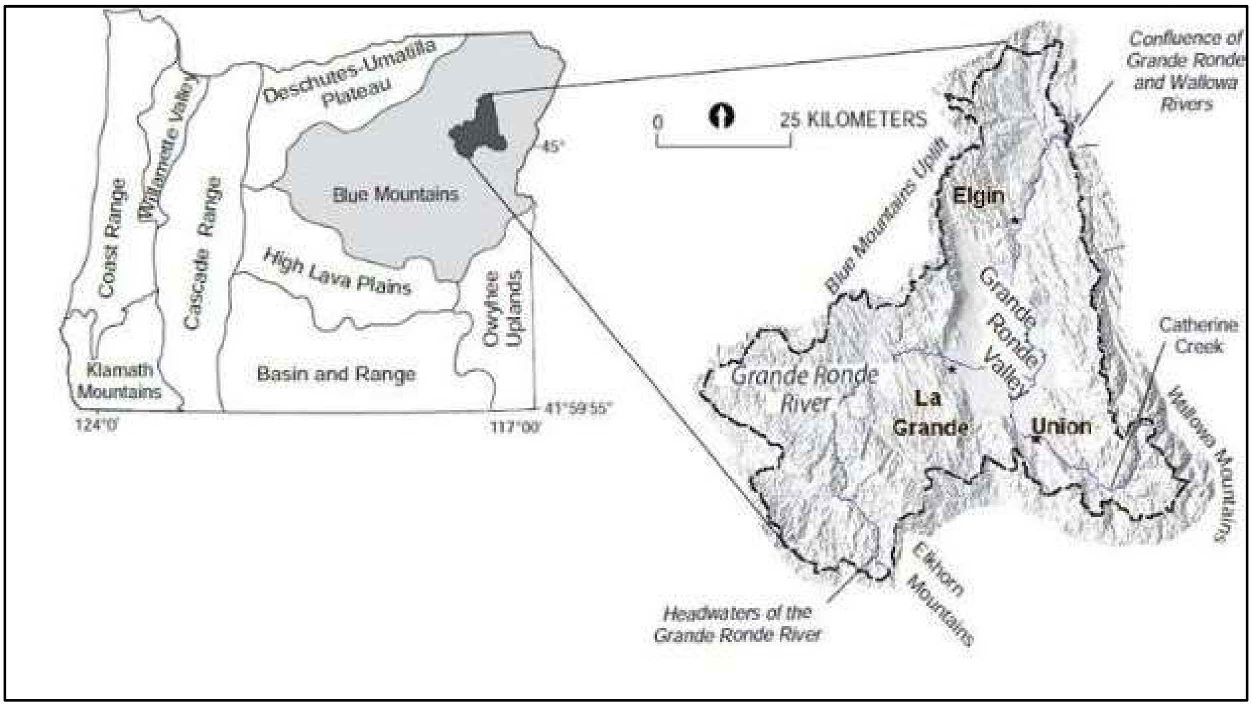
Bird Track Springs Fish Habitat Enhancement Project

The Bird Track Springs (BTS) Project Area is located approximately 10 air miles west of La Grande, Oregon along approximately 1.9 miles of the Grande Ronde River adjacent to State Highway 244. The area encompasses 1.2 miles of river on Wallowa-Whitman National Forest (WWNF) system lands and 0.7 miles on privately-owned lands along the reach beginning from just upstream of Bird Track Springs Campground (at river mile 146.1) downstream to river mile 144.2. The general legal description is Township 3 south, Range 36 east, sections 15 and 16 (Figure 5). Project start Latitude and Longitude is 45.175724/118.190287; Project end Latitude and Longitude is 45.180893/118.174686.

The project is located in the Upper Grande Ronde Subbasin (HUC 17060104) within the Coleman Ridge-Grande Ronde River (HUC 170601040307) subwatershed within the NOAA Fisheries Grande Ronde recovery plan assessment units UGC3A and UGS16.

BIRD TRACK SPRINGS VICINITY MAP



BIRD TRACK SPRINGS PROJECT REACH

Existing Conditions 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 (Bureau of Reclamation 2014) four moderately confined to unconfined reaches were identified including the area of the proposed project, the "Bird Track/Longley Reach" (Figure 7). The Bird Track/Longley 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 supports species listed as Threatened under the Endangered Species Act (ESA).

Three species in the Upper Grande Ronde Subbasin are listed as Threatened under the ESA:

> 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)

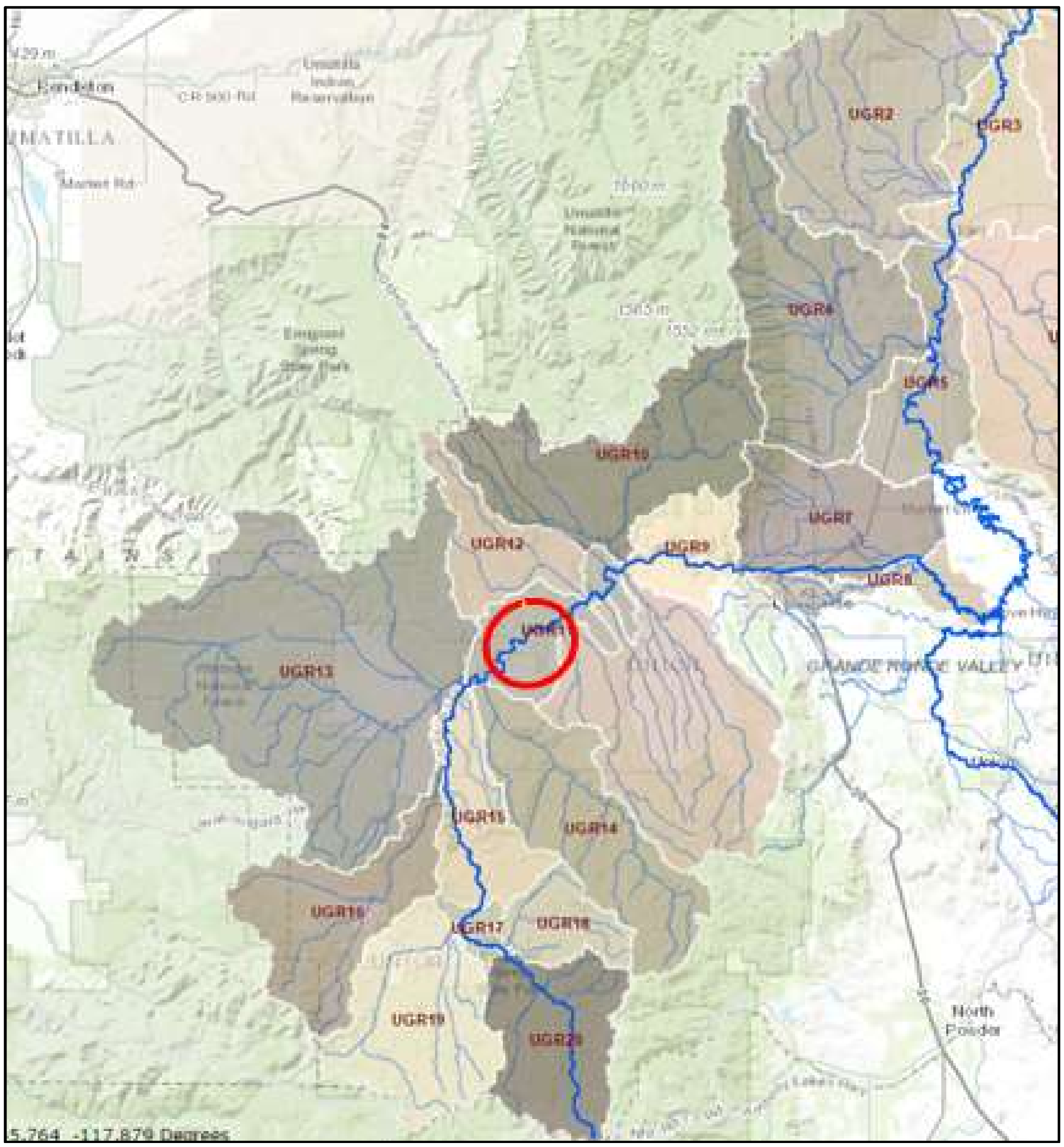
Columbia River bull trout (Salvelinus confluentus), ESA listed as Threatened, June 10, 1998. (http://www.fws.gov/pacific/bulltrout/)

An additional 2 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).

