CTUIR GRANDE RONDE SUBBASIN RESTORATION PROJECT ANNUAL REPORT
A Columbia River Basin Fish Habitat Project

Northwest Power Planning Council Project # 199608300

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CONFEDERATED TRIBES UMATILLA INDIAN RESERVATION

BONNEVILLE POWER ADMINISTRATION

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Introduction/Background Information

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Grande Ronde Subbasin Restoration Project was initiated by the Confederated Tribes of the Umatilla Indian Reservation in 1996 to protect, enhance, and restore riparian and instream habitat for natural production of anadromous salmonids in the Grande Ronde River Subbasin. The project is coordinated with multiple basin partners to promote land stewardship and enhance habitat for focal fish species, primarily spring Chinook salmon, summer steelhead, bull trout, resident trout and other native species. Emphasis is placed on improving juvenile rearing habitat and adult spawning habitat by restoring natural channel morphology and floodplain function, cold water refugia, and complex aquatic habitat that supports required life histories for focal species.

During Fiscal Year 2019 (May 1, 2019-April 30, 2020), the CTUIR was involved in multiple planning processes and projects. Basin planning, coordination and project review and vetting was coordinated through the Grande Ronde Model Watershed Board of Directors and Technical Implementation Team. CTUIR staff focused project development and implementation on the Bird Track Springs, Middle Upper Grande Ronde River, Longley Meadows Project. Staff also participated on project planning teams for the Buffalo Flats and Hall Ranch Projects. Additionally, CTUIR staff provided technical assistance to multiple project partners, including the USWCD and Trout Unlimited involving topographic survey for the Elmer Dam passage project and development of design drawings for the USFS Middle Fly Creek Project. Project staff continued BPA-CTUIR Accord land acquisition planning, identification, and development of future site specific fish habitat projects. Project development and initial planning included; baseline field surveys, assessments, development of conceptual project plans, coordination with private landowners, and initiation of environmental planning.

During the reporting period, project staff were focused on: 1) CC44 Southern Cross Conservation Property monitoring, adaptive management, and ongoing maintenance, 2) Longley Meadows project planning, design, environmental permitting, and construction; 3) Bird Track Springs year 2 construction period beginning in January, 2019 and completed December, 2019; 4) Middle Upper Grande Ronde River (MUGR) Phase I project planning, design, and environmental permitting, and implementation and 4) Dark Canyon Cunha, Catherine Creek Southern Cross, Kinsley, Kirby, Fite, and Rock Creek conservation easement maintenance. Additionally, CTUIR staff continued to coordinate with the Wallowa-Whitman National Forest on fish passage and habitat project planning and development in the headwaters of the Grande Ronde Basin.

Project effectiveness monitoring was continued through our habitat program and the CTUIR Research, Monitoring and Evaluation Program in select project areas to track trends and response. Information and data collection included drone imagery, photo points, water temperature, groundwater, vegetation, geomorphic and instream habitat and fish spawning and rearing.

Finally, our program continued to scope and develop future project opportunities through the GRMW Stepwise Process, including development of Project Prospectus' coordination with BPA Tributary Lead and Bureau of Reclamation program staff

Background

The CTUIR retains aboriginal and treaty rights related to fishing, hunting, pasturing of livestock, and gathering of traditional plants within the Tribes Ceded Territory, including the Grande Ronde Subbasin. The CTUIR Department of Natural Resources (DNR) has developed and accepted a First Foods organization and approach to ecosystem management based on the cultural traditions and practices of the Longhouse. The organization follows the serving order of food and conceptually "Extends the Table" to manage for sustainability within the Ceded Territory. The First Foods are considered to be the minimum ecological products necessary to sustain CTUIR culture. The order is watershed-based beginning with water as the foundation and progressing to salmon (Pacific lamprey, steelhead, trout, and whitefish), deer, cous, and huckleberry. The First Foods provide clear linkages to treaty rights and natural resources and defines direction and goals that relate to the community culture. In conjunction with the First Food principle, the CTUIR DNR developed the River Vision (Jones K. L., 2008) that describes and organizes ecological processes and functions that provide the First Foods.

The River Vision outlines physical and biological processes encompassing 5 touchstones: **Hydrology, Geomorphology, Connectivity, Riparian Vegetation, and Aquatic biota** which together with the First Foods, provide an overall framework for guiding tribal programs in regards to protecting and restoring ecological processes and functions. Healthy watershed processes and functions are the fundamental elements that create diversity, resiliency, and the ability of our river systems to provide sustenance and natural resources to support our culture and heritage.

The Subbasin historically supported viable and harvestable populations of spring/summer and fall Chinook salmon (*Oncorhynchus tshawytscha)*, coho salmon (*O. kisutch*), sockeye salmon (*O. nerka),* summer steelhead *(O. mykiss),* Pacific lamprey (*Entosphenus tridentatus*), bull trout (*Salvelinus confluentus*), rainbow/redband *(O. mykiss sp.)*, and mountain whitefish (*Prosopium williamsoni).* These native fishes are paramount to tribal cultures, economies and the region (CBFWA, 1990) and (CRITFC, 1995). Beginning in the late 1800's, fish populations started to decline with sockeye and coho extirpated in the early 1900's. The abundance of Chinook, steelhead, bull trout, and other fish species has also been dramatically reduced (NPCCa, 2004) and (NPCCb, 2004). With declining fish populations, Tribal governments and State agencies were obligated to eliminate or significantly reduce subsistence and sport fisheries by the mid 1970's. By the early 1990's, Snake River spring-summer Chinook and summer steelhead populations were suppressed to the point of triggering Federal ESA listings (spring-summer Chinook in 1992 and summer steelhead in 1997, and bull trout in 1998). Other native fish, including Pacific lamprey populations are also highly suppressed and with possible future ESA listing. The following tables illustrate estimated historic and current spring Chinook salmon and summer steelhead returns to the Grande Ronde Subbasin (NPCCa, 2004). Of particular note is an 87 percent decrease in spring Chinook and 70 percent decrease in summer steelhead populations from estimated historic levels.

The **CTUIR Grande Ronde Subbasin Restoration Project** (199608300), funded by Bonneville Power Administration (BPA) through the Northwest Power Planning Council Fish and Wildlife Program (NPPC), is an ongoing effort initiated in 1996 to protect, enhance, and restore fish habitat in the Grande Ronde River Subbasin. The project focuses on the mainstem Grande Ronde and major tributaries that provide spawning and rearing habitat for Threatened Snake River spring-summer Chinook salmon, summer steelhead, and bull trout. The project also provides benefits to other resident fish and wildlife.

The project is an integral component of Subbasin Plan implementation and is well integrated into the framework of the Grande Ronde Model Watershed (GRMW) established by the NPCC in 1992 to coordinate restoration work in the Subbasin. As a co-resource manager in the Subbasin, the CTUIR contributes to the identification, development, and implementation of habitat protection and restoration in cooperation with Federal, State, and local agencies. The CTUIR, ODFW, GRMW, and other participating agencies and organizations have made significant progress towards addressing habitat loss and degradation in the Subbasin (see http://www.grmw.org/).

The project was initiated in 1996 under the NPCC-BPA Early Action Project process. The project was proposed through the GRMW and NPCC program to provide the basis from which to pursue partnerships and habitat grant funds to develop and implement watershed and fish habitat enhancement activities in the Subbasin. Annual project budgets have averaged about $136,000 and ranged from a high of $200,000 in 1999. Annual operating budgets and associated tributary habitat efforts by the CTUIR were increased as a result of the CTUIR-BPA Accord Agreement with an annual average budget of $589,500. The project has historically administered multiple grants from various agencies, including Natural Resource Conservation Service (NRCS) Wetland Reserve Program (WRP), CREP, WHIP, and EQIP, OWEB, EPA-ODEQ 319, GRMW-BPA, CRITFC, NMFS, USFWS, ODOT, and NAWCA and developed an effective working relationship with multiple agencies and organizations.

The project has been successful in the development and implementation of several large-scale, partnership habitat enhancement projects and has developed effective interagency partnerships, working at the policy and technical levels with the Grande Ronde Model Watershed Program (GRMWP), federal and state agencies, and private landowners. A complete project overview and technical approach is described in the 2013 NPPC Project Proposal for the CTUIR Watershed Restoration Project (199608300) incorporated here by reference.

During the 24-year project history, the CTUIR has contributed to the development, administration, and implementation of multiple fish habitat enhancement projects along 50 plus river miles in the Grande Ronde Basin. The CTUIR has secured conservation easements totaling about 1,900 acres on six large ranches/farms using a combination of conservation tools, including Natural Resource Conservation Program and BPA programs. *(Figure 4).*

The Project has coordinated and facilitated construction of 18 miles of riparian exclusion fencing, 18 off-channel water developments, installed over 160,000 trees, shrubs, sedge/rush plugs, and seeded over 800 acres with native grass seed. Improving habitat trends and biological response can be readily observed at multiple project sites.

A combination of both passive and active strategies have been employed. Guidance from the CTUIR's River Vision has helped facilitate the shift towards focusing on larger, contiguous stream reaches and broader scale projects that focus on restoring floodplains and physical and hydrological process to form and maintain complex and diverse habitats. Recent projects, including the Catherine Creek complex (CC44) and Bird Track Springs sponsored by the CTUIR as well as project sponsored for basin partners are examples of broader and more completed watershed restoration efforts in the Grande Ronde Basin.

Project summaries, trends, and results are reported in various forms including Pisces status reports, project completion reports, and annual reports. The GRMW maintains a complete database on project implementation and results through development of project completion reports. The CTUIR also maintains and comprehensive data base (Comprehensive Data Management System (CDMS) that houses and maintains project information and data associated with CTUIR Grande Ronde as well as ceded land wide tributary habitat programs administered by the CTUIR.

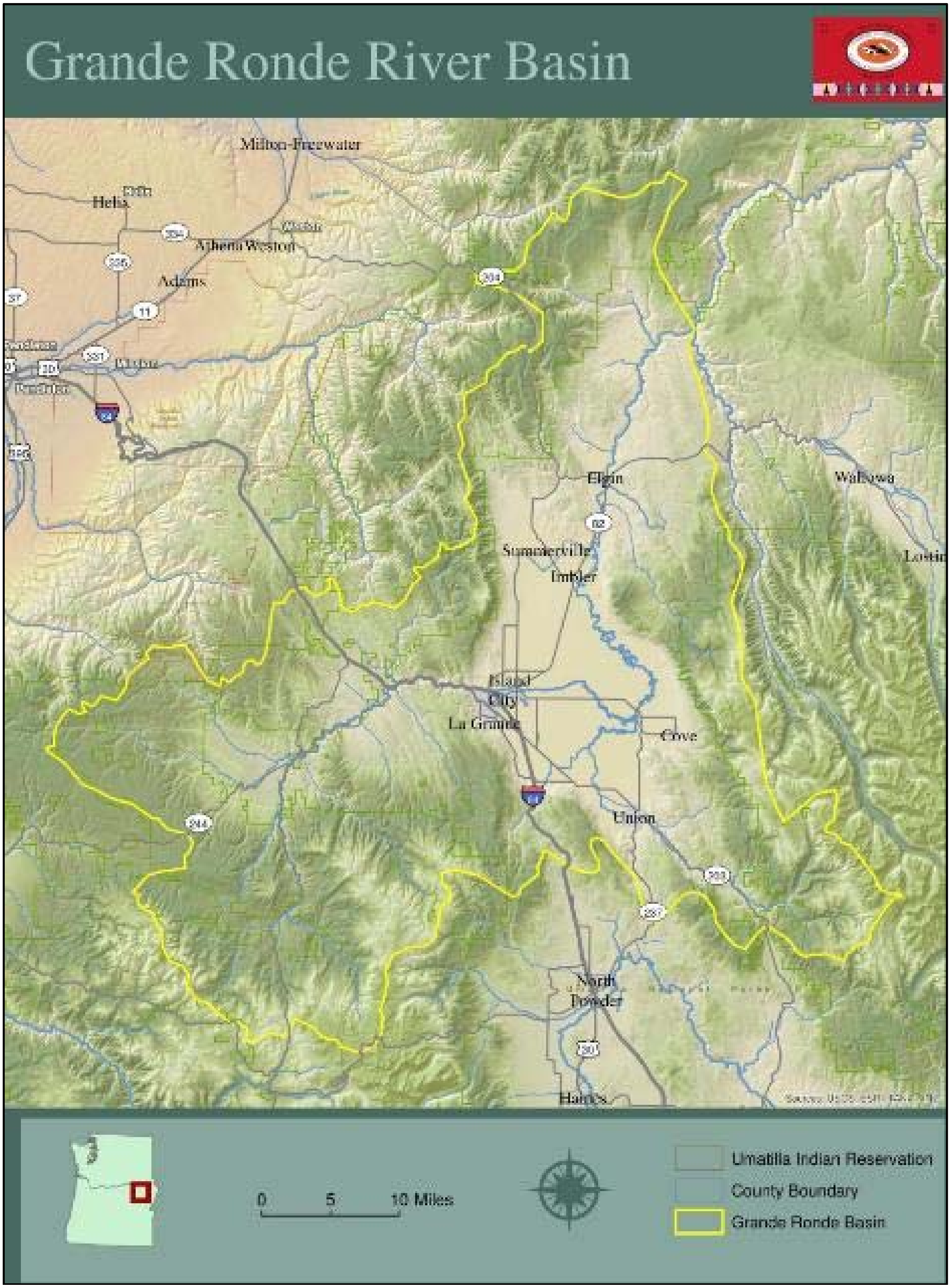
Description of Project Area

The project is located in the Grande Ronde Subbasin, in the southwest portion of the Blue Mountain Ecological province *(Figure 1).* The Subbasin encompasses about 4,000 square miles in northeastern Oregon and southeastern Washington. The headwaters of the Grande Ronde River originate near Anthony Lakes in the Elkhorn Mountains and flow northeast for about 212 miles before joining the Snake River in Washington at river-mile (RM) 169.

