater and hyporheic exchange. A total of 10 piezometers were installed within the Bird Track Springs Project area and 5 were installed within the Longley Meadows Project area (*below*).



Understanding groundwater data is complicated by variables including geology and hydrology, and often monitoring wells may be inadequate in number or location. However, groundwater wells can provide measurable outcomes for how stream restoration projects influence groundwater elevation and temperature. Increasing the amplitude and duration of cold water elevations and the subsequent buffering of surface water temperatures through hyporheic flow is a desired outcome for fish habitat restoration activities.

Combined with monitoring surface water elevation (*below*), discharge and stream temperatures, we may be able to gather a more complete picture of how stream restoration techniques can influence thermal refuge in terms of volume and capacity for aquatic organisms.

AVERAGE DAILY GROUND WATER LEVELS FOR WELLS 17-19 AND DISCHARGE (CFS), JANUARY, 2018 TO MARCH, 2021.



MONTHLY AVERAGE GROUNDWATER LEVELS FOR WELLS 17-19 AND CORRESPONDING GROUNDWATER TEMPERATURES, JANUARY, 2018 TO MARCH, 2021.

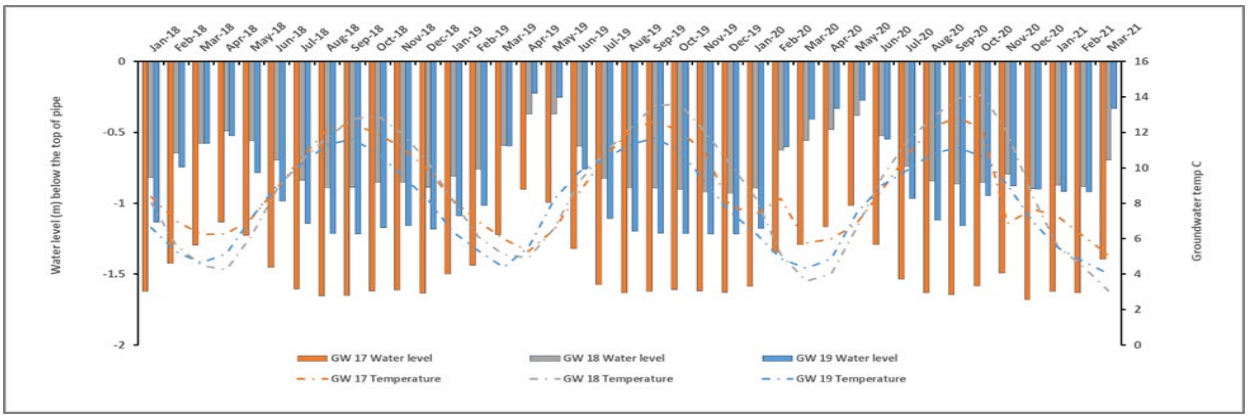
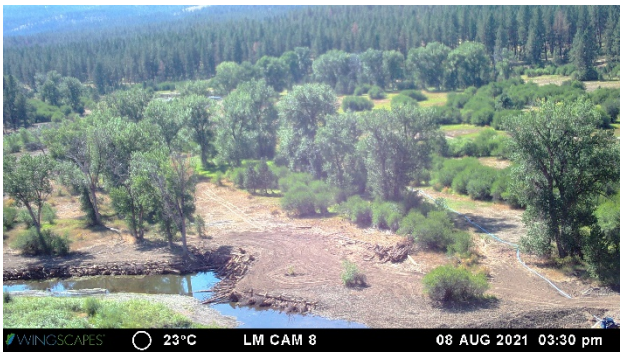


Photo Points

Photo points are an effective monitoring method used to document morphological changes on restoration projects. Representative photos are taken at intervals throughout each project, the number being determined by the project size and complexity. A master photo point notebook is used to align each subsequent year's photo with the image taken the previous year. Ideally, images are captured in the exact location as the earlier image, with landmarks (trees, hillsides, etc.) used to align the photo. Images are taken during midday for optimal lighting conditions and jpeg images are saved into a master photo point file. Aerial photos and videos are also taken at varying intervals along several project locations using a UAV operated by the Grande Ronde Model Watershed. Staff will revisit these locations in spring 2022 to determine which photo points to use moving forward to document long-term project effectiveness.