BIRD TRACK SPRINGS AND LONGLEY MEADOWS PROJECT AREAS



Historic floodplain and stream channel alterations, including but not limited to, systematic removal of beavers, channelization, historical logging and splash-dams, agriculture, railroad and road construction, livestock grazing and 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 and, channel morphology and large wood/completed (habitat quality and quantity) are the most critical limiting factors for these salmonid populations.

The pre-project condition of the Grande Ronde River in the Bird Track Springs reach was an unconfined, free-formed alluvial channel that had a straight planform with a plane-bed, and lower degree of channel-floodplain interactions compared to historic conditions (Figure 8). Artificial channel constrictions and disconnected floodplains due to railroad grades, road grades and levees had changed the channel geometry and floodplain cross-sectional area which increases flow depths, flow velocities and shear stresses during high water events.

PRE-PROJECT CHANNEL CONDITIONS

This condition translated into increased sediment mobilization and transport resulting in a wider, shallower channel with an armor layer that inhibited pool development when flows were not sufficient to mobilize the armoring particles, or in the absence of channel-spanning structures or significant channel constrictions.

Riparian vegetation conditions include scattered patches of woody shrubs and immature trees, and large areas of herbaceous vegetation where the floodplain has been cleared and drained for ranching. Beavers are not common and no longer play a major role in wood delivery to the channel, maintaining diverse off-channel habitats and riparian conditions, or maintaining stable habitat for fish during the winter by creating habitat with consistent water levels, very low current velocities and stationary ice cover (Jackober et al. 1998).

Additionally, the project reach exhibited lack of heterogeneity, large pools and side channels, a lower degree of channel-floodplain interaction, and poor riparian forest and wetland vegetation (Figure 9). Large wood features that would have played a significant role in channel form were nearly non-existent. In addition to channel changes, the floodplain within the project reach had been extensivity altered, negatively affecting off-channel habitats and floodplain water storage. The most prevalent historical feature within the floodplain includes remnants of the Mount Emily Logging Company railroad grade. The grade has been breached and removed in a few locations, but still acts as a barrier to natural floodplain inundation within the reach.

PRE-PROJECT CONDITIONS OF BIRD TRACK SPRINGS PROJECT REACH

Icing is a significant process affecting habitat condition in the basin during low flows in the winter months due to the wider, shallower channel geometry in the project area. Trees with ice scars have been identified in the upper .5 miles of the channel in the Bird Track Springs 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).

Anchor ice effects on salmonids include filling pools or other habitat and displacing fish, and creating high-velocity conduits for water to flow through that create velocities that are 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 ice or anchor ice, which demands using limited stores of energy in their bodies during the winter and increases 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 be killed when frazil or anchor ice forms in streams and reduces water interchange between the stream and the red (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 melt, the water released can displace the streambed substrate and scour redds (Bjornn and Teiser 1991). The formation of ice dams and their subsequent failure can result in scouring the stream bed and damaging banks and riparian vegetation.

Previous attempts at restoring this reach consisted of the placement of instream structures including rock weirs, rock barbs, and large wood buried in banks, but those attempts to restore habitat complexity have been largely unsuccessful. This is likely due in part to the scale of previous attempts in light of winter ice issues and a lack of existing large streamside trees within the reach. Freeze-up ice jams have been problematic in this reach. During the winter months, the Upper Grande Ronde River is generally shallow and has a relatively low flow along with cold temperatures that favor ice formation. Ice that forms tends to create jams, which then break and raft through the reach. For the most part, these ice processes are naturally occurring, but have likely been exacerbated by 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.

The following table (Figure 10) illustrates factors limiting productivity and recovery of native fishery resources. The table is derived from the Grande Ronde Model Watershed Program developed by the Grande Ronde Basin Technical Implementation Team through the basin Atlas, which is s strategic habitat restoration action plan. 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

Project Goals and Objectives

The desired conditions for the habitat within this project area relate primarily to spring/summer Chinook habitat, summer steelhead habitat, and resident fish species specifically through the following habitat elements (Figure 11). Restoration of natural processes that create and maintain habitats required for native fish, including salmonids, is the overarching desired condition for the Bird Track Springs reach of the Grande Ronde River.

The desired future conditions (DFCs) listed below for the Bird Track Springs project provide a future vision for the area consistent with the overarching goals of the project and can assist in development of management options for the project. The Interdisciplinary Team (IDT) developed DFCs using Forest Plan goals, objectives, standards, and guidelines. These DFCs focus on major resource areas associated with this project within the project area. The focus of this project would be in meeting the DFCs related to water quality and fisheries habitat as follows:

Networks of watersheds with good habitat and functionally intact ecosystems contribute to and enhance conservation and recovery of specific threatened or endangered fish species and provide high water quality and quantity. The networks contribute to short term conservation and long term recovery at the major population group, core area, or other appropriate population scale. Roads within the watershed do not present substantial risk to aquatic resources.

Connectivity exists within watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact habitat refugia. These network connections provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic, riparian-dependent, and many upland species of plants and animals.

Habitat elements (including spawning and rearing habitat, substrate, pool habitat, winter habitat, migration corridors, cover, food, habitat complexity, water quality, refugia, productivity, and connectivity) are in a functional condition and are sufficiently distributed to support self-sustaining populations of native resident and anadromous fish (Figure 12). Native fish species have access to historically occupied habitats and connectivity between habitats allows for the interaction of local populations.

Project specific goal and objectives were developed for the project though an Interdisciplinary, multi-agency team that included hydraulic engineers, fluvial geomorphologist, and fishery biologists representing the CTUIR, BOR, BPA and consultants.

ESA salmon and steelhead recovery plans, BiOp, and GRMW Atlas were consulted for details associated with habitat limiting factors, priority habitats, and actions plans previously developed. (ETC)

The following table illustrate the project restoration vision, goals by targeted fishery resource life stages, project goals, and project design criteria.

RESTORATION VISION AND KEY LIFE STAGES TARGETED

Bird Track Springs Reach - Restoration Vision
Rehabilitate and restore the Bird Track Springs Reach to achieve immediate and long-term benefits to chinook, steelhead, and bull trout at all life stages. Benefits to salmonids will be achieved through restoration and rehabilitation of the whole floodplain system as defined by CTUIR's River Vision touchstones. Targeting of specific limiting factors such as temperature will achieve immediate benefits to salmon. Long term benefits will be achieved through a focus on restoring fluvial and habitat-forming processes,floodplain, groundwater, and hyporheci connectivity, riparianand wetland plant communities, and instream complexity and diversity commensurate with the reaches natural poteneital. An inclusive approach to project implementation which accounts for the interests and needs of stakeholders and the broader community is essential for project success.