The Subbasin is divided into three watershed areas—the Lower Grande Ronde, Upper Grande Ronde, and Wallowa watersheds. Approximately 46 percent of the Subbasin is under federal ownership. Historic land uses include timber harvest, livestock grazing, mining, agriculture and recreation.

A comprehensive overview of the Subbasin is contained in the Grande Ronde Subbasin Plan (NPPC, 2004). The CTUIR Grande Ronde Subbasin Restoration Project focuses primarily on the Upper Grande Ronde portion of the Subbasin, which includes approximately 1,650 square miles with 917 miles of stream network (about 221 miles of salmon habitat).

FIGURE 1 UPPER GRANDE RONDE SUBBASIN VICINITY



However, past project development and success of the program in terms of the types of projects that have been developed and the partnerships that have formed, are leading to watershed restoration project opportunities throughout the Subbasin. Figure 1 illustrates the vicinity of the Grande Ronde Subbasin within the Blue Mountain Province and key projects that have been completed, are underway, or planned under the CTUIR's Grande Ronde Subbasin Restoration Project.

Grande Ronde Subbasin fish populations have declined and habitat degradation is widespread in tributary streams. Mainstem Columbia River harvest, development of Columbia and Snake River hydroelectric projects, and habitat degradation has played an important role in the demise of Grande Ronde Subbasin fisheries (NPCC 2004a and b). Although hatchery programs currently support subsistence and sport fishing opportunities for steelhead and limited Chinook salmon, there remains significant need to re-build viable and harvestable fish stocks throughout the Subbasin.

TABLE 1 SUMMARY OF ESTIMATED HISTORIC AND CURRENT GRANDE RONDE SPRING CHINOOK SALMON RETURNS BY POPULATION (DATA PROVIDED BY B. JONNASSON, ODFW PERS. COMM. 2004)

	Estimated Historic Returns		**Estimated Current Returns**					
Population	count	% of total	count	% of total	**Miles of spawning habitat**	**Adults /Mile Template**	**Adults /Mile Current**	**% Decrease Historic to Current**
Wenaha Spring Chinook	1,800	15%	453	30%	*45.60*	39.48	9.94	75%
Minam Spring Chinook	1,800	15%	347	23%	*42.54*	42.31	8.16	94%
Wallowa-Lostine Spring Chinook	3,600	30%	211	14%	*56.10*	64.17	3.76	95%
Lookingglass Spring Chinook	1,200	10%	190	12%	*29.82*	40.24	6.37	81%
Catherine Creek Spring Chinook	1,200	10%	188	12%	*29.82*	40.24	6.30	84%
Upper Grande Ronde Spring Chinook	2,400	20%	132	9%	*79.11*	30.34	1.67	84%
Total	**12,000**		**1,521**		***283.00***	**42.4**	**5.37**	**87%**

TABLE 2 SUMMARY OF ESTIMATED HISTORIC AND CURRENT GRANDE RONDE SUMMER STEELHEAD RETURNS BY POPULATION (DATA PROVIDED BY B. JONNASSON, ODFW PERS. COMM. 2004)

	Estimated Historic Returns		**Estimated Current Returns**					
Population	count	% of total	count	% of total	**Miles of spawning habitat**	**Adults /Mile Template**	**Adults /Mile Current**	**% Decrease Historic to Current**
Lower Grande Ronde	2,400	16%	608	14%	253.84	9.45	2.39	75%
Joseph Creek	3,600	24%	945	21%	223.10	16.14	4.24	74%
Wallowa River	3,750	25%	1,193	27%	173.45	21.62	6.88	68%
Upper Grande Ronde	5,250	35%	1,755	39%	613.96	8.55	2.86	67%
Total	**15,000**		**4,500**		1,264.35			**70%**

Figures 2 and 3 display estimates of historic and current abundance, productivity, and life history diversity predicted through the Ecosystem Diagnosis and Treatment (EDT) Method for Grande Ronde Subbasin Chinook salmon and summer steelhead, respectively (NPCC, 2004a and Mobrand, 2003). Graphs illustrate that current abundance, productivity, and life history diversity for spring Chinook and summer steelhead has been reduced from estimated historic levels.

Chinook and steelhead populations furthest from historic potential are in geographic areas that have experienced the highest levels of anthropogenic influence with significant declines illustrated for Wallowa-Lostine, Catherine Creek, Lookingglass, and Upper Grande Ronde spring Chinook and Upper Grande Ronde, Wallowa, and Joseph Creek summer steelhead. Current productivity and life history diversity for spring Chinook in the Wenaha and Minam watersheds (primarily designated wilderness areas) is similar to estimated historic conditions (NPPC, 2004a).

FIGURE 2 EDT ESTIMATES OF ABUNDANCE, PRODUCTIVITY, AND LIFE HISTORY DIVERSITY COMPARED TO THE ESTIMATED HISTORIC POTENTIAL FOR GRANDE RONDE SUBBASIN CHINOOK SALMON (NPCC 2004A, FIGURE 8, PG. 54)

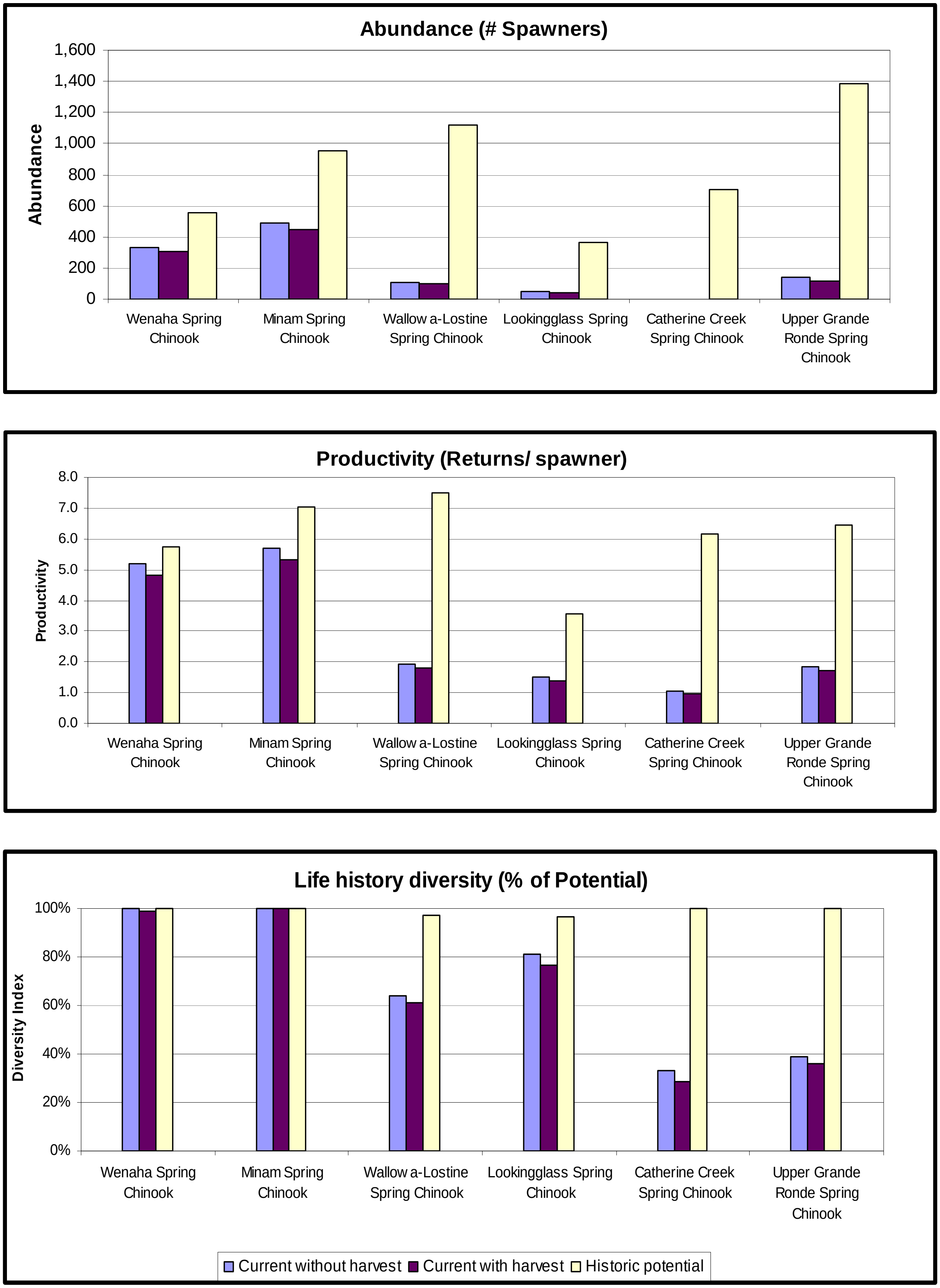
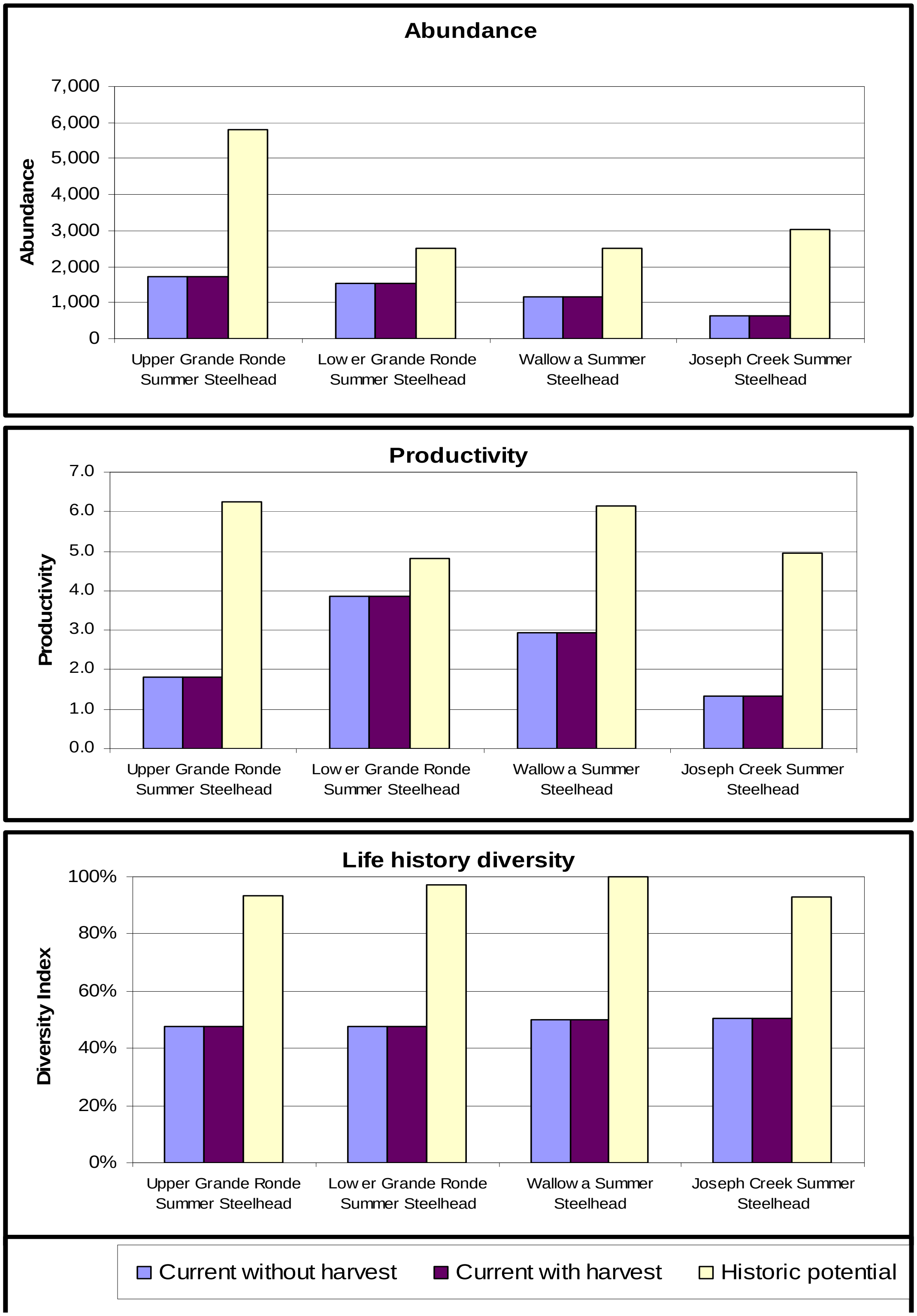


FIGURE 3 **EDT ESTIMATES OF ABUNDANCE, PRODUCTIVITY, AND LIFE HISTORY DIVERSITY COMPARED TO ESTIMATED HISTORIC POTENTIAL FOR GRANDE RONDE SUBBASIN SUMMER STEELHEAD (NPCC 2004A, FIGURE 22, PG. 72)**



Degradation of instream and riparian habitat in the Subbasin has been the dominant cause of salmon and steelhead decline (NPCC, 2004). The adverse effects of poorly managed logging, grazing, mining, dams, irrigation withdrawals, urbanization, exotic species introductions, and other human activities have been documented in all of Columbia River tributaries (ISG 1996). Riparian and instream habitat degradation has most severely impacted spring Chinook production potential in the Grande Ronde Subbasin (ODFW and CTUIR 1990, NPCC 2004a) and habitat loss and degradation has been widespread with the exception of road-less and wilderness areas (Anderson et al. 1992; CTUIR 1983; Henjum et al.1994; McIntosh et al. 1994).