PHOTO POINT #8 JULY 8, 2021 AND AUGUST 8, 2021



Project Funding and Budget

Project planning, design, and permitting was funded through the CTUIR-BPA Accord (Project 199608300), the CTUIR-BOR funding agreement, and the BOR's Columbia-Snake Recovery Office. Longley Meadows Fish Habitat Enhancement Project activities were made possible through funding agreements with the GRMW/BPA, and OWEB.

GRMW/BPA allocated $1,925,555.75. OWEB FIP/GRMW 750,091 toward project construction, large wood procurement, and planting costs. Funding received from GRMW/OWEB-FIP totaled $750,091.

Project construction expenditure totaled $2,561,703.40.

GRMW/BPA, $1,826,317.40 (balance underspent $99,238.35)
OWEB/FIP, $735,386 (construction) and $14,705 (GRMW Admin)

Lessons Learned

Year 2 construction and the in-water work window began the first week of July, 2021 and coincided with a region-wide heatwave that hindered fish salvage efforts due to resulting above average stream temperatures. CTUIR staff closely monitored nearby stream temperature probes during the extreme heatwave to predict when daily stream temperatures would likely be coolest in order to minimize the stress that salvage efforts would have on the captured fish. High water temperatures resulted in abbreviating fish salvage hours on several days, and on some occasions even the lowest daily river temperature was above the maximum allowable temperature in which to safely handle captured fish. On these days salvage operations were canceled or delayed until daily minimum temperatures fell below the 18° C threshold. Salvage crews paid close attention to the voltage and amplitude settings on the e-fisher equipment, and to the physiological condition of the fish at the time of release. No mortalities were observed during Year 2 salvage efforts among captured and released ESA listed chinook and steelhead.

During Year 2 fish salvage operations, CTUIR staff observed that the channelized mainstem Grande Ronde River along the highway contained a larger population of freshwater mussels than was previously estimated. This was problematic in that extensive excavation would occur throughout this entire reach, and the channel was to be eventually filled. CTUIR Fish Habitat staff coordinated with the CTUIR Freshwater Mussel Program to organize a large crew and relocate the mussels to suitable habitat within the Bird Track Springs Project area, approximately 2 miles upstream of Longley Meadows construction activities. CTUIR's Fish Habitat Program will continue to build on previously established coordination efforts with the Freshwater Mussel Program to better understand the potential impact to established freshwater mussel populations within future project opportunity reaches as well as factoring mussel presence into early phases of the planning process and channel design alternatives.