Project Goals - Key Life Stages Targeted

#	Life Stage Description	Rank of Importance*	Goal Statement (compiled from Jesse Steele document)
1	Adult Immigration	3	Improve habitat for immigrating and holding adults by decreasing summer temperatures and enhancing the availability of thermal refugia, increasing the abundance and complexity of pool habitat, enhancing main channel passage during low-flow conditions by restoring natural width to depth ratios, and increasing complexity through addition of LWD.
2	Adult Holding	4	
3	Spawning / Incubation / Emergence	5	Restore spawning in the project reach first and foremost by decreasing temperatures and creating thermal refugia for adults (reducing pre-spawn mortality). Improve conditions for spawning, incubation, and emergence by improving natural gravel sorting through LWD placement.
4	Juvenile Emigration	6	Improve habitat for emigrating juveniles by increasing the number and area of pools, creating additional side channels, alcoves, and off-channel habitat, and creating slow-water edge and cover habitat through addition of LWD.
5	Summer Rearing	2	Increase summer and winter rearing habitat in the main channel and side channels through (1) addition of LWD to provide cover and create pools, (2) creation of natural pool-riffle sequences and enhanced riparian vegetation to increase foraging opportunities, (3) creation of additional side channel habitat mimicing existing side channels in the project reach, (4) creation of enhanced area of thermal refugia providing cool temperatures in the summer and warm temperatures in the winter. As a whole, the design should increase the occurance of low velocity refugia, increase the availability of open water habitat during the winter, and moderate winter temperatures to reduce anchor ice formation.
6	Winter Rearing	1	

Project Goals - Key Life Stages Targeted

NOAA ID	Description	Rank of Importance**	Goal Statement (Source: CTUIR Spreadsheet)
4.1	Riparian Condition: Riparian Condition	4	Facilitate development of a diversity of native plant communities and seral stages that contribute to floodplain process and function. In conjunction with natural channel and floodplain objectives, a combination of riaparian/wetland habitat protection, planting and seeding, and natural recruitment result in increased tree, shrub, and herbaceous plant communities that are resilent and self sustaining, contributing to shade, structure, terrestrial food web, streambank stability, and future large wood recruitment.
4.2	Riparian Condition: LWD Recruitment	4	
5.1	Peripheral and Transitional Habitats: Side Channel and Wetland Condtions	3	Increase activation of historic floodprone area by restoring and promoting connection of main channel to network of side channel and floodplain swales, decreasing width to depth and adjusting vertical position of mainstem Grande Ronde, where appropriate, to increase annual floodplain inundation. A functioning floodplain system contains hydraulic and vegetative diversity, including an assemblage of forests, shrub-scrub areas, and emergent wetlands. This diversity is a foundation for a healthy aquatic food-web and improved temperatures through hyporheic exhange. Beaver recolonization is a key path toward this reinvigorated floodplain system.
5.2	Peripheral and Transitional Habitats: Floodplain Condition	3	
6.1	Channel Structure and Form: Bed and Channel Form	5	Enhance in-stream structural diversity and complexity by reconnecting historic floodplain and side channel network, promoting natural channel function and form, and increasing instream and floodplain structural diversity through large wood comlex additions that promote roughness, scour, sorting and storage of sediment, and development of a diverse assemblage of riffle, run, pool, glide, side channel, and alcove habitat.
6.2	Channel Structure and Form: Instream Structural Complexity	2	
7.2	Sediment Condition: Increased Sediment Quantity	6	Encourage sediment sorting, transport, and storage consistent with stable channel morphology to provide a diverse and complex distribution of particle sizes commensurate with hydrologic amd morphologic processes that provide spawning and rearing habitat diversity and productive and resilient aquatic invertebrate communities that support food web processes. Enhance sorting and flushing of high loads of fine sediment generated in the upper Grande Ronde watershed.
8.1	Water Quality: Temperature	1	Increase diversity and function of hydrodynamics that decreases summer maximum water temperatures, increases winter water temperatures, and moderates and buffers diurnal water temperature changes during both summer and winter rearing periods. Apply restoration techniques that maximize the interaction and function of small and large scale hyporheic and groundwater exchange, reduce channel width to depth ratios and decrease solar input to increase the productivity of cold water fishery resources.

PHYSICAL OBJECTIVES/DESIGN CRITERIA

Physical Objectives/Design Criteria						
#	Type	Targeted Response Time	Objective	Targeted Life Stages	Ecological Concerns Addressed	Needed Design Target(s)
Rip1	Riparian Planting/Management	Long-term	Plant riparian and floodplain vegetation mimicking the composition and diversity of natural plant communities to in turn provide shade, stabilize banks, and increase LWD recruitment.	All	4.1, 4.2, 6.1, 8.1	Species composition and density.
Rip2	Riparian Planting/Management	Immediate	Preserve existing vegetation communities wherever possible, with particular focus on vegetation in the vicinity of existing hydraulic features on the floodplain including wetlands, side channels, and swales.	All	4.1, 4.2, 6.1, 8.1	-
Rip3	Riparian Planting/Management	Long-term	Construct riparian fencing exclude cattle and promote vegetation growth to stabilize banks and promote channel narrowing.	All	4.1, 4.2, 8.1	Desired riparian corridor width.
ChRec1	Channel Reconstruction	Immediate	Channel realignments and construction of the project should take advantage of existing riparian vegetation communities, where possible to increase shade from existing riparian communities.	All	4.1, 4.2, 6.1, 8.1	-
ChRec2	Channel Reconstruction	Immediate	Restore the main channel planform in line with natural analogs to reestablish channel migration and habitat forming processes.	All	5.1, 5.2, 6.1, 6.2, 8.1	Sinuosity, side channel frequency and

						length per main channel length.
ChRec3	Channel Reconstruction	Immediate	Reposition and reconstruct the main channel in key locations to establish hyporheic flow paths that create areas of upwelling cool water in the summer and warm water in the winter. The channel's natural planform should be adhered to with each channel relocation.	All	8.1	Groundwater flow modeling to identify upwelling locations.
ChRec4	Channel Reconstruction	Immediate	Reposition and reconstruct the main channel in key locations to increase the vertical position of the channel and in turn increase floodplain inundation and enhance the frequency and area of floodplain.	All	5.1, 5.2	-
MC1	Reshape Main Channel	Immediate	Increase floodplain and side channel activation by downsizing the channel bankfull capacity in line with the natural channel form in the project reach.	1, 2, 5, 6	5.1, 5.2, 6.1	Bankfull discarge, channel cross-sectional form
MC2	Reshape Main Channel	Immediate	Restore natural width to depth ratios of the main channel to facilitate fish passage during summer low flows and reduce solar input.	All	6.1, 8.1	Width to Depth Ratio
MC3	Reshape Main Channel	Immediate	Construct natural sequences of pools, glides, riffles, and runs in line with natural channel form to enhance stability, complexity, and natural sediment sorting in the project reach.	All	5.1, 5.2, 6.1, 6.2, 7.1, 8.1	Pool and riffle spacing. Pool and riffle lengths.

OffCh1	Construct Off-Channel Habitat	Immediate	Construct alcoves to provide off-channel habitat. Alcove construction should preferentially occur in areas of expected hyporheic upwelling to provide thermal refugia.	All	5.1, 5.2, 6.1, 6.2, 8.1	Groundwater flow modeling. Bedrock outcrop locations (upstream of which are expected upwelling zones).
OffCh2	Construct Off-Channel Habitat	Immediate	Construct additional perennial side channels and split flow channels to enhance off-channel habitat area in line with the reach's natural planform and potential to sustain side channels.	1, 2, 5, 6	5.1, 5.2, 6.1, 6.2, 8.1	Analog reach channel planform (side channel length/main channel length, divergence angles, and side channel longitudinal and sectional form)
OffCh3	Construct Off-Channel Habitat	Immediate	Construct high-flow (seasonal) side channels to enhance high-flow refuge during winter high flows.	5, 6	5.1, 5.2, 6.1, 6.2, 8.1	Analog reach channel planform (side channel length/main channel length, divergence angles, and side channel longitudinal and sectional form
FP1	Floodplain reconstruction	Immediate	In select areas, excavate the floodplain to promote inundation during high flows and increase connectivity with off-channel features.	1, 2, 5, 6	5.1, 5.2	Bankfull discharge