Approximately 379 miles of degraded stream miles have been identified in the Subbasin (ODFW et al. 1990), with an estimated 80 percent of anadromous fish habitat in a degraded condition (Anderson et al. 1992). McIntosh (1994) documented a 70 percent loss of large pool habitat in the Upper Grande Ronde River since 1941. Riparian shade on low gradient streams was found to be less than 30 percent (Huntington, 1993). Stream channelization, diking, wetland drainage, and use of splash dams were common and widespread practices until the 1970's resulting in severe channel incision and degradation in some locations. The Oregon Department of Environmental Quality (ODEQ) listed over 60 stream reaches in the Subbasin on the State's list of water quality limited water bodies 303 (d). Of these stream segments, 24 are listed for habitat modification, 27 for sediment, and 49 for temperature. Table 3 illustrates priority areas for water quality treatment in the Subbasin (ODEQ, 2000).

TABLE 3 GEOGRAPHIC PRIORITY AREAS FOR WATER QUALITY TREATMENT IN THE UPPER GRANDE RONDE WATERSHED DEVELOPED THOURSOUGH TMDL PROCESS (H=HIGH, M=MEDIUM, L=LOW) (NPCC 2004A, TABLE 18, ODEQ, 2000)

Watershed	Temperature	Sediment	Flow
Lookingglass	L[1]	L	L
Lower Grande Ronde	L	L	L
Willow/Philips	H	H	H
Indian/Clark	M	M[2]	M
Catherine Creek	H	H	H
Beaver	M	M	L[3]
GRR Valley	H	H	H
Ladd Creek	H	H	H
Upper Grande Ronde	H	H	H[4]
Meadow Creek	H	H	H[4]
Spring/Five Pts.	H	M	M

Watershed analysis through the EDT (NPCC, 2004a and Mobrand, 2003) and synthesis through the Subbasin Plan Management Plan development process, identified instream habitat condition, high water temperature, sediment loads, and flow modification as primary limiting factors for Chinook and steelhead (pg. 11 NPCC 2004c, pg. 3 NPCC 2004d). Primary habitat degradation includes:

- **Channel Habitat Conditions** – Channel instability associated with removal of streamside cover and channelization has resulted in channel incision/down cutting, increased gradient, reduced channel length, elevated erosion, increased width-to-depth ratios, and loss of channel complexity. The quality of instream habitat has correspondingly been altered throughout much of the Subbasin.

- **Sediment** – Loss of upland and streamside vegetative cover has increased the rates of erosion. Soils lost from upland areas has overwhelmed hydraulic processes resulting in decreased availability of large pool habitat, spawning areas, riffle food production, and hiding cover.
- **Riparian Function** – Riparian habitat degradation is the most serious habitat problem in the subbasin for fish (McIntosh 1994, ICBEMP 2000). The loss of floodplain connectivity resulting from road/dike construction and channel incision, in addition to reduced habitat suitability for beaver, have altered dynamically stable floodplain environments and contributed to degradation and limited habitat recovery." This loss leads to secondary effects that are equally harmful and limiting, including increased water temperature, low summer flows, excessive winter runoff, and sedimentation.
- **Low Flow** – Water resources in many streams have been over-appropriated resulting in limited summer and fall base flow, development of fish passage barriers, and increased summer water temperatures.

Table 4 illustrates key habitat limiting factors by geographic priority area. The table has been edited from the Subbasin plan to depict only those geographic areas addressed under this proposal. These watersheds have been identified as the three highest priority areas to conduct habitat restoration with the greatest response in Chinook salmon and steelhead production potential (NPCC, 2004a, Supplement, Pgs. 49-50, Table 5-6).

TABLE 4 GRANDE RONDE SUBBASIN PRIORITY GEOGRAPHIC AREAS AND HABITAT LIMITING FACTORS (NPCC, 2004A)

Watershed	Fish Population(s)	EDT Priority Geographic Area(s) highlighted areas are priorities for multiple pops.	Habitat Limiting Factors
Wallowa River (including Lostine River)	Wallowa Steelhead Wallowa-Lostine Chinook Lostine/ Bear Cr Bull Trout	**Steelhead Priorities** Prairie Creek Upper Wallowa River –Wallowa Chinook Hurricane Cr , Whiskey Cr Lower Wallowa (1-3) -Minam Steelhead **Chinook Priorities** Lower Lostine – Wallowa Steelhead Mid-Wallowa – Wallowa Steelhead	➢ Key Habitat Quantity (reduced wetted widths) ➢ Habitat Diversity (reduced wood, riparian function) ➢ Sediment ➢ Temperature ➢ Flows
Upper Grande Ronde	Upper GR Steelhead Upper GR Chinook Upper GR Complex Bull Trout	Mid GR 4 (GR 37 - 44) - Chinook Mid GR Tribs 4 (Whiskey, Spring, Jordan, Bear, Beaver, Hoodoo…) Phillips Creek Upper GR Ronde 1 (45-48) - Chinook Mid GR 3 (GR – 34-36) Valley Sheep Cr, Fly Cr, Lower Meadow Cr – Chinook	➢ Sediment ➢ Flow ➢ Temperature ➢ Key Habitat Quantity (reduced wetted widths)
Catherine Creek/ Middle Grande Ronde	Upper GR Steelhead Catherine Cr Chinook Catherine Cr Bull Trout Indian Cr Bull Trout	Mid Catherine Creek (2-9) – UGR Steelhead SF, NF Catherine Creek Lower Grande Ronde R. 2	➢ Key Habitat Quantity (reduced wetted widths) ➢ Habitat Diversity (reduced wood, riparian function) ➢ Sediment ➢ Flow ➢ Temperature

Habitat protection and restoration needs in the Subbasin have been recognized in numerous reviews, planning processes, and reports (CTUIR, 1983), Noll and Boyce 1988, (ODFW, 1990), Wallowa-Whitman et.al. 1992, (Huntington, 1993) GRMWP (1994), (Mobrand, 2003), (NPCC, 2009), and (NPCCa, 2004). NPCC (2004a) Appendix 5 (pg 254) provides a relatively complete list of habitat protection and restoration strategies that can be applied to achieve goals and objectives.

The NMFS proposed recovery plan for Snake River Chinook salmon recognized the importance of tributary habitat restoration and protection of habitat on both federal and private lands to Chinook and steelhead recovery (NMFS, 1997). NMFS has recently restarted the recovery planning effort for Chinook salmon and steelhead and tributary habitat restoration is expected to play a prominent role in the final NMFS recovery plan. NRC, (1996) has also noted the importance of protecting and rehabilitating freshwater habitat as part of salmon recovery. They specifically note the importance of riparian areas and recommend that habitat reclamation or enhancement should emphasize rehabilitation of ecological processes and function.

The USFWS draft bull trout recovery plan recognized the importance of habitat protection and restoration as well (USFWS, 2002), specifically noting the need to improve water quality, reduce or eliminate fish passage barriers, and restoring impaired instream and riparian habitat.

Noteworthy Accomplishments, FY2019

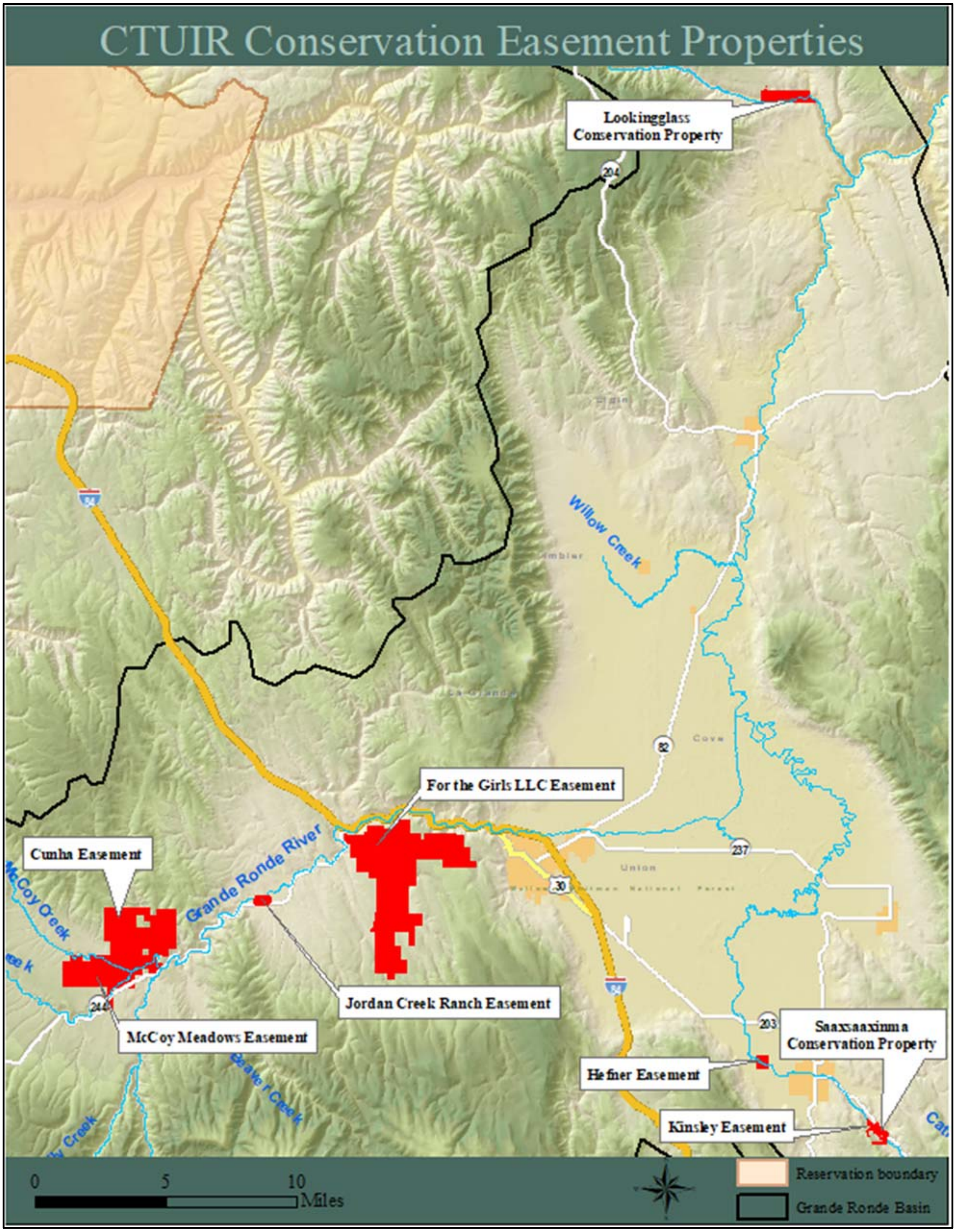
- Continued fish habitat enhancement activities, including maintenance, monitoring, and adaptive management, on the Catherine Creek (CC 44) Southern Cross Phase III project, which permanently protects 1 mile mainstem and 64 acres of historic floodplain.
- Maintained and monitored conservation easements on the Grande Ronde River, Catherine Creek, Rock Creek, Meadow Creek, McCoy Creek, and Dark Canyon Creek (Figure 4).
- Initiated planning, field surveys, and design on projects planned for construction through 2020 including:
    - Wood acquisition for the Middle Upper Grande Ronde River (MUGRR) Project Phase 2.
    - Continued planning and design on the Catherine Creek RM 54 Project, the Lookingglass Conservation Property, the CTUIR McCoy Meadows Conservation Property, the Longley Meadows Project, the Middle Upper Grande Ronde River (MUGRR) Phase 2 Project, and the Catherine Creek Adult Weir Project.

- Completed construction of the Bird Track Springs Project. Construction activities included:
    - Environmental controls followed (installation of silt fence, 1200C permit and dust abatement)
    - 75,389 CY (54%) of channel excavation (approximately 5,000 feet of main channel and about 9,500 feet of side channel) and 8885 CY of material screening
    - 9973 cubic yards constructed riffles and 832 imbedded boulders
    - 846 cubic yards constructed point bars
    - 6694 square yards access road decommissioning
    - 8.8 acres staging area decommissioning
    - 145 large wood structures along the main channel

    - 750+ wood pieces along floodplain, side channel, and alcoves
    - 7,400 feet willow brush bank/roughened edge treatments
    - 8 alcoves constructed
    - 2 temporary bridges installed and removed
    - 7,000 square yards of sod salvage, storage and placement
    - 7275 square yards of woody riparian clumps salvaged and transplanted
    - 56% of riffles and 11% of point bars completed
    - Applied native grass seed (15 lbs/ acre) and straw mulch to 24 acres of disturbed area
    - Approximately 125 acres of floodplain connected

- Project Leader participated on the Grande Ronde Model Watershed Board of Directors
- Project Leader and Assistant Biologist participated in the Technical Implementation Team as part of the GRMW Step Wise and Atlas Strategic Planning and Project Development Process.
- Project Leader and Assistant Biologist participated in NRCS Local Working Group and Regional Conservation Partnership Program planning (RCCP).
- Staff conducted monitoring and evaluation activities on project areas, including expanded water temperature and groundwater monitoring efforts at restoration sites and application of ungulate browse deterrent.
- CTUIR habitat staff supported other research and monitoring efforts at project sites including AEM and CTUIR physical habitat monitoring program.
- CTUIR staff hosted multiple tours on the Bird Track Springs Project for groups and individuals during 2019, including local newspaper article interviews, Trout Unlimited groups, the Oregon Water Resources Sponsored Place-Based Planning Group, U.S. Forest Service Regional Managers, Bureau of Reclamation groups, and tours with other agencies and individuals.
- Project Leader and Biologists presented at symposiums, meetings, and information sessions including GRMW Implementation Team meetings, CTUIR Habitat Program meeting, 2019 State of the Science Meeting, 2019 CTUIR Legal Counsel Retreat, CTUIR Department of Natural Resources Open House, Grande Ronde Habitat temperature presentation, and Grande Ronde Basin Partnership OWEB FIP presentation, and Buffalo Flats Project public information meeting..
- Pursued future restoration efforts by continuing discussions with federal land managers and private landowners about restoration opportunities along Catherine Creek, Grande Ronde River, Dry Creek, Whiskey Creek, Indian Creek, Rock Creek, and Winter Canyon Creek.
- Project staff coordinated with landowners, NRCS, and UCSWCD to provide technical assistance for restoration project enrollment in EQIP, CREP, and OWEB small grants on Rock Creek (For the Girls LLC) and Bird Track Springs (Jordan Creek Ranch).