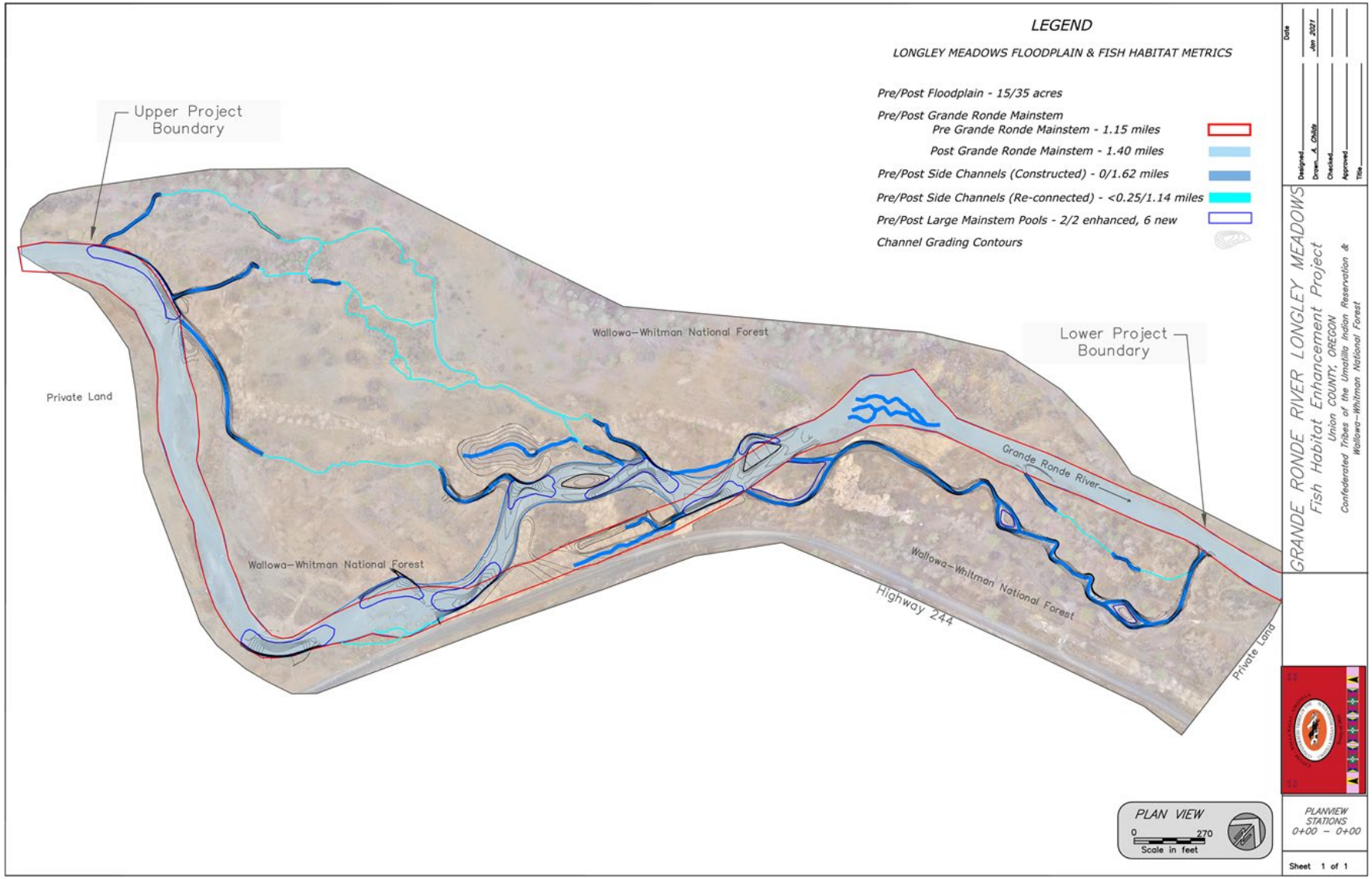
The Project construction contractor utilized GPS-equipped excavators and dozers to increase productivity and precision during channel excavation and floodplain grading. Occasionally, satellite interference from overhead trees or the valley horizon limited satellite reception while equipment operators and CTUIR staff waited for GPS equipment to reestablish satellite connection. Having an already established backup survey method capable of checking grade would allow construction excavation to continue and mitigate time spent waiting on satellite reconnection issues. Moving forward, project oversite staff will utilize survey equipment such as total stations and/or laser levels, in the event that GPS-equipped machinery encounters satellite interference, to maintain construction productivity and accuracy.

One key aspect of pre-project planning and design is to determine the volume and consistency of needed riffle material. Ideally, all riffles would be constructed with materials generated onsite to eliminate the cost of importing substrate from offsite locations. Coordination with geotechnical engineers during project planning and excavating sample test pits will provide valuable information about the potential to generate required volumes onsite. In situations where project managers expect a shortage of suitable material, it is prudent to identify areas within the constructed channel network where modifications could be made to over-excavate and mine specific reaches that contain suitable riffle material. Additionally, contingency planning should consider options to import suitable material.