LWD1	LWD Placement	Immediate	Place large woody debris jams in the main channel to promote formation of scour pools and gravel sorting, increase bank stability in key locations, increase floodplain inundation, and increase overall complexity. Debris jams are to mimic natural wood accumulations in channels of similar size and gradient to the project reach.	All	5.1, 5.2, 6.1, 6.2, 7.1, 8.1	Natural debris jam types for channels of similar size and gradient to the project reach. Key member size for stability. Large woody debris piece and key member frequency.
LWD2	LWD Placement	Immediate	Place LWD jams (channel-spanning LWD and beaver dam analogs) in existing and constructed side channels to create pools and wetland areas that act as thermal refuge for over-wintering juveniles and cool water refuge for summer rearing.	1, 2, 5, 6	5.1, 5.2, 6.1, 6.2, 8.1	Winter temperature in natural analoges. Unknown what the best approach to providing off-channel winter habitat (that doesn't freeze).
LWD3	LWD Placement	Immediate	Construct log jams at side channel entrances to divert and mediate flow into side channels as well as prevent sediment deposition.	1, 2, 5, 6	5.1, 5.2, 6.1, 6.2, 8.1	-
LWD4	LWD Placement	Immediate	Place LWD jams in side channels to create complexity and cover.	All	5.1, 5.2, 6.1, 6.2, 8.1	Natural debris jam analogs in side channels.
LWD5	LWD Placement	Long-term	Promote channel migration by placing LWD (apex and deflector) structures at key locations (where risk to human development is minimal) to promote channel migration as a natural habitat-forming process. Also create 'hard points' adjacent to the main channel to maintain an anabranching channel	All	4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 8.1	Low risk areas. Radius of curvature to promote migration.

			planform and long term forest diversity in the project reach.			
LWD6	LWD Placement on Floodplains	Long-term	Place LWD on floodplains to increase floodplain roughness and increase LWD recruitment into the channel.	All	4.2, 5.1, 5.2	Areas of expected channel migration. Floodplain areas with reduced vegetation cover.
Sp1	Reconnect Springs	Immediate	Enhance connection and access to existing springs and cold-water sources to provide refuge during summer months.	All	8.1	Temperature mapping of cold-water anomalies.
Beav1	Increase Beaver Habitat Suitability to Support Recolonization	Long-term	Promote floodplain connectivity, development of peripheral and side channel habitat, and facilitate regeneration of healthy riparian habitat. Increased habitat suitability and beaver recolonization over time would complement restoration activities and contribute to natural habitat forming processes that creates floodplain wetlands, pools, and vegetation diversity. Off-channel pools and wetland complexes created and maintained by beaver provide deep, low velocity habitat, instream and floodplain complexity and buffer water temperatures.	1, 2, 5, 6	4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 8.1	Existing beaver activity (currently limited, small colonies, streambank lodges, dam building typically limited to tributaries)

Lev1	Structure Removal/Replacement	Immediate	Remove historic railroad grade, historic roads, artificial fill, and undersized culverts in the project reach to enhance connectivity and erodibility of floodplain materials.	All	5.1, 5.2, 6.1	-
Bldr1	Boulder Placement	Immediate	Place boulders in key locations along the main channel to break-up ice jams and increase spawning success in the project reach.	3, 6	6.1, 6.2	Boulder sizing. Locations of ice jam accumulation

Project Design

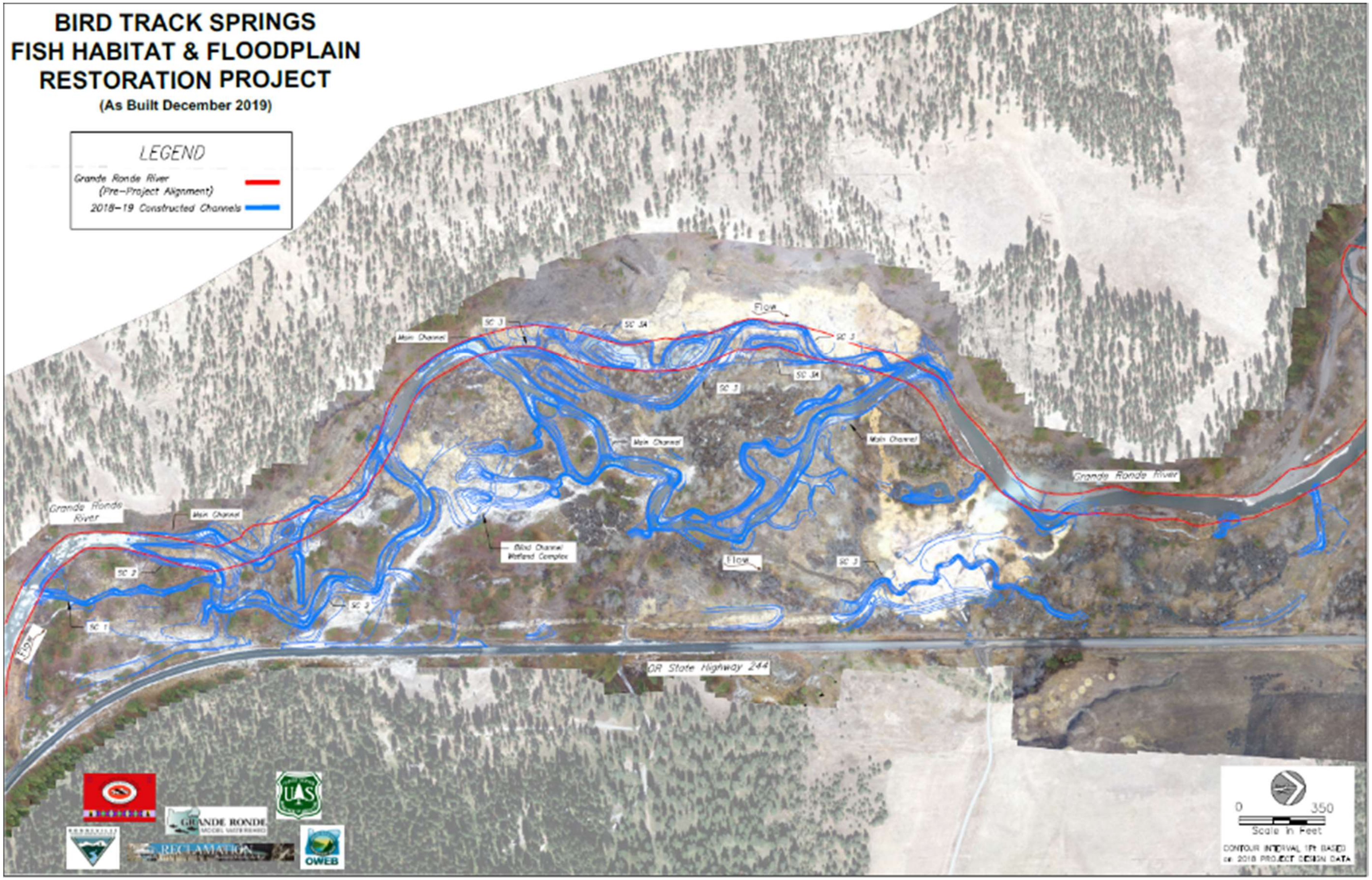
An alluvial design process was utilized for this project such that constructed riffles would behave similarly to those found naturally near the project site. This process required evaluation of computed critical shear stresses at proposed riffles along with allowable shear stress of existing material gradations found within and near the project site. Newly constructed riffles are intended to be at least as stable as those found upstream of the project to allow the channel to mature gradually. However, riffles are expected to move and transform at higher discharge frequencies.

Design stream channels would be stable vertically for varying discharge values dependent upon location. 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.