FIGURE 4 CTUIR CONSERVATION EASEMENT PROPERTIES MAP



Discussion of Completed Work

Bird Track Springs Fish Habitat Enhancement Project

Introduction

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.

FIGURE 5 BIRD TRACK SPRINGS VICINITY MAP

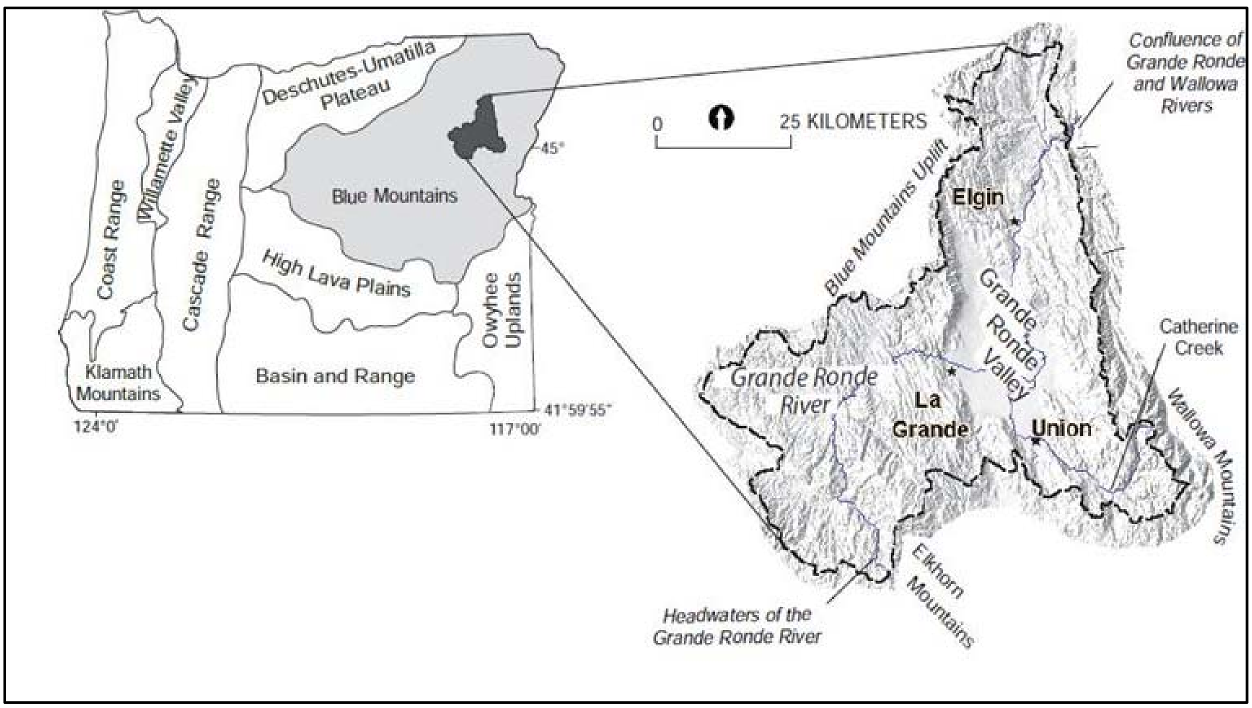


FIGURE 6 BIRD TRACK SPRINGS PROJECT REACH

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)

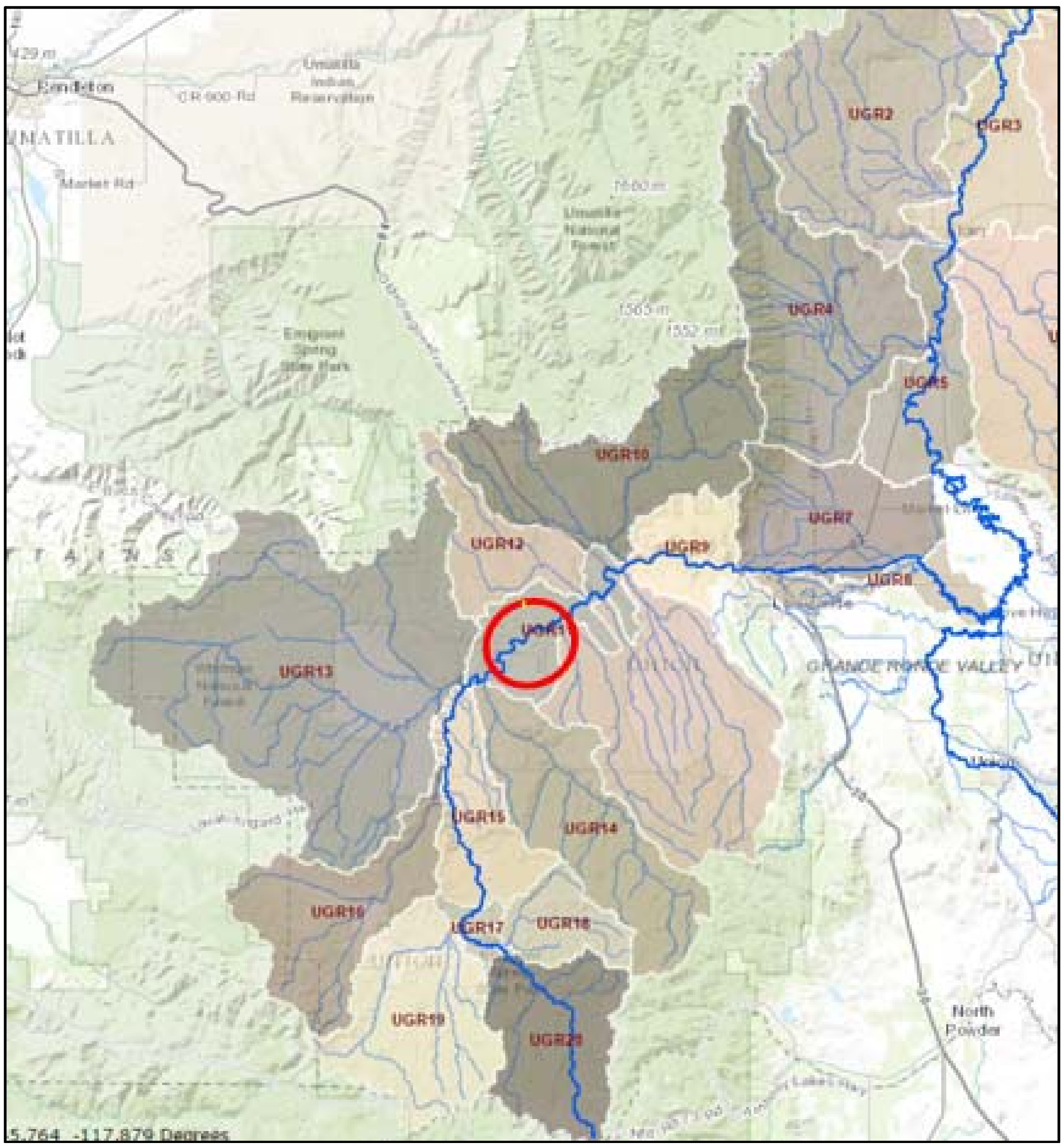
Columbia River bull trout (Salvelinus confluentus), ESA listed as Threatened, June 10, 1998. (http://www.fws.gov/pacific/bulltrout/)

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).

FIGURE 7 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.

FIGURE 8 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.

FIGURE 9 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.

FIGURE 10 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.

FIGURE 11 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.

FIGURE 12 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 planform and long term forest diversity in the project reach.	All	4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 8.1	Low risk areas. Radius of curvature to promote migration.
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.

FIGURE 13 PROJECT OVERVIEW MAP SHOWING AS-BUILT LINEWORK OVERLAYED ONTO POST-PROJECT AERIAL IMAGERY

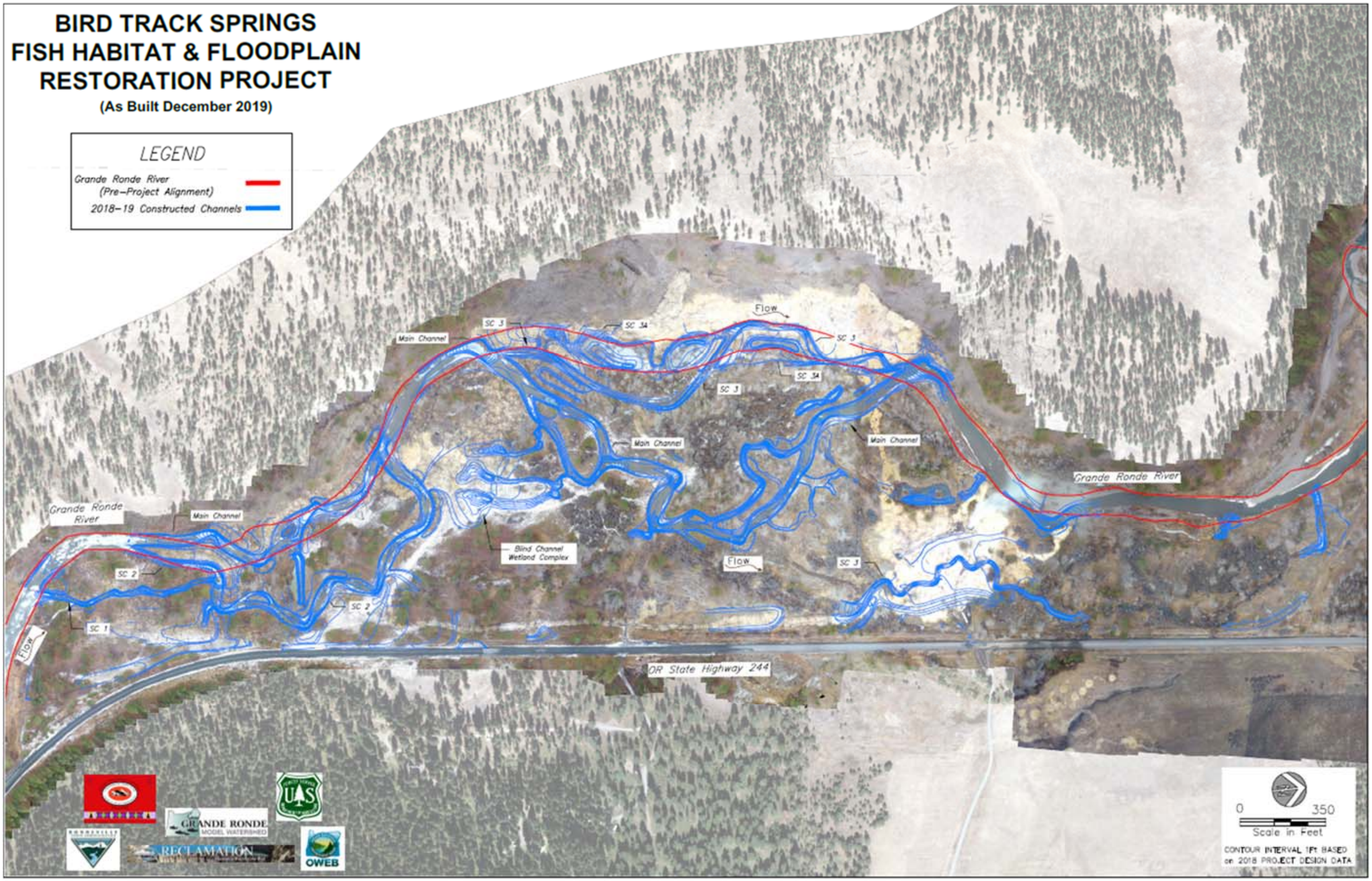
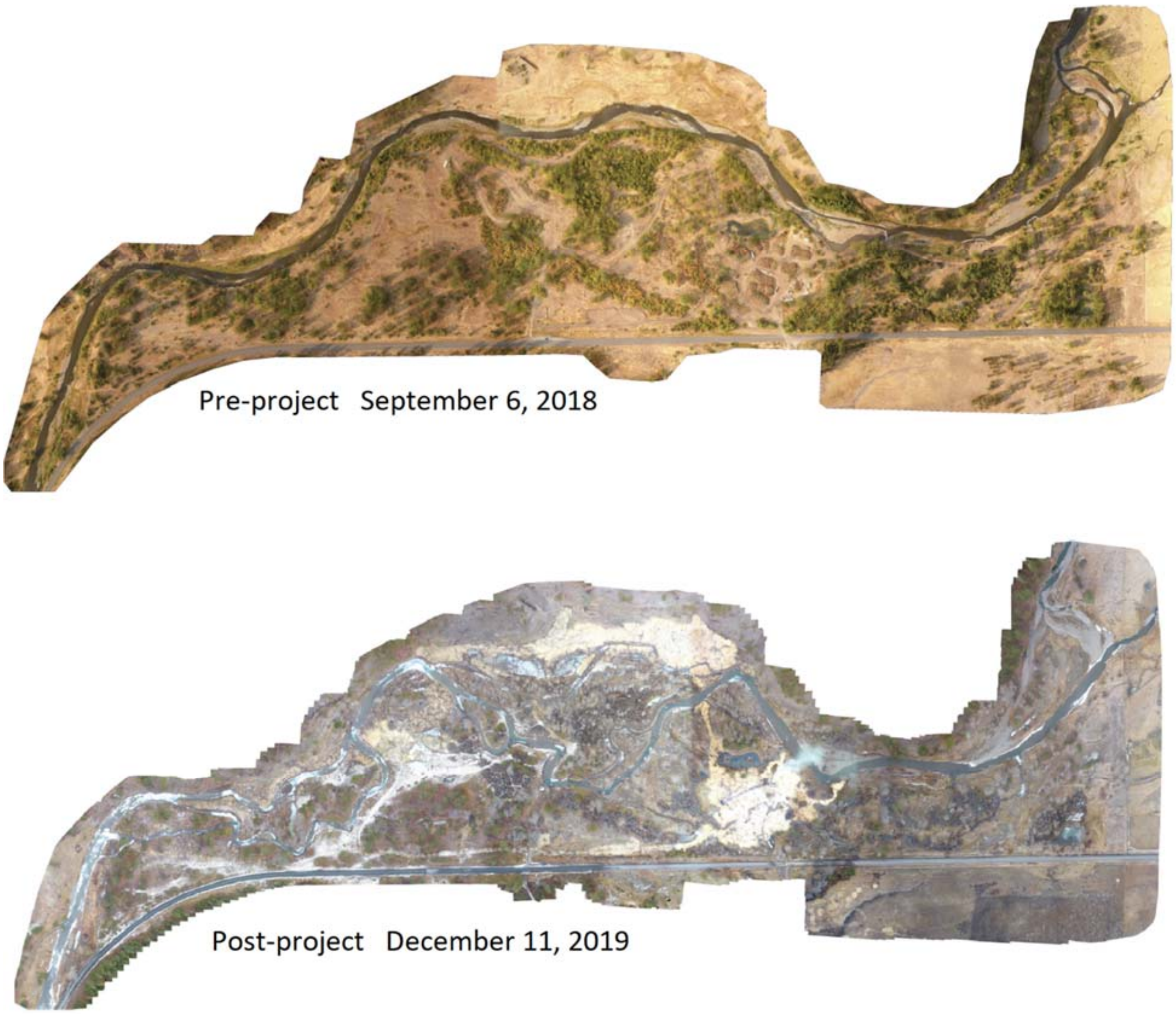