Determining accurate wood quantities during the design process can be challenging, particularly for wood structures requiring varying sizes of wood and slash. Clear and consistent coordination is required between the project team and construction contractor and is paramount to success. Additionally, it is important to keep accurate records of the number and size class of large wood materials during the installation of engineered log structures to reduce the potential of creating a wood surplus or deficit.

As noted earlier, Section 106 permit compliance created challenges during project construction, most of which should have been avoided. CTUIR staff recommendations to help avoid future problems include: 1) Archaeology staff need to provide gps coordinates for avoidance area stakeout and assist with stakeout and review in advance of initiating project construction, 2) While avoidance areas are typically buffered a certain distance from significant heritage resources, there should be onsite review and discussion about construction activities and potential risks and measures to avoid disturbance in buffers, 3) During construction, it would be helpful for an archaeologist to conduct observation surveys in advance of initiating construction project features to help with inadvertent discovery prior to ground disturbance. Additional follow-up with BPA and CTUIR staff should also occur to further discuss lessons learned and steps forward to improve efforts on future projects.

PROJECT OVERVIEW ILLUSTRATING EXISTING AND POST HABITAT CONDITION



Before-After Project Aerial Project Imagery

UPPER PROJECT AREA FLOODPLAIN AND CHANNELS, VIEWING DOWNSTREAM

UPPER PROJECT AREA FLOODPLAIN AND CHANNELS, VIEWING DOWNSTREAM

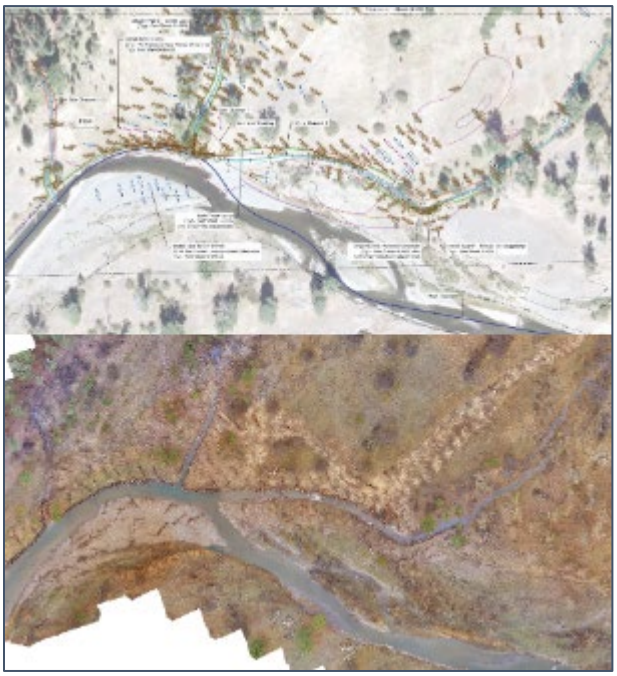
MID-PROJECT AREA FLOODPLAIN AND CHANNELS, VIEWING DOWNSTREAM

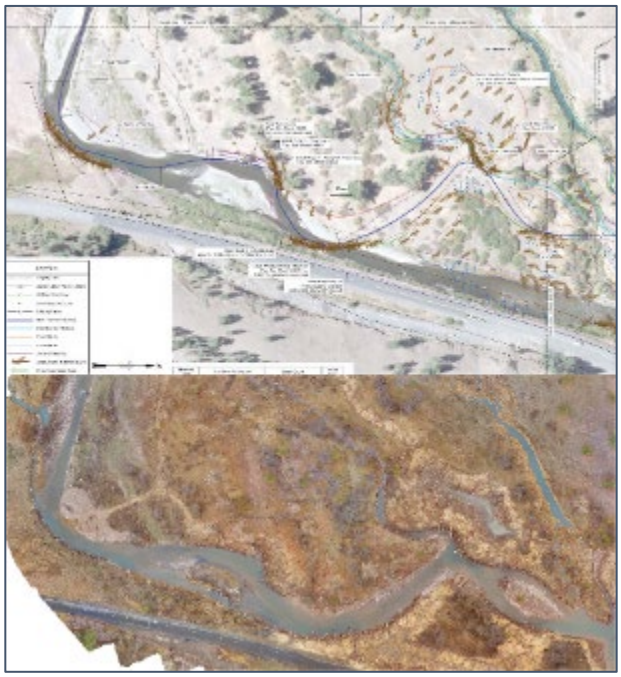
MID-PROJECT AREA FLOODPLAIN AND CHANNELS, VIEWING DOWNSTREAM

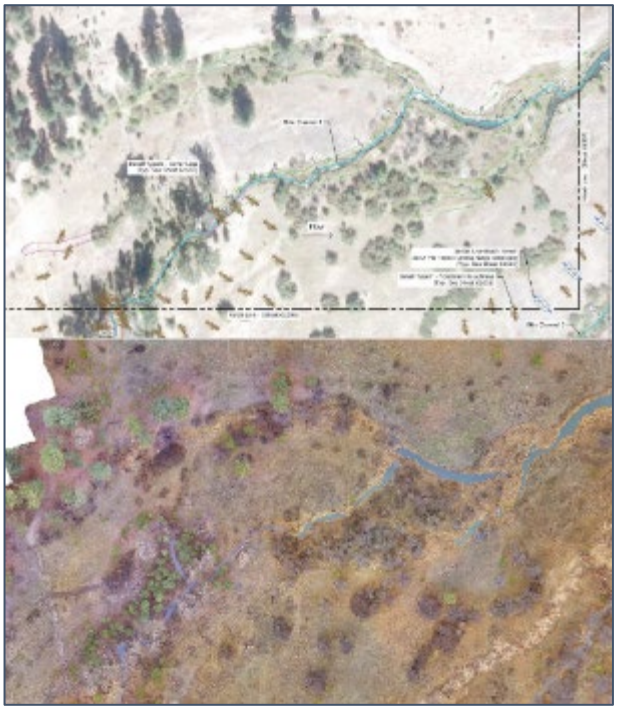
MID-PROJECT AREA FLOODPLAIN AND CHANNELS, VIEWING UPSTREAM

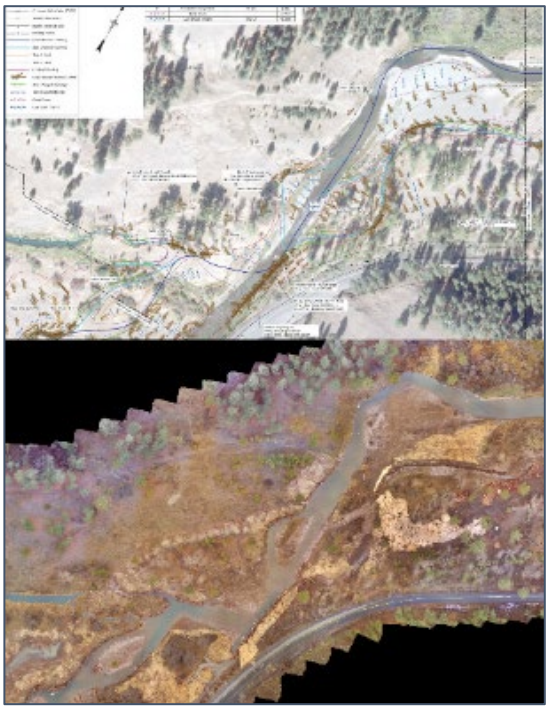
MID-PROJECT AREA FLOODPLAIN AND CHANNELS, VIEWING DOWNSTREAM

AERIAL IMAGERY COMPARING DESIGN TO AS-BUILT CONDITIONS POST-PROJECT.









PROJECT FEATURE CONSTRUCTION PHOTOS

SIDE CHANNEL 5 POOL AND LARGE WOOD STRUCTURE

SIDE CHANNEL 5 POOL AND LARGE WOOD STRUCTURE

SIDE CHANNEL 5 CHANNEL GRADING

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