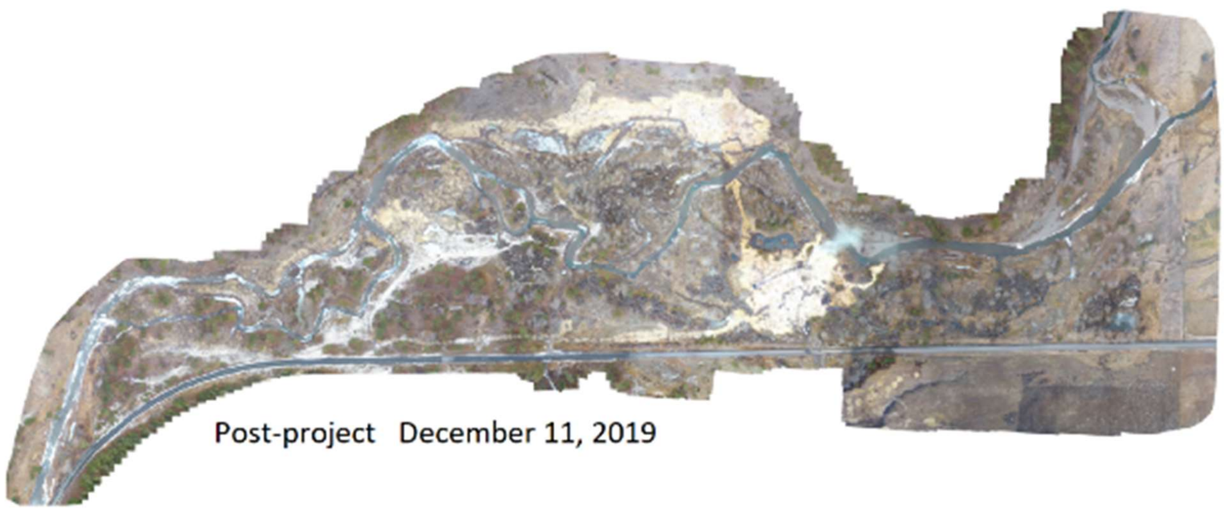
The design for the channel bed continues to leverage opportunities on the site such as swales, relic channel features and existing backwaters and ponds; to anticipate the incorporation of in-situ materials in areas that will be reactivated by flow only and to design and construct appropriate features in excavated channels and/or required control points.

Vertical stability of channels within the proposed project will be provided by hardened riffles constructed in the channel bed. Riffles will be constructed in the new channel segments by over-excavation of the native materials by 2-feet (approximately 2-times the D100 material) and replacement with native rock of specific gradation and methods to form a well-graded mixture of compacted alluvium similar to what is found in natural riffles within the upper Grande Ronde River.

PROJECT OVERVIEW MAP SHOWING AS-BUILT LINEWORK OVERLAYED ONTO POST-PROJECT AERIAL IMAGERY



AERIAL COMPARISON OF PRE-PROJECT CONDITIONS (TOP) AND POST-PROJECT COMPLETED CONSTRUCTION (BOTTOM)



The above aerial imagry compares pre-project conditions from May 2018 (top image) with during or after construction activities and conditions from drone photos taken August 2019 (bottom image). The following comparison photos begin at upstream portion of project and move downstream, and arrows indicate corresponding reference points.

VIEWING UPSTREAM. STATIONING MC 22+00 – 26+00, SC2 ENTRANCE

VIEWING DOWNSTREAM. STATIONING MC 37+00 – 42+00, SC2 AND MC CONFLUENCE

GROUND PHOTO POINTS – BEFORE (LEFT) AND AFTER CONSTRUCTION (RIGHT)