FIGURE 14 AERIAL COMPARISON OF PRE-PROJECT CONDITIONS (TOP) AND POST-PROJECT COMPLETED CONSTRUCTION (BOTTOM)



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.

FIGURE 15 VIEWING UPSTREAM. STATIONING MC 22+00 – 26+00, SC2 ENTRANCE

FIGURE 16 VIEWING DOWNSTREAM. STATIONING MC 37+00 – 42+00, SC2 AND MC CONFLUENCE

FIGURE 17 GROUND PHOTO POINTS – BEFORE (LEFT) AND AFTER CONSTRUCTION (RIGHT)

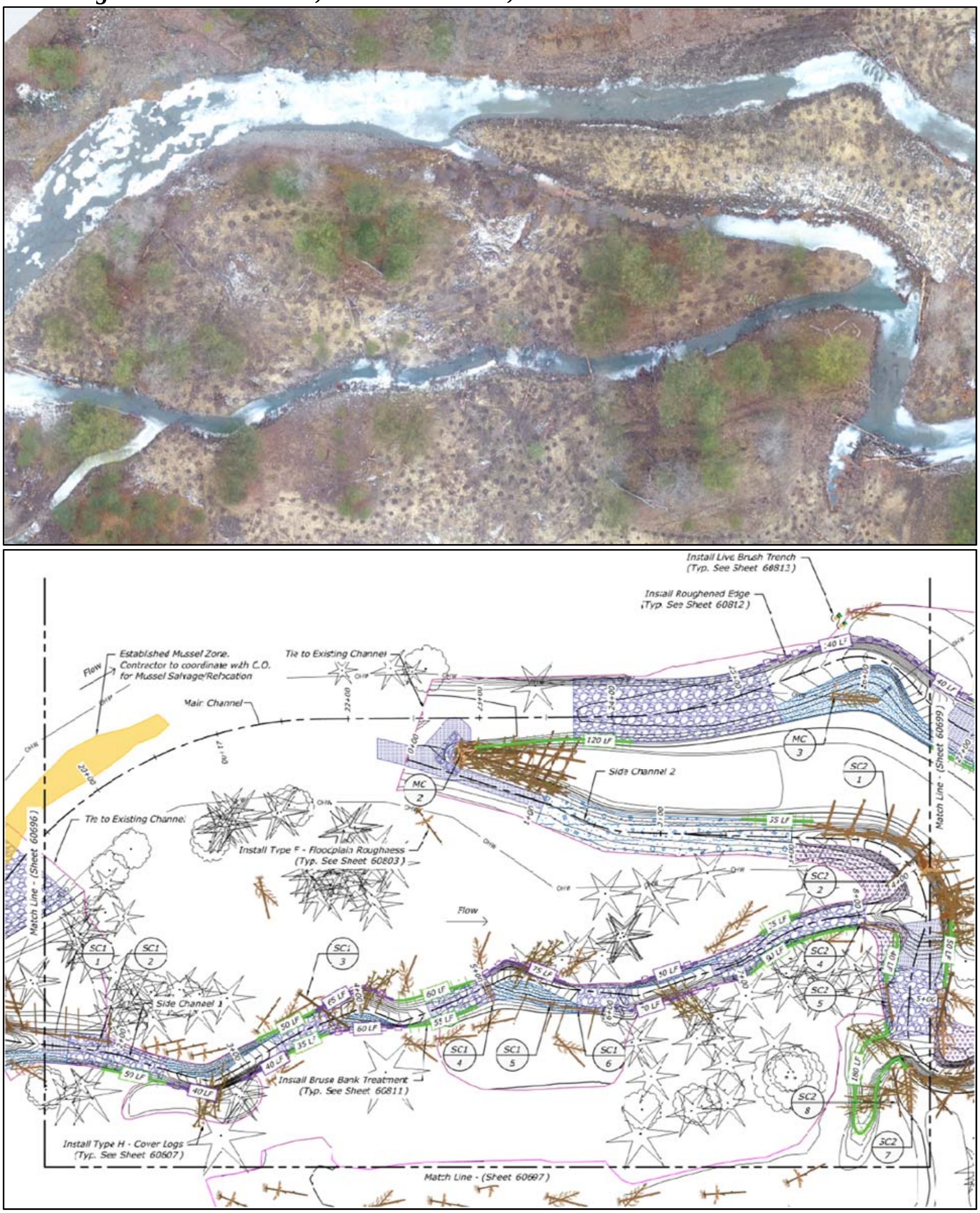
Viewing downstream. Stationing SC1 2+50

Viewing upstream. Stationing SC1 8+00

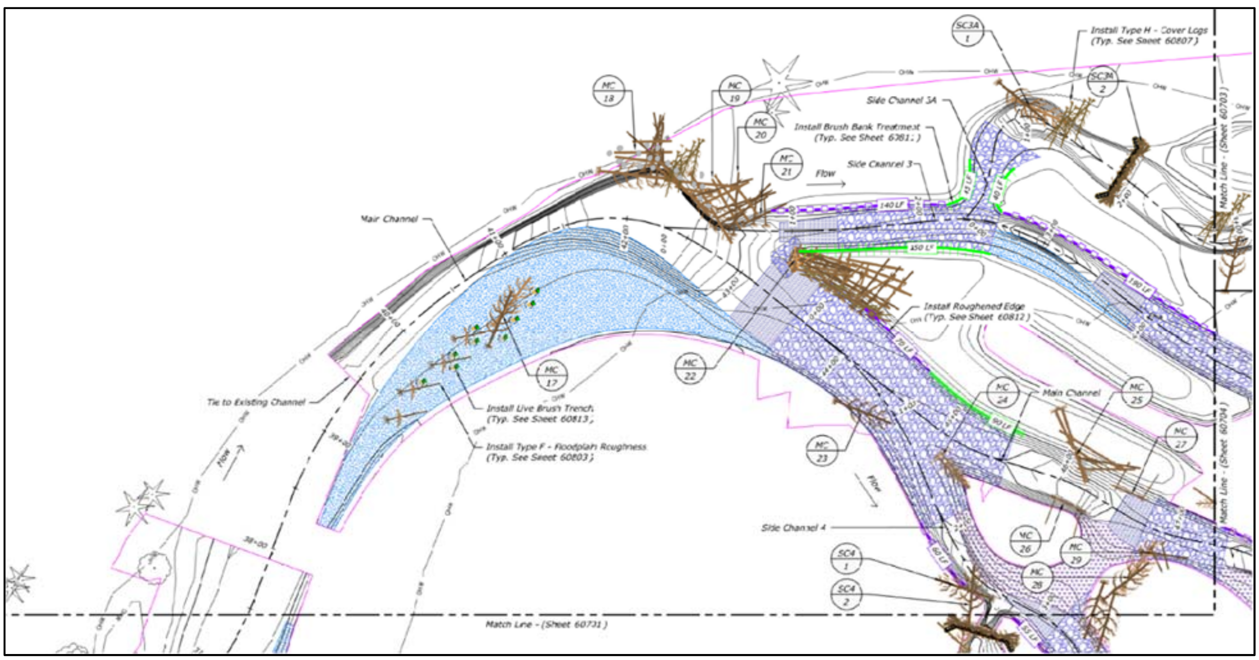
Viewing upstream. Stationing SC2 14+00

FIGURE 18 PHOTOS COMPARING POST-PROJECT CONSTRUCTION AERIAL IMAGRY WITH CORRESPONDING PLANSET DESIGN

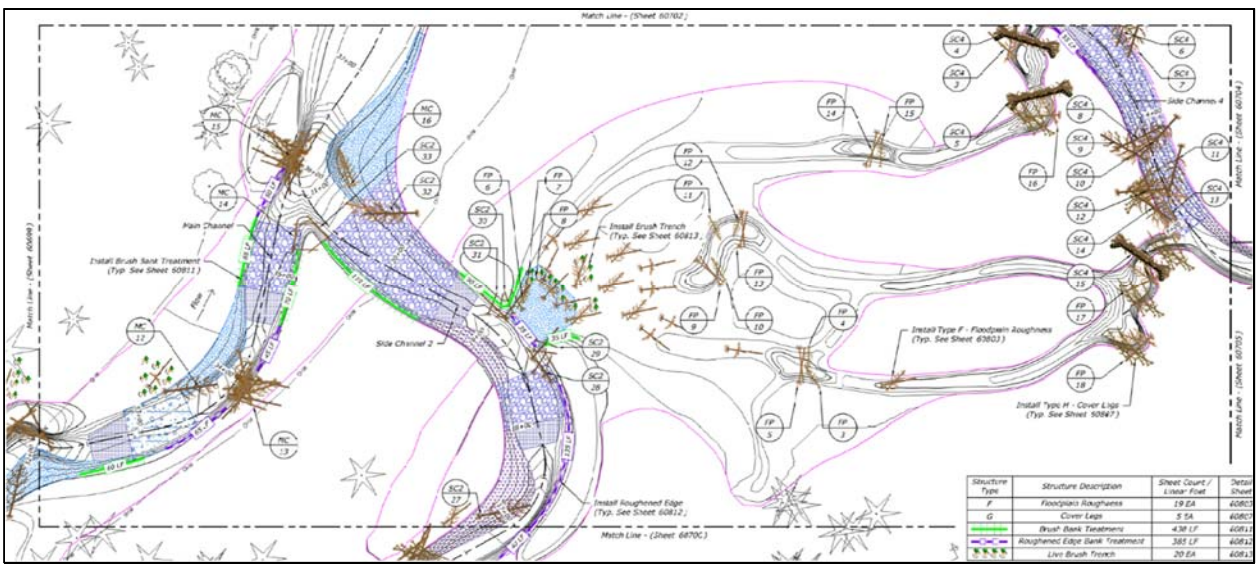
Stationing MC 20+00 – 27+00, SC1 1+00 – 8+00, SC2 1+00 – 6+00



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.

FIGURE 19 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.

FIGURE 20 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.

FIGURE 21 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.

FIGURE 22 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.

FIGURE 23 COMPLETED FLOODPLAIN WOOD STRUCTURE

TABLE 5 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 - Dow nstream 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 - Sw eeper Jam (Single)	32	0	0	0	32	0	0	0	32	0
E1 Sw eeper 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.

FIGURE 24 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.

FIGURE 25 REPLANTED FLOODPLAIN AREAS

Stationing SC2 11+00

Stationing MC 77+00

TABLE 6 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 26 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 7 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 Year 1, 3, 5 minimum	snorkel survey 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 Steelhead March to June. Chinook August/September. Review at year 5 post restoration.	Bimonthly Field surveys March-June and August-September 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 10 years post restoration	Field Sample Collection for 12 samples 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 8 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**

Middle Upper Grande Ronde Fish Habitat Restoration Project (MUGRR)

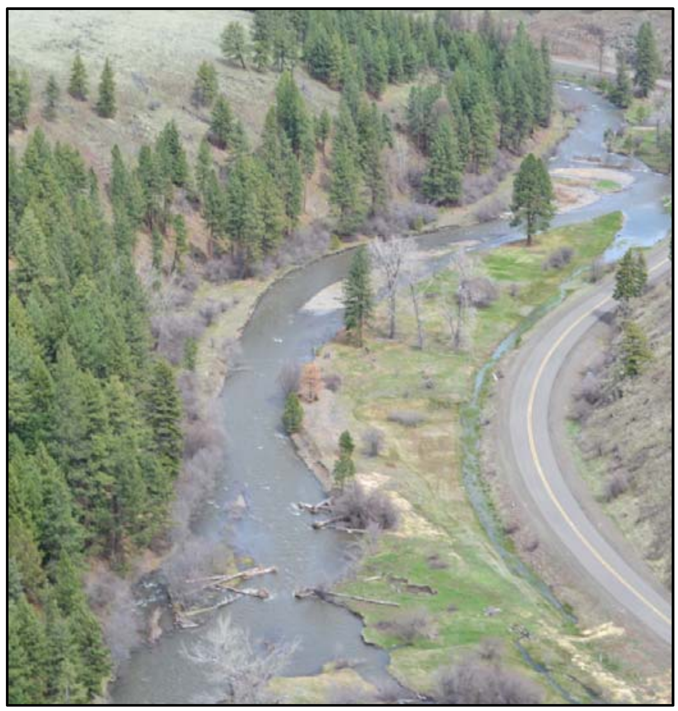
Introduction

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Wallowa-Whitman National Forest (WWNF), La Grande Ranger District, Grande Ronde Model Watershed (GRMW), and Bonneville Power Administration (BPA) partnered on the Middle Upper Grande Ronde River Project Fish Habitat Enhancement Project which was constructed in July, 2019.

The project is located in the Upper Grande Ronde Subbasin along the Grande Ronde River between RM 156 and RM 158. The Project reach is located on the Wallowa-Whitman National Forest within the Upper Grande Ronde River Atlas Biological Significant Reach UGR15.
The project was designed to increase habitat suitability and capacity for Threatened Snake River Spring Chinook salmon, Summer Steelhead, and Bull trout. Native trout, whitefish and other native species are target fishery resources as well. River Vision of the CTUIR provides linkages to cultural, physical watershed processes and functions, and linkages to natural resource recovery, resiliency, and productivity to address limiting factors and promote watershed health.

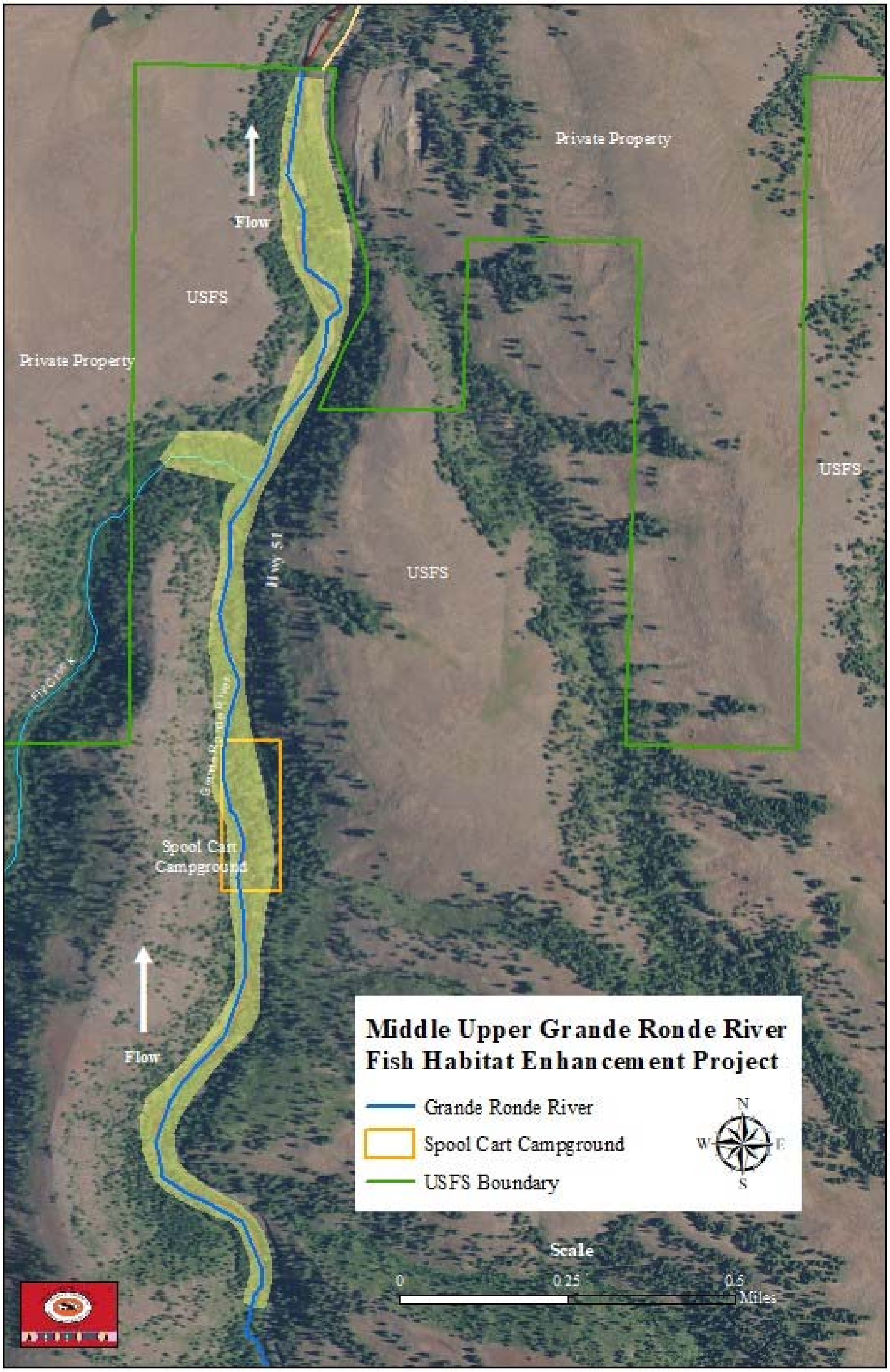
The Project is a continuation of habitat restoration actions previously conducted by the WWNF, including large wood placements in the early and mid-2000. Project planning, design, and wood structure types included hydraulic modeling, identification of priority wood placement locations, and selection and design of wood structures and specifications. Priority wood placement locations included locations with potential for floodplain and side channel activation and large pool formation.

FIGURE 27 EXISTING PROJECT REACH CONDITION



The project is part of an 8 mile project reach that was stratified into geomorphic reaches (response/confined), with response reaches prioritized for treatment due to potential for floodplain and side channel reconnection with the main channel. Approximately 4 miles of response reach was identified through the analysis and prioritized for treatment. Due to the length of the planning reach, four treatment reaches were identified and prioritized with the lowermost reach at USFS boundary upstream 2 miles identified for the initial implementation phase

FIGURE 28 MIDDLE UPPER GRANDE RONDE RIVER OVERVIEW MAP



The project included installation of large wood structures at strategic locations as well as floodplain and side channel wood to provide habitat complexity. Structure design objectives and structure types were driven by site condition and potential with large main channel structures focused on providing channel roughness, sediment storage and routing, pool formation and habitat complexity. Small wood assemblages were utilized in conjunction with large wood to provide floodplain roughness as well as racking and habitat complexity. Strategic small wood placement upstream of large wood structures was employed to promote natural racking on these large structures to provide additional cover, complexity, velocity refuges and deposition of sediments.

Sediment routing and deposition will initiate structure sealing and greater potential for effectively promoting backwater and pool habitat. Sediment is known to be limiting along the project reach, and the plan is to monitoring and adaptively manage if necessary to achieve sediment and wood structure effectiveness. Gravel augmentation is a technique under consideration to promote project development and habitat uplift.

Project construction was originally planned with both helicopter and ground based heavy equipment installation. A decision was made to initially implement the project using helicopter placement only due to heritage resource concerns in the project area. Ground based installation would have included entering treatment site following rough placement by helicopter. Large structure construction was originally designed in accessible locations to include trenching and backfilling structures boulder placement using track-mounted excavators to increase structure stability. Following July 2019 installations, plans have been in development to pin large wood structures with bolts with follow up boulder placement in July 2020-2021 by helicopter to further stabilize structures.

Watershed Problems

Fish habitat suitability within the Project reach has been significantly affected and suppressed by physical alterations of the river and its associated floodplain (splash dam logging, mining, and road construction) that have contributed to severely degraded habitat conditions. Problems include homogenous, high energy, plane bed riffle-run channel types with a lack of large pool habitat, channel complexity, peripheral habitat bed armoring and alteration of sediment sorting and coarsening of streambed gravel, altered groundwater and hyporheic function, and degradation of riparian and wetland plant communities.

Natural habitat recovery is limited by current environmental conditions that suppress development of diverse hydrologic and geomorphic processes, including an armored streambed, lack of mature riparian vegetation and associated complexity/wood loading, and lack of significant floodplain activation/connection.

Core habitat suitability limiting factors affecting juvenile summer and winter rearing and adult holding and migration include: water quality (temperature), channel and bed form and complexity (limited low velocity and large pool habitat), riparian conditions, and sediment.
In the Project reach, the upper Grande Ronde River historically would have had both unconfined and confined channel reaches with alternating pool-riffle and run bed forms. Beechie et al. (2006) empirically determined based on regional data that intermediate sized unconfined

channels that transport their sediment primarily as bedload and retain wood long enough to establish erosion-resistant points were transitional, and generally favored island-braided patterns in forested mountain systems. Beechie et al. (2006) data also shows that island-braided channels are continually adjusting to intermittent perturbations which sustains a high degree of successional states, resiliency, and habitat diversity. In general, island-braided riverine systems provide abundant peripheral and transitional habitats, and complex channel structure and bed forms resulting in the highest degree of biological diversity that supports both aquatic and terrestrial species during varying life stages.

Channel degradation has occurred in response to floodplain constriction from constructed roads, levees, and railroads, as well historical log transport operations by splash damming through the project reach. The quantity and force of logs moving along the channel are known regionally to have coarsened stream beds and severely truncated pool-riffle sequences.

Railroad grades, road grades, and levees along rivers create artificial channel constrictions and disconnected floodplains that have resulted in a single-thread, enlarged, and incised channel which poor habitat complexity and diversity. Constriction increases flow depths, flow velocities, and shear stresses during high water events. The outcome is a wider, more uniform plane-bed armored channel.

Existing riparian vegetation conditions include scattered patches of woody shrubs and immature trees, and large areas of herbaceous vegetation with shallow rooting depths. Beavers are uncommon and no longer play a major role in wood delivery to the channel or maintaining diverse off-channel habitats and riparian conditions.

The Oregon Department of Environmental Quality (ODEQ) has identified many stream segments within the Upper Grande Ronde Subbasin as water quality limited (ODEQ 2010). Oregon's 1998 303(d) List of Water Quality Limited Waterbodies identifies nine parameters of concern: algae, bacteria, dissolved oxygen, flow modification, habitat modification, nutrients, pH, sedimentation, and temperature. Water quality parameters of concern within the Project reach include: dissolved oxygen, flow modification, habitat modification, nutrients, pH, sedimentation, and temperature. Water quality parameters (and standards) of temperature (64°F/55°F, rearing/spawning), dissolved oxygen (98% sat), habitat modification (pool frequency), and flow modification (flows) directly relate to the beneficial use for fish life. (NPCC 2004).

Project Goals

The long-term rehabilitation vision (CTUIR's River Vision) for the Middle Upper reach of the Grande Ronde River is to improve physical and ecological processes by rehabilitating and restoring the project area to achieve immediate and long-term benefits to chinook, steelhead, and bull trout at all life stages.

- Floodplain connectivity (base flow, shallow groundwater capacity, and capability of functional connection and interaction with the floodplain through hyporheic flow);
- Channel morphology (channel form, sinuosity, complexity, geomorphic and hydrograph stability);
- Fish habitat (the quality and diversity of in-stream habitat for resident and anadromous fish in the Grande Ronde River);
- Restoration of natural channel processes through the addition of large wood to increase channel complexity sediment routing and storage.

Large wood material provides habitat complexity, diversity, pool habitat, velocity refuge, sediment routing and storage, floodplain roughness and stability. Benefits to salmonids will be achieved through restoration and rehabilitation of the whole floodplain ecosystem. Targeting of present and specific limiting factors such as temperature, in-stream habitat conditions, and sediment loads will achieve immediate benefits to salmon. Long term benefits will be realized through a focus on restoring fluvial habitat-forming processes, floodplain and groundwater hyporheic connectivity, riparian and wetland plant communities, and instream complexity and diversity commensurate with the reach's natural potential.

Project Objectives

- Increase the quantity of suitable habitat for all life stages of spring Chinook salmon, summer steelhead, bull trout and other native fish (including pools, side channels, complexity, and physical and hydraulic diversity).
- Promote diverse geomorphic processes, features, and patterns of sediment movement, sorting and deposition in stream channels and floodplain.
- Promote physical, geomorphic, and ecologic conditions that buffer diurnal and seasonal water temperature fluctuations within the project area and allow access to cold water spring sources.
- Re-connect floodplain and side channels to provide off channel habitat and natural flooding,
- Promote riparian vegetation establishment to support overall bank stability, particularly in locations where habitat structures have been installed and along banks with increased hydraulic roughness that are susceptible to erosion from loss of root mass.