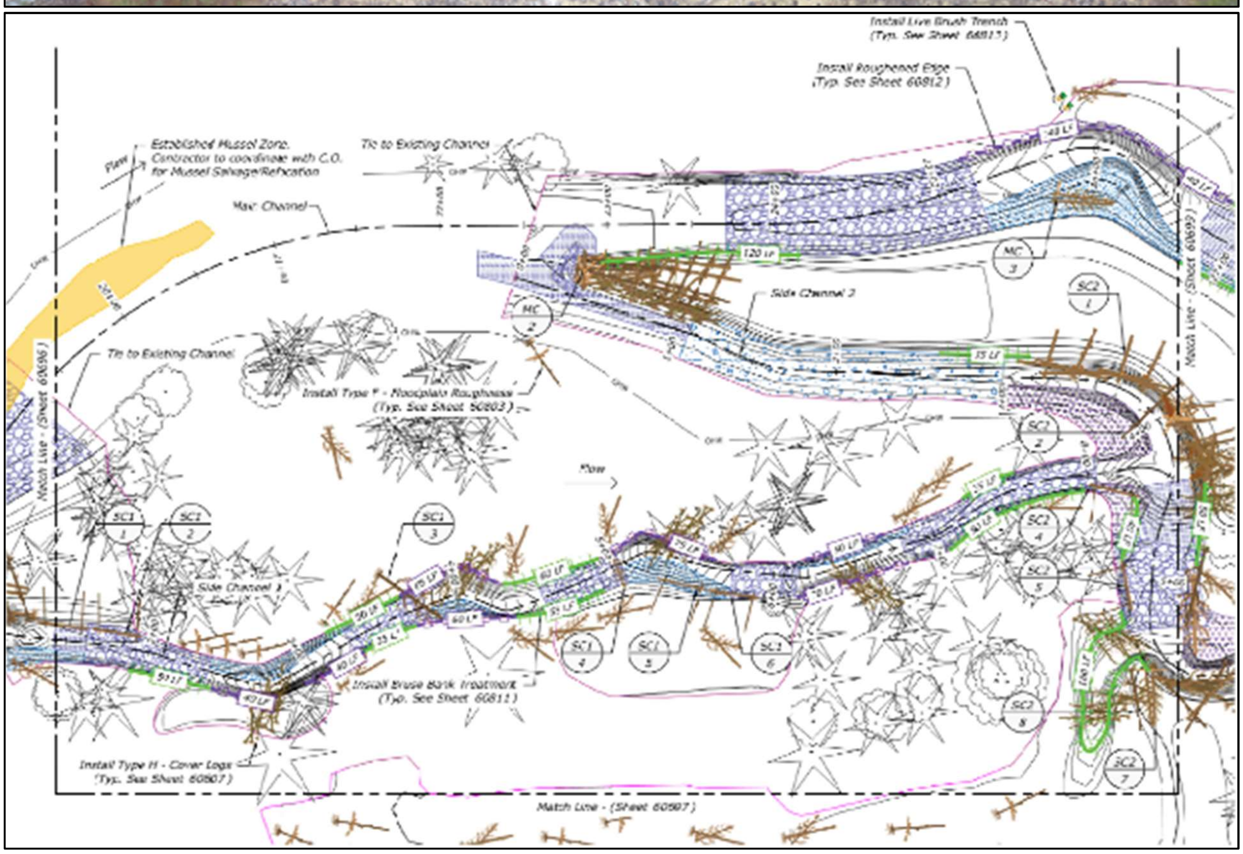

Viewing downstream. Stationing SC1 2+50


Viewing upstream. Stationing SC1 8+00

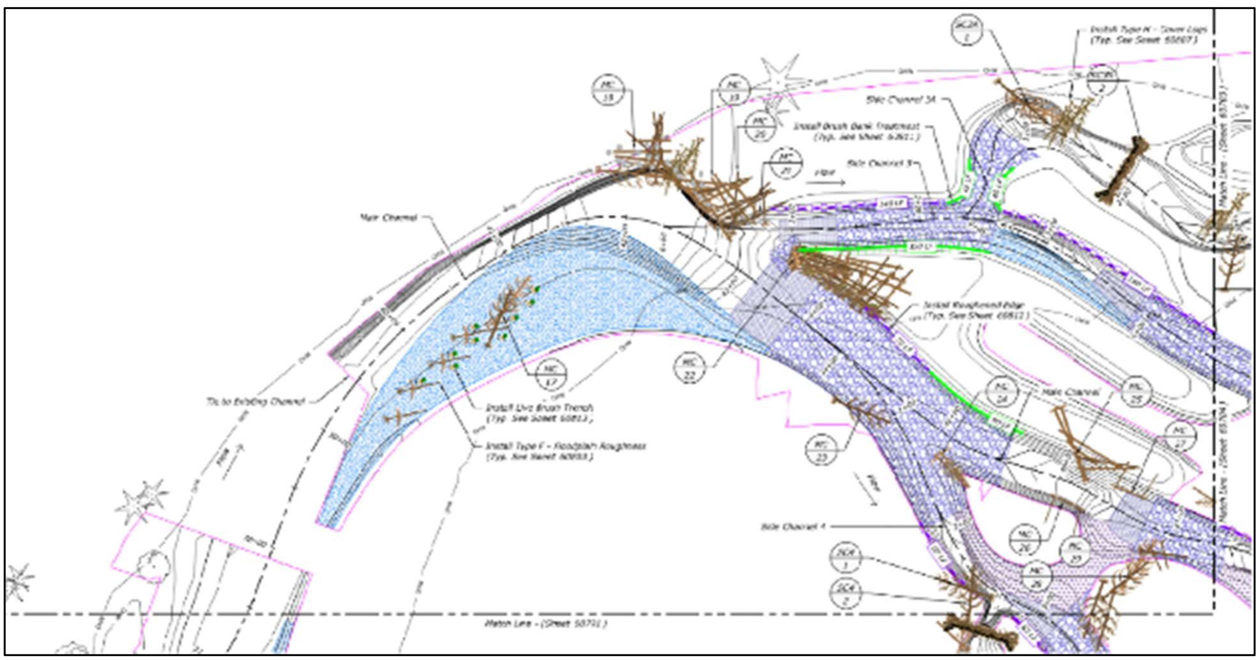

Viewing upstream. Stationing SC2 14+00

PHOTOS COMPARING POST-PROJECT CONSTRUCTION AERIAL IMAGRY WITH CORRESPONDING PLANSET DESIGN

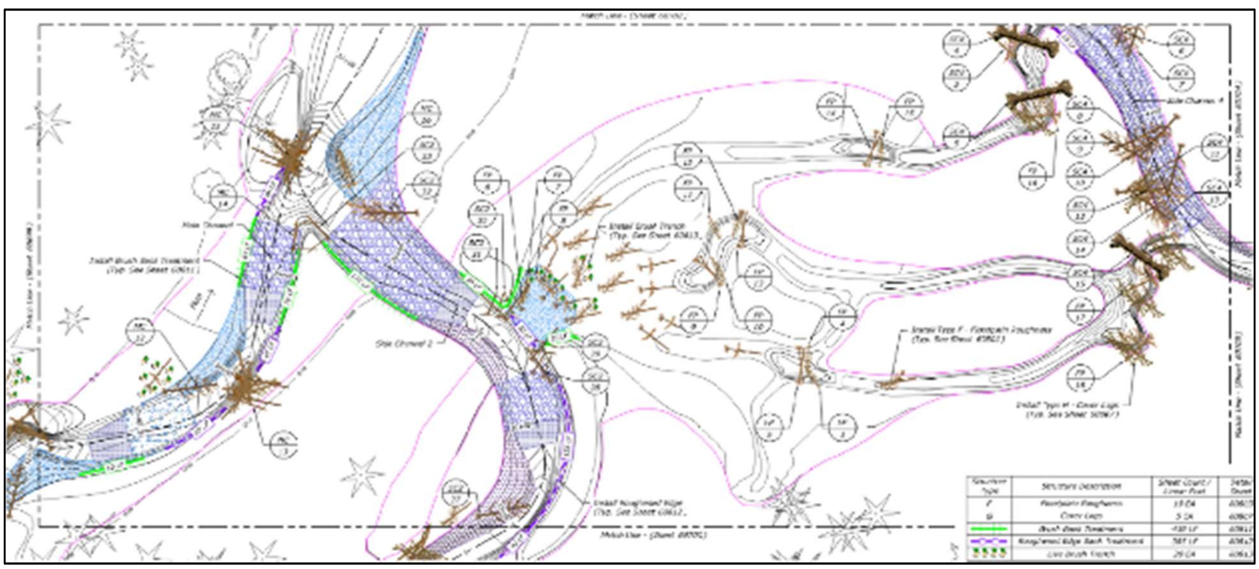
Stationing MC 20+00 – 27+00, SC1 1+00 – 8+00, SC2 1+00 – 6+00



Stationing MC 37+00 – 47+00, SC3 and SC4 entrance



Stationing MC 36+00, SC2 confluence with MC, blind channel swale complex



Bird Track Springs Fish Habitat and Floodplain Restoration Metrics –
Year 1 & 2 (2018-2019)

Main Channel and Side Channel Construction

The project included construction of approximately 5,000 linear feet of new main channel Grande Ronde River (including four confluences with the existing channel). In addition, 9,500 feet of side channel were constructed that will allow the confined and straightened channel to once again meander through the valley bottom, increasing channel sinuosity, decrease channel slope, and assist in floodplain reconnection and the development of more diverse channel structure and hydraulic variability. At project completion, earthwork quantities totaled 82,723 cubic yards (CY) of excavated material.

MAIN CHANNEL CONSTRUCTION

Stationing MC 26+00

Stationing MC 18+50

Alcove Construction

Construction of secondary channels, alcoves, and other periphery habitats was focused in areas where low swales or historic channels currently existed. These channel forms will principally be dependent on stream hydraulics for development. Approximately 2,000 linear feet of floodplain swale habitat was re-connected, with a total of 8 alcoves constructed, measuring a total of 1,200 linear feet.

Riffle Construction

A total of 16 main channel riffles and 48 side channel riffles were constructed using approximately 9,973 cubic yards of riffle matrix mix, and will aid in maintaining floodplain connection and preventing potential head cuts or channel degradation. A total of 1,389 individual boulders were embedded as clusters into each of the riffle locations to increase channel bottom roughness, provide habitat diversity and velocity refuge, and assist in maintaining vertical grades.

MAIN CHANNEL AND SIDE CHANNEL CONSTRUCTION

Stationing SC2 20+00

Stationing MC 24+50

Stationing MC 44+00

Pools, Glides, and Point Bars

The project increased pool frequency in the reach from 1 to 10 pools/mile with a total of 17 deep main channel pools constructed. In addition, a total of 47 medium side channel pools (26 pools/mile) were constructed. Pools will be located in natural areas of scour to increase persistence of depth, while providing velocity refuge for adult and juvenile salmonids. Glides occur in transitions between pools and riffles and will be zones of depositional features where gravels are deposited to increase spawning potential through the reach.

CONSTRUCTED SIDE CHANNEL AND MAIN CHANNEL POOLS

Stationing SC2 10+50

Stationing MC 78+50

Large Wood Structures and Habitat Complexity

A total of 293 large wood structures and complexes were installed along the main channel and side channels to provide complex and diverse habitat components within the project reach. Purposes of large wood structures included creating hydraulic conditions that maintain deep pool habitat, complexity and diversity, providing temporary streambank protection by redirecting flow and shear stress from near bank and stable bank conditions for establishing riparian vegetation, and providing overhead cover, velocity refuge, and organic nutrients that support food web process and complex rearing and holding habitat.

LARGE WOOD STRUCTURE CONSTRUCTION

Stationing MC 42+00

Stationing SC2 9+50

Stationing MC 42+00

Additional large wood material was placed throughout the floodplain and along decommissioned floodplain access roads to provide roughness, decrease overland flow velocities, and promote sediment storage and revegetation.

A total of 605 floodplain roughness wood structures were installed during the two year construction window. Willow cuttings were planted within each structure with the intention that over time, as the plantings mature, they will assist in fine sediment sorting and maintaining floodplain roughness as LWD deteriorates. Fine sediment in suspension during high flow events will settle out around floodplain wood, providing excellent growth medium for cottonwood and willow seeds as floodwaters recede. Additionally, floodplain wood will provide nurse logs that help retain soil moisture, shade, and potential protection from herbivory.