Monitoring

Effectiveness monitoring for this project will be conducted post-project and is designed to measure progress toward achieving the project objectives, inform maintenance needs, and provide input into whether the restoration project is trending towards or away from achieving project goals. Based on the project goals, physical and biological parameters will be monitored using standard field techniques that will produce data compatible with various monitoring protocols including:

- Water temperature monitoring.
- Snorkel surveys (White, et al., 2011). Protocol for Snorkel Surveys of Fish Densities. A component of Monitoring Recovery Trends in Key Spring Chinook Habitat Variables and Validation of Population Viability Indicators. Snorkel surveys are carried out pre-project and post project by CTUIR RM&E.
- Chinook spawning surveys (Crump and Van Sickle, 2016). Protocol for monitoring redd distribution spatially and temporally. Protocol describes field methods of redd identification, data recording and reporting. Surveys are carried out yearly by CTUIR RM&E and ODFW Fish Research.
- Channel Cross Sections and Longitudinal Profiles
- Drone Imagery (Ortho Imagery)
- Photo Points

Project Construction

Project construction included wood material acquisition (logging and hauling) and stockpiling and sorting at helicopter landing located along USFS Road 5110 at the 5110 rock pit. Wood haul and stockpiling at designed landing was completed in November 2018. Helicopter and construction subcontractors mobilized to the project site in late June 2019. Project construction was initiated on July 1 and completed July 5, 2019. Traffic control and signage along Highway 51, Spool Cart Campground, and USFS Road 5110 was managed by CTUIR subcontractor during helicopter flight operations.

FIGURE 29 EXISTING PROJECT REACH CONDITION

CTUIR staff provided all site layout and construction detail for the project. Individual wood sites were staked and flagged. Station stakes along the project reach were staked out to provide reference for the entire project. The project included installation of 39 large wood structures and placement of an additional 574 wood pieces in complexes along the main Grande Ronde River channel, side channels and on the floodplain. The project encompassed approximately 2 miles of the Grande Ronde River and 0.30 miles of lower Fly Creek.

Five types of wood structures were designed to achieve project objectives with 22 Type A, 2 Type B, 10 Type C, 3 Type D, 2 type E, and 574 Type F structures. See Figure 33 below for structure types and wood details.

Project Administration and Construction Subcontracting

The CTUIR solicited competitive bids for logging and tree haul in August 2018 and helicopter and construction subcontractors in May 2019. Following contractor selection, CTUIR awarded construction subcontracts and processed formal construction subcontract documentation.

Project construction, maintenance of staging area and log deck, and traffic control was administered in an orderly manner and no major issues developed. The helicopter subcontractor was required to check in daily to file flight plans with the Blue Mountain Interagency Fire Center and daily safety meetings were conducted to discuss project issues, any possible threats to property, public and construction staff, and general plans for each day of operation.

CTUIR staff erected signs on the boundaries of the project and on access roads to inform the public of the project and to alert public land users of safety matters related to the helicopter operation and anticipated traffic delays.

Ground crew, including Helicopter subcontract staff and CTUIR/USFS staff directly involved in helicopter construction conducted daily tailgate safety meetings to review protocols for wood structure layout and implementation to insure safety for ground crews. Helicopter and construction contractor communicated regularly during each work day to communicate regarding traffic control and safety consideration during flight operations.

FIGURE 30 HELICOPTER LARGE WOOD PLACEMENT

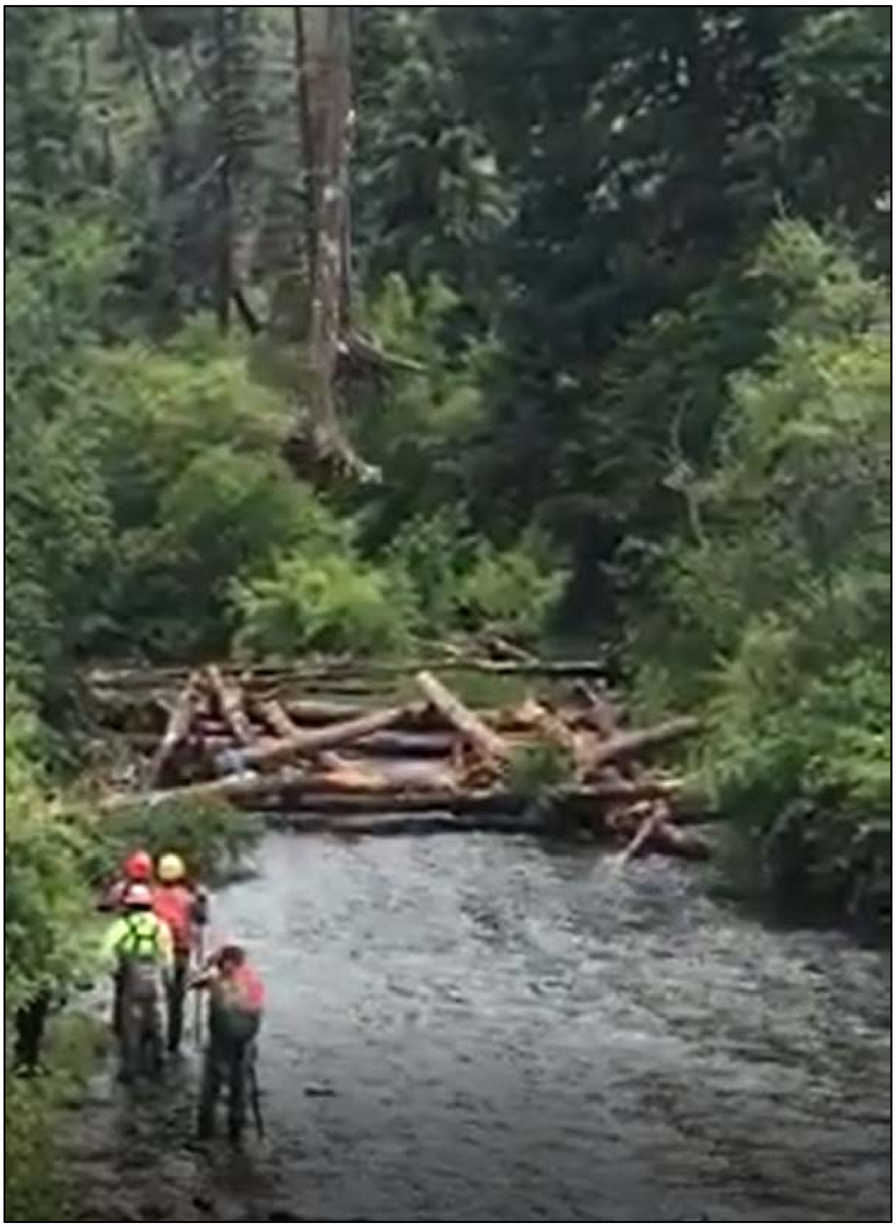


FIGURE 31 SUMMARY OF LARGE WOOD STRUCTURE QUANTITIES

SUMMARY OF QUANTITIES		
Large Wood Structures	**Quantity**	**Unit**
TYPE A - Habitat Structure		
# Structures	22	each
Key member w/RW, (18" dbh+, 45'+ L	286	each
Racking Logs/tops, 8-14" dbh, 20-30' L	396	each
TYPE B - Existing Structure Augmentation		
# Structures	2	each
Key member w/RW, (18" dbh+, 45'+ L	20	each
Racking Logs/tops, 8-14" dbh, 20-30' L	32	each
TYPE C - Defector		
# Structures	10	each
Key member w/RW, (18" dbh+, 45'+ L	60	each
Racking Logs/tops, 8-14" dbh, 20-30' L	100	each
TYPE D (Apex)		
# Structures	3	each
Key member w/RW, (18" dbh+, 45'+ L	12	each
Racking Logs/tops, 8-14" dbh, 20-30' L	18	each
TYPE E (Bleeder)		
# Structures	2	each
Key member w/RW, (18" dbh+, 45'+ L	14	each
Racking Logs/tops, 8-14" dbh, 20-30' L	20	each
Type F - Floodplain & Misc Wood	574	each
Small-Medium Whole Trees/Logs 6-14" DBH, 20-30" L		
SUMMARY		
Total large Wood Structures (not incuding FP & Misc Wood)	39	each
Total Key Member Pieces of Wood, 18"+ DBH, 45' L	286	each
Total Racking Material (Logs/Treetops, 8-14" DBH, 20-30' L	566	each
Total Floodplain Augmentation Logs, 8-14" DBH, 20-30' L	574	each

FIGURE 32 SUMMARY OF PROJECT EXPENDITURES

MIDDLE UPPER GRANDE RONDE HABITAT ENHANCEMENT PROJECT EXPENDITURES	
	Total
Helicopter Subcontract (BPA #73982 REL 44)	$289,250
Helicopter Subcontract (BPA #73982 REL 75)	$51,150
Logging and Wood Delivery Subcontract (BPA #73982 REL 44)	$220,225
Construction Subcontract (BPA #73982 REL 44)	$28,920
TOTAL EXPENDITURES	**$589,545**

FIGURE 33 LARGE WOOD STRUCTURE TYPE A TYPICAL DRAWING DETAIL

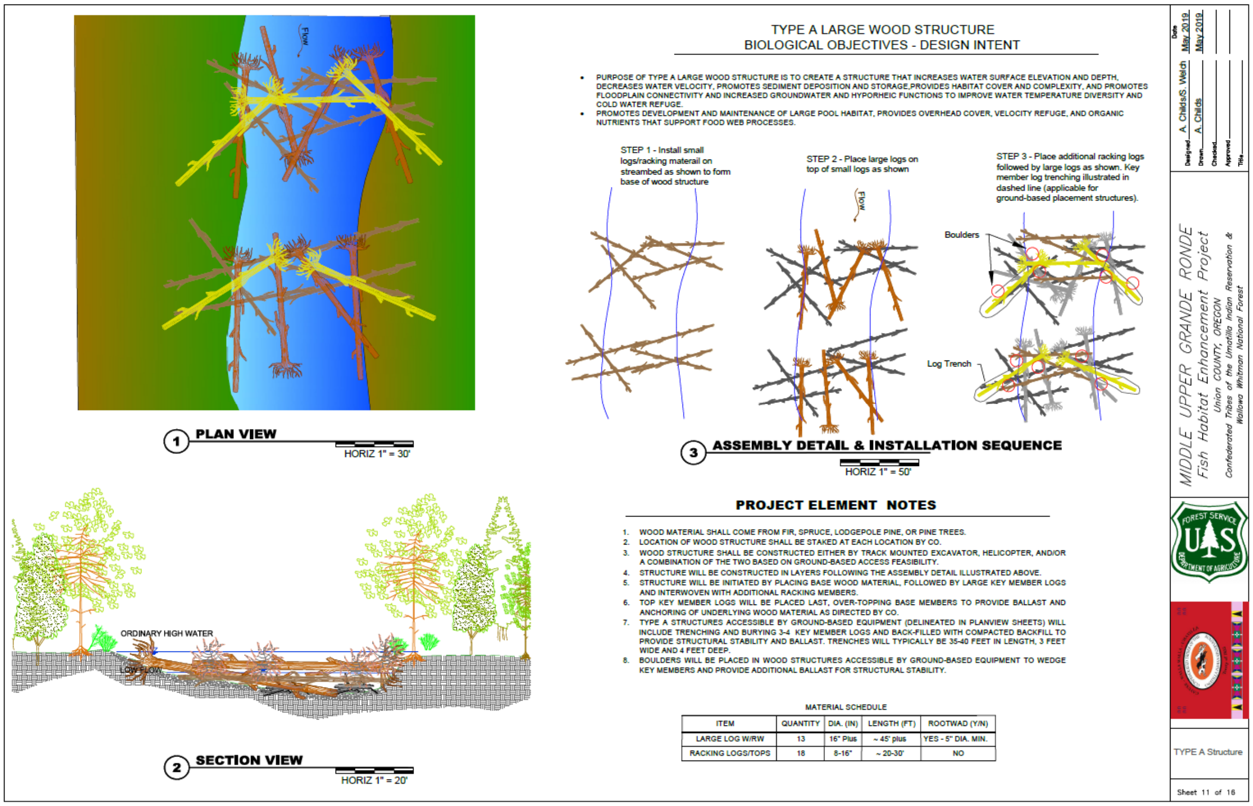


FIGURE 34 POST CONSTRUCTION DRONE ORTHOMOSAIC IMAGE

Ongoing Work Elements

The following sections present work elements followed by discussion of accomplishments for the project during the contract period.

Manage and Administer Projects

This work element includes a suite of management actions required to administer the project, including preparation of annual operations and maintenance budgets, managing and preparing statements of work and budgets, and milestone and metrics reporting in Pisces, supervising and directing staff activities, conducting vehicle and equipment maintenance and management, payroll, purchasing, subcontracting for services, and administering/inspecting habitat enhancement activities. CTUIR staff administered the Rock Creek Phase III and the Bird Track Springs Phase II Projects, including construction subcontract solicitation, field stakeout, and observation and inspection.

The Project Leader supervised 4 permanent employees and a seasonal crew of 2 180-day fish habitat technicians to accomplish fish salvage and riparian planting project activities.

Environmental Compliance and Permits

Environmental compliance methods include development of appropriate documentation under various federal and state laws and regulations governing federally funded project work. Methods involve coordination with various federal and state agencies and development, oversight, and submittal of permit applications, biological assessments, cultural resource surveys, etc.

Primary accomplishments during the reporting period included coordination with BPA environmental compliance personnel to prepare supplemental documentation and reporting for ongoing and planned management actions.

Additionally, CTUIR staff continued EC compliance on projects including the Longley Meadows Project and Middle Upper Grande Ronde River Project. Activities included participation in NEPA, ESA/ARBO, Section 106, and USCOE/ODSL fill removal permit processes.

Coordination and Public Outreach/Education

Coordination and public education were undertaken to facilitate development of habitat restoration and enhancement on private lands, participate in Subbasin planning, ESA recovery planning, BiOp/Remand project development and selection processes, and assist with providing watershed restoration education. CTUIR technical staff coordinates through the GRMW on the Board of Directors and Technical Committee to help facilitate development of management policies and strategies, project development, project selection, and priorities for available funding resources.