COMPLETED FLOODPLAIN WOOD STRUCTURE

TABLE 1 **WOOD QUANTITIES USED IN THE CONSTRUCTION OF LARGE WOOD STRUCTURES. WOOD WAS PROCURED THROUGH COOPERATIVE AGREEMENT WITH PRIVATE LANDOWNER.**

Structure Type	Quantity	Large Tree (>18")			Medium Tree (12"-18")			Small Tree (6"-12")		Tree Top (>8")
		Full Tree	Key w/ RW	Key w/o RW	Full Tree	Med w/ RW	Med w/o RW	Sm w/ RW	Sm w/o RW	Tree Top
		55	40	40	55	35	35	35	35	25
A1 - Apex	18	0	36	0	0	0	18	0	90	0
B1 - Meander Jam - Upstream Component	4	0	8	32	0	0	0	0	32	0
B2 - Meander Jam - Middle Component	4	0	12	4	0	0	20	0	32	12
B3 - Meander Jam - Downstream Component	12	0	96	0	12	0	0	0	156	0
B4 - Meander Jam - Mallet Jam	9	0	27	18	0	0	0	0	117	0
C1 - Longitudinal Channel Margin Jam	24	0	0	0	0	0	72	0	0	0
C2 - Angled Channel Margin Jam	33	0	33	0	0	33	33	0	165	0
D1 - Deflector Jam	8	16	8	24	0	0	0	0	64	0
D2 - Deflector (Large)	3	3	15	6	0	0	3	0	30	0
D3 - Split Deflector	1	1	8	2	0	0	1	0	10	0
E - Sweeper Jam (Single)	32	0	0	0	32	0	0	0	32	0
E1 Sweeper Jam (Double)	14	14	0	0	14	0	0	0	28	0
F - Floodplain Roughness	221	0	0	0	0	110.5	0	110.5	221	110.5
G1 - SC Habitat (Single Log)	16	0	0	0	16	0	0	0	0	0
G2 - SC Habitat (Double Log)	7	0	0	0	0	7	0	0	7	0
G3 - SC Habitat (Triple Log)	19	0	0	0	0	19	38	0	0	0
H - Cover Logs	77	0	0	0	0	0	0	0	539	0
Type I1 - Ice Crib Jam (Small)	2	0	56	20	0	0	14	12	32	0
Type J - Reinforced Habitat Structure	14	0	0	0	0	0	56	0	84	0
Roughend Edge (per 40 LF)	90	0	0	0	0	0	0	359.7	809.3	0
	TOTALS	34	299	106	74	170	255	483	2449	123

Streambank Treatments and Revegetation

Approximately 7,399 feet of bioengineered bank treatments were installed along the banks of newly constructed main and side channels. These features are composed of trenched dead branches, salvaged shrub material, and live willow cuttings. Brushy material will increase roughness along banks, and willow growth will shade the channel and provide bank protection as robust root mass establish.

BIOENGINEERED BANK TREATMENTS

Stationing SC3 12+00

Stationing SC1 5+50

Following Year 2 construction, disturbed areas were treated with native grass seed, straw mulch, and native plant species to assist in recovery. Cleared native vegetation was salvaged and replanted, or used in the construction of wood structures. Native grass seed was distributed over approximately 24 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. USFS contracted the planting of 4,800 one-gallon potted conifer plants (primarily Ponderosa pine), 20,600 one-gallon potted deciduous plants (willow, cottonwood, alder, birch, aspen, wild rose, snowberry, chock cherry, hawthorne, service berry, Oregon grape, elderberry, ninebark, red osier dogwood), 11,500 10-cubic inch conifer seedlings (primarily Ponderosa pine), 5,000 15-cubic inch deciduous seedlings (willow and cottonwood). There will be an additional 4,250 15-cubic inch deciduous seedlings planted in the spring of 2020 (willow, cottonwood, Hawthorne, aspen, mock orange, chock cherry). Grubbed material consisting of woody debris and sod were dispersed on disturbed areas to assist rehabilitation.

REPLANTED FLOODPLAIN AREAS

Stationing SC2 11+00

Stationing MC 77+00

TOTAL LIVE PLANTS OBTAINED BY THE USFS AND USED IN POST PROJECT SITE REHABILITATION.

2018/19 Years 1 & 2 planting quantities	**# plants**
one-gal. conifers (primarily Ponderosa)	4800
one-gal. deciduous (willow, cottonwood, alder, birch, aspen, wild rose, snowberry, choke cherry, hawthorne, service berry, Oregon grape, elder berry, ninebark, red osier dogwood)	20600
10-cu in. conifers (primarily Ponderosa)	11500
15-cu in. deciduous (willow, cottonwood)	5000
Total BTS plantings installed	41900
2020 additional plantings	
15-cu in. deciduous (willow, cottonwood, hawthorne, aspen, mock orange, choke cherry)	4250
Total BTS plantings after 2020 additions	**46150**

Removal of Floodplain Levees and Relocation of Cattle Operation Infrastructure

Approximately 300 feet of levee material was removed from the upper Bird Track Springs project area, allowing for increased connectivity between main and side channels and their historic floodplain. Approximately one-third of the project area is on private ground, and through a cooperative agreement with the willing landowner, the cattle operation and corral infrastructure was moved out of the floodplain and across the highway to a new upland location. In addition, an off-channel spring fed water development was established as part of the corral relocation agreement.

Site restoration

As described above, attention was made to salvage and replant much of the native plant material that would be within the limits of new channel excavation. Slight adjustments were made to field fit project design elements to minimally disturb established robust plant communities. One project objective was to decommission 6,694 square yards of access roads used during the two years of project construction activities. Due to heavy machinery compaction, a D6 dozer was utilized to scarify and fracture the roadbed to a depth of at least 24 inches. This will allow post-construction riparian plantings to better establish roots within the old road prism. In addition, 8.8 acres of equipment and wood staging areas were decommissioned utilizing the same scarifying and compacted soil fracturing methods described above.

To further rehabilitate the decommissioned roads and staging grounds, native grass seed was spread at a rate of 15 lbs./acre on disturbed soils, and straw mulch was spread over top to help retain moisture, reduce the amount of seed relocated by wind and rain, and to suppress competitive weeds.

FIGURE 1 SEEDED AND MULCHED DECOMMISSIONED ROAD AT STATIONING MC 55+00

Bird Track Springs – Fish Salvage Overview 2018-2019

Year 1 fish salvage efforts began on August 20, 2018 and concluded on September 26, 2018. The terminus to side channel 10, wood structures near station 86+50 and the bend in the river between stations 76+00 and 81+00 were de-fished during the salvage period. Stream temperatures ranged from 12-17 degrees Celsius during the morning hours between 7:00-9:30 am during the August salvage and 6.9-11.2 C during September. A summary of the catch is below:

- 22 age-0, 9 age-1 and 1 age-2 for a total of 32 *O.mykiss* were captured during the fish salvage efforts
- 407 Pacific lamprey ammocoetes
- 81 western Pearlshell mussels
- The majority of the biomass salvaged was a healthy assemblage of freshwater cyprinids (dace, sculpin, shiner and suckers)

Fish salvage efforts for Year 2 began on July 1, 2019 and concluded on July 17, 2019. Year 2 fish salvage efforts were divided into two reaches; upper and lower reaches of main channel Grande Ronde River, divided at Sta. 36+00. Beginning July 8 the lower reach was de-fished over a four-day period and required four passes with electrofishers and netters. The following week the upper reach was salvaged beginning July 15 and ending July 17, 2019. Three passes were necessary to remove fish from the Upper reach during these three days. Stream temperatures ranged from 12 to 18 degrees Celsius during the morning hours between 6:00a – 12:00p. Sections of bypass channels that were to be decommissioned and filled were also salvaged. A summary of the catch is below:

- 11 age-0, 86 age-1, 44 age-2, and 4 age-3 for a total of 145 *O.mykiss* were captured during fish salvage efforts.
- 41 age-0, and 5 age-1 Chinook were salvaged.
- Other freshwater species made up the majority of fish captured during salvage efforts (sculpin, dace, shiner, suckers, and pikeminnow)
- 550 Pacific lamprey ammocetes were captured by fish salvage crew. A separate crew from CTUIR Lamprey Project conducted their own salvage targeting only lamprey while fish salvage crew focused primarily on fish removal.
- 10,000+ western Pearlshell freshwater mussels were salvaged and relocated to nearby existing colonies outside of project area with guidance from CTUIR Freshwater Mussel Project staff.

Monitoring Plan

Commonly used engineering models generally provide a good basis for restoration design and prediction of stream channel function over time; however, in the case of complex channel reconstruction, these models have limited capacity. Rather than increasing data collection and model complexity, which would not necessarily ensure a better project, a monitoring and adaptive management approach is warranted. The purpose of this monitoring and adaptive management plan is to extend project management, which generally includes conception, planning, implementation, and closure, to include longer-term monitoring that will address not only implementation compliance, but project effectiveness as well. By developing a robust monitoring plan that is linked to project objectives and maintenance actions, the assurance of project success and minimization of negative impacts to aquatic habitat and species is greatly increased.

The goal of this habitat monitoring is to provide empirical data to restoration managers on fish responses/use of restoration structures, new channels, and floodplains. In addition to fish response, data will be collected on biological and physical factors that affect stream health and habitat suitability in order to track trends post restoration that will inform project effectiveness. Some elements include: water and air temperature, cold water refugia, river flows and stage recording, groundwater elevation, aerial and ground photo documentation of floodplain vegetation development and inundated flood area.

Monitoring objectives are:

1. To provide restoration managers with information about fish response/use of different types of habitat structure, constructed channel segments, or floodplain habitat.
2. To provide –empirical data on changes in thermal refugia associated with the restoration project.
3. To provide – Macro invertebrate assemblage information from different habitats within the restoration area.

Monitoring objectives will be accomplished by:

- Determining whether juvenile and adult fish responses are positively affected within the project area, post restoration compared to pre-restoration levels (such as increased juvenile abundance and densities, and increased spatial distribution of juveniles and redds).
- Determine fish use of restoration structures, such as large wood sites, constructed pools, side channels, alcoves, flood prone areas etc.
- Collecting continuous water temperature, groundwater elevations, and flow stages from established sites within project area pre and post restoration.
- Mapping thermal refugia within the project area pre and post restoration during snorkel surveys.
- Collect macroinvertebrate samples and compare assemblage's pre and post restoration.
- Conducting habitat surveys to measure LWD and collect bathymetric data with total station.
- Document floodplain vegetation development using aerial and ground photo points, as well as mapping inundated flood area using UAV (drone) flights.

TABLE 2 MONITORING METHODS, METRICS, AND SURVEY FREQUENCY

Method	Citation	Metrics	Temporal Frequency and Extent	Tasks
Snorkel Survey	White (2011), Crawford (2011)	Juvenile salmonid abundance, density, species diversity, habitat usage	Annual- low flow season	snorkel survey
			Year 1, 3, 5 minimum	Data QA/QC and loading into CDMS, data summary
Juvenile salmonid floodplain use sampling development (Catherine Creek – Southern Cross)	Sommer (2001)	Juvenile abundance, density, growth	Annual – 3 sample events during floodplain inundation for 3 consecutive years.	Develop and initiate floodplain sampling protocol
				Data QA/QC and loading into CDMS, data summary
Spawning Survey	Gallagher (2007), Nelle (2009)	Adult spawning and holding	Annual-Bimonthly during seasons	Bimonthly Field surveys March-June and August-September
			Steelhead March to June. Chinook August/September. Review at year 5 post restoration.	Data QA/QC and loading into CDMS, data summary
Targeted Riffle & Multi Habitat Benthic Samples	Peck (2006)	Macroinvertebrate Assemblage, B-IBI	Annual-low flow season	Field Sample Collection for 12 samples
			10 years post restoration	Shipping and Lab Analysis Costs x12

Project Funding and Budget

Bird Track Springs Restoration Project activities were made possible through several funding agreements with the Grande Ronde Model Watershed (GRMW)/Bonneville Power Administration (BPA), and the Oregon Watershed Enhancement Board (OWEB). GRMW/construction costs, and another $ 1,033,105 to procure large wood material, plant materials and planting subcontracts. In addition, $274,656 was contributed through the CTUIR-BPA Fish Accord. Funding received from OWEB totaled $ 497,076.

TABLE 3 2018-2019 PROJECT CONSTRUCTION BUDGET FOR COMBINED YEARS 1 AND 2.

Lindley Contracting, LLC Bird Track Springs Construction Budget			
Item	**Description**	**Unit**	**Quantity**
1	Mobilization and Demobilization	Lump Sum	Lump Sum
2	Temporary Traffic Control	Lump Sum	Lump Sum
3	Environmental Controls (SWPPP, ESC, Etc.)	Lump Sum	Lump Sum
4	Install and Maintain Temporary Access Routes	Lump Sum	Lump Sum
5	Work Area Isolation, Channel Diversion, and Water Management	Lump Sum	Lump Sum
6	Construction Surveying	Lump Sum	Lump Sum
7	Provide Temporary Channel Crossings	Lump Sum	Lump Sum
8	General Site Clearing	AC	2.6
9	Sod Salvage, Store, Maintain, and Place	SQYD	7000
10	Salvage, Maintain, and Transplant Riparian Clumps	SQYD	7275
11	Earthwork - Excavate, Haul, Segregate, Store, and Place	CY	82723
12	Channel Materials Screening	CY	8885
13	Furnish and Place Class 100 Rip-Rap	CY	0
14	Furnish Class 700 Rip-Rap (for Riffle at Station 18+16) (Class 714 w/o fines)	CY	0
14a	ADD - 7-14" Rock Imported (Came in as washed)	CY	0
14b	ADD - 7-14" Angular Basalt Rock (non-washed)	CY	0
14c	ADD - 4"+ washed rounded river rock (blind channels)	CY	475
15	Constructed Riffles	CY	9973
16	Constructed Point Bars	CY	846
17	Constructed Glides	CY	0
18	On-Site Boulder Salvage and Placement	Each	1696
19	Type A1 - Apex Jam	Each	14
20	Type B1 - Meander Jam - Upstream Component	Each	3
21	Type B2 - Meander Jam - Middle Component	Each	4
22	Type B3 - Meander Jam - Downstream Component	Each	13
23	Type B4 - Meander Jam - Mallet Jam	Each	7
24	Type C1 - Longitudinal Channel Margin Jam	Each	21
25	Type C2 - Angled Channel Margin Jam	Each	38
26	Type D1 - Deflector Jam (Small)	Each	8
27	Type D2 - Deflector Jam (Large)	Each	3
28	Type D3 - Split Deflector Jam	Each	1
29	Type E - Single Log Sweeper Jam	Each	19
30	Type E - Double Log Sweeper Jam	Each	14
31	Type F - Floodplain Roughness	Each	605
32	Type G1 - Side Channel Habitat - Single Log	Each	80
33	Type G2 - Side Channel Habitat - Double Log	Each	0
34	Type G3 - Side Channel Habitat - Triple Log	Each	14
35	Type H - Cover Logs	Each	37
36	Type I1 - Ice Crib Jam	Each	2
37	Type J - Reinforced Habitat Structure	Each	15
38	Brush Bank Treatment	LF	2925
39	Roughened Edge Bank Treatment	LF	4474
40	Live Brush Trench	Each	32
41	Access Road Decommissioning	SQYD	6694
42	Staging Area Decommissioning	AC	8.8
43	Apply Seed to Disturbed Areas Outside of Channel Bank Limits	AC	32
44	Furnish and Place Straw Mulch	AC	32
45	Medium Track Hoe (i.e. CAT 330 or similar)	Hours	378
46	Small Track Hoe (i.e. CAT 318 or similar)	Hours	143
47	Off-Road Dump Truck (i.e. CAT 735 or similar)	Hours	516
48	Dozer (i.e. CAT D6 or similar)	Hours	114
49	ADD - Water Truck	Hours	95.8
50	ADD - Wood Purchase, Large tree w/RW (18" DBH+, 45L)	Each	25
51	ADD - Large Wood Purchase, Med tree w/ or w/o RW (12" DBH+, 30L+)	Each	40
52	ADD -Temporary Fence Install and Removal	Each	1.3
		Total Budget	**$ 2,838,028.00**