The Project Biologist participates in multiple basin programs and processes associated with project prioritization and selection, funding, and technical review. Focus during FY2019 included participation on the Grande Ronde Model Watershed Board of Directors, Executive Committee, and Grande Ronde Basin Technical Atlas Implementation Team to evaluate and select projects for funding recommendations through the GRMW Step-Wise Process. Additionally, CTUIR staff continued working on look forward projects with close coordination between BPA and BOR to develop core project complexes and initiate concept planning in conjunction with CTUIR-BPA Accord land acquisition strategies.

CTUIR staff also participated in a several educational and public outreach activities including: project tours at the Bird Track Springs, Middle Upper Grande Ronde and Catherine Creek Projects. Tours and field visits included: Upper Grande Ronde and Catherine Creek project tours with BOR staff, BPA staff, and the Region 6 USFS Leadership Team at Bird Track Springs. Additionally, staff prepared and delivered multiple project presentations, including the CTUIR annual habitat meeting and the Buffalo Flats public information meeting.

Planting and Maintenance of Vegetation

The CTUIR habitat program annually participates and/or assumes the lead role in re-vegetation activities on individual habitat restoration and enhancement projects. Planting and seeding methods are developed to address site specific conditions and vegetation objectives. Natural colonization and manual techniques are utilized.

Staff efforts associated with planting during the reporting period included the purchase, staging, and planting of approximately 6,000 containerized trees (Black Cottonwood, Hawthorne, Ponderosa Pine, Douglas fir, Elderberry, Salmonberry, and Red-Osier Dogwood) on the Bird Track Springs Project for installation on point bars, riffle margins, side channels, and floodplains. Disturbed areas were also seeded and mulched with a native grass seed mix consisting of Basin Wild Rye (33.06%), Rosanna Western Wheat Grass (19.07%), Snake River Wheat Grass (9.34%), Tufted Hairgrass (10.41%), Idaho Fescue (16.51%), and Big Blue Grass (9.94%). Containerized plants were installed by a Forest Service contracted planting crew using a tracked loader with an auger attachment. Multiple applications of the animal repellant Plantskydd® occurred within the Southern Cross RMZ.

Identify and Select Projects

Habitat protection, restoration and enhancement project opportunities continued to be identified, evaluated, and developed during reporting period. Activities included coordination with basin partners and private landowner to discuss and develop opportunities for future fish habitat and watershed protection and enhancement. Staff prepared project prospectus' to the GRMW Implementation Team for the McCoy Meadows and Lookingglass conservation properties and continued to scope projects in the Catherine Creek and Upper Grande Ronde watersheds.

Operate and Maintain Habitat & Structures

CTUIR staff maintains riparian easement fences on nine fish habitat restoration project area properties throughout the field season. Project maintenance includes conducting custodial responsibilities on individual projects to ensure that developments remain in functioning repair and habitat recovery is progressing towards meeting projects goals and objectives. Operations and maintenance of habitat and structures was supervised by biologists and carried out by two permanent technicians, two seasonal technicians (6 month hires), and multiple contractors. Activities included:

- Construction and maintenance of plant enclosures (panels/cages) within the Southern Cross RMZ, and the McCoy Meadows/Meadow Creek Project areas.
- Construction and maintenance of water gaps/water access sites on Meadow Creek (Habberstad), Dark Canyon Creek, Rock Creek, and Catherine Creek Project areas (CC37, CC44).
- Construction and repair of fences along Catherine Creek (CC37, CC44), McCoy Creek, Meadow Creek, Dark Canyon Creek, Bird Track Springs, and Rock Creek Project areas.
- Manual control of noxious weeds within the Southern Cross Conservation Property.
- Regular stream/air temperature and groundwater well data collection on Catherine Creek, McCoy/Meadow Creek, Upper Grande Ronde River and tributary streams.
- Collection of willow/cottonwood cuttings for swale channel roughness enhancement and bioengineered bank treatment for the Bird Track Springs Project.
- Enhancement of swale channel roughness with willow/cottonwood cuttings (trenching/auguring) within Southern Cross RMZ.
- Spot re-seeding and mulching of swale complexes within the Southern Cross RMZ using riparian and wetland seed mixes.
- Construction and maintenance of post assisted wood structures within swale channel complexes on Southern Cross Conservation Property utilizing hydraulic and pneumatic post pounders and woven willow cuttings/lodgepole slash.
- General maintenance of project vehicles (trucks/ATVs/trailers), power tools (pumps/chainsaws/augers/pounders), and miscellaneous hand tools.
- Inspected and maintained riparian easement protection fences on CC44 (Southern Cross, Kinsley), Rock Creek, and Dark Canyon-Cuhna properties.
- Treatment of noxious and invasive weeds through a cooperative agreement with the Tri-County Cooperative Weed Management Area (CWMA) on the Southern Cross Conservation Property, Lookingglass Creek Property, CC37 Project, the Rock Creek Project the Bird Track Springs, and McCoy Meadows Projects (Figure 35).
- Fence construction and maintenance on the Jordan Creek Ranch riparian conservation easement (Bird Track Springs Project).
- Ongoing application of Plantskydd®within the Southern Cross Riparian Management Zone (RMZ).
- Removal of dilapidated fences on the Bird Track Springs Project.
- Assisted US Forest Service with plant transport and storage.

FIGURE 35 2019 TRI-COUNTY CWMA NOXIOUS WEED SUMMARY

TRI-COUNTY COOPERATIVE WEED MANAGEMENT AREA

BAKER COUNTY * UNION COUNTY * WALLOWA COUNTY

10507 N. McAlister Rd. Rm. 5 • La Grande, Oregon 97850 • Phone (541) 624-5353 • www.tricountycwma.org

The following is a report of work completed by Tri-County from May-November 2019

Southern Cross:

Treatment Acres: 73.91 acres

Treatment Cost: $6,002.18 (70 hours @ $60/hour)

Herbicides Used:

Freelexx (2,4-D)	660 oz.	$105.80
Garlon	640 oz.	$221.35
Rifle D (Dicamba + 2,4-D)	528 oz.	$122.51
Milestone	364 oz.	$787.72
Platoon (2,4-D)	96 oz.	$7.91
Telar	2 oz.	$23.49
Escort	18 oz.	$39.60
Transline	24 oz.	$21.57
WeedMaster (Dicamba + 2,4-D)	6 oz.	$1.31
Activator 90 (surfactant)	551 oz.	$59.84
MSO (surfactant)	532 oz.	$41.94
Hi-Light (dye)	643 oz.	$193.40
Mileage from site to shop 303 miles at $.58/mile		$175.75

Total Project Cost = $6,002.18

Birdtrack Springs:

Treatment Acres: 2.22 acres

Treatment Cost: $1,650 (27.5 hours @ $60/hour)

Herbicides Used:

Milestone	7 oz.	$15.15
Tordon	7.04 oz.	$2.33
Platoon (2,4-D)	39.04 oz.	$3.22
Transline	16 oz.	$14.38
Bulls Eye (dye)	22.20 oz.	$6.68
Activator 90 (surfactant)	22.20 oz.	$2.41
MSO (surfactant)	16 oz.	$1.26
Mileage from site to shop 92 miles at $.58/mile		$53.36

Total Project Cost = $1,748.79

CC37:
Treatment Acres: 6.5 acres
Treatment Cost: $720 (12 hours @ $60/hour)
Herbicides Used:

Milestone	31.5 oz.	$68.17
Platoon (2,4-D)	144 oz.	$11.87
Transline	32 oz.	$28.75
Bulls Eye (dye)	22.20 oz.	$6.68
Activator 90 (surfactant)	65 oz.	$19.55
MSO (surfactant)	65 oz.	$7.06

Mileage from site to shop 30 miles at $.58/mile $17.40
Total Project Cost = $872.80

Rock Creek:
Treatment Acres: 3 acres
Treatment Cost: $420 (7 hours @ $60/hour)
Herbicides Used:

Telar	1 oz.	$11.74
Rifle D (Dicamba + 2,4-D)	32 oz.	$7.43
Transline	32 oz.	$28.75
Freelexx (2,4-D)	64 oz. used	$10.26
Bulls Eye (Dye)	24 oz.	$7.22
Activator 90 (surfactant)	24 oz.	$2.60

Mileage from site to shop 37 miles at $.58/mile $21.46
Total Project Cost = $509.46

Lookingglass Creek:
Treatment Acres: 21 acres
Treatment Cost: $8,000 (contractor- Jon Wick) + $240 (4 hours @ $60/hour)
Herbicides Used:

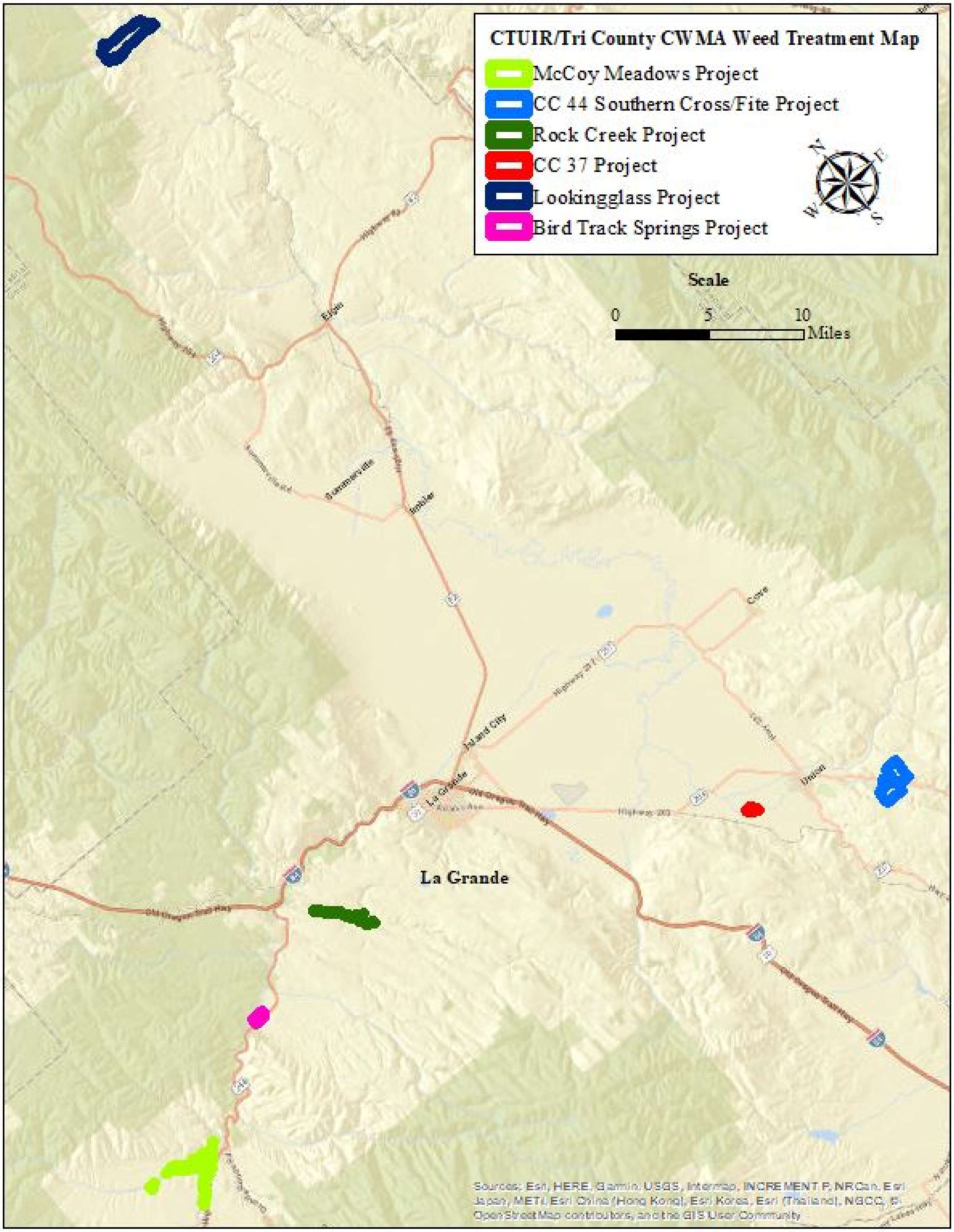
Milestone	112 oz.	$242.37
Escort	5 oz.	$11.00
Transline	80 oz.	$71.88
Hi-Light (dye)	210 oz.	$63.16
Activator 90 (surfactant)	210 oz.	$22.80

Mileage from site to shop 50 miles at $.58/mile $29.00
Total Project Cost = $8,680.21

McCoy Meadows (Leafy Spurge):
Treatment Acres: 35 acres **Total Cost: $1,860**
Treatment Cost: $1,200 (contractor- Jon Wick) + $660 (11 hours @ $60/hour)
Herbicides Used: Chemical was paid for by OWEB

Tordon	960 oz.
Freelexx (2,4-D)	992 oz.
Hi-Light (dye)	350 oz.
Activator 90 (surfactant)	350 oz.

FIGURE 36 CTUIR/TRI-COUNTY CWMA WEED TREATMENT MAP



Monitoring & Evaluation

Monitoring and evaluation (M&E) of individual projects is conducted either independently by the CTUIR or jointly with project partners, Fish Habitat Enhancement Biological Effectiveness Monitoring 2019 Annual Progress Report (project #2009-014-00; BPA contract #71934) depending on the project.

M&E efforts include annual drone imagery collected by the GRMW including aerial video and DTM/Ortho imagery, annual photo-points, time lapse cameras at select locations, installation and maintenance of water and air temperature probes, stream channel cross sections and longitudinal profiles, pebble counts, juvenile fish population and habitat surveys, stocking/census surveys on re-vegetation efforts, and groundwater monitoring. Public tours, workshops, and presentations of individual projects will continue to be conducted. These activities provide for the discussion of various approaches, restoration techniques, successes, failures, and ultimately adaptive management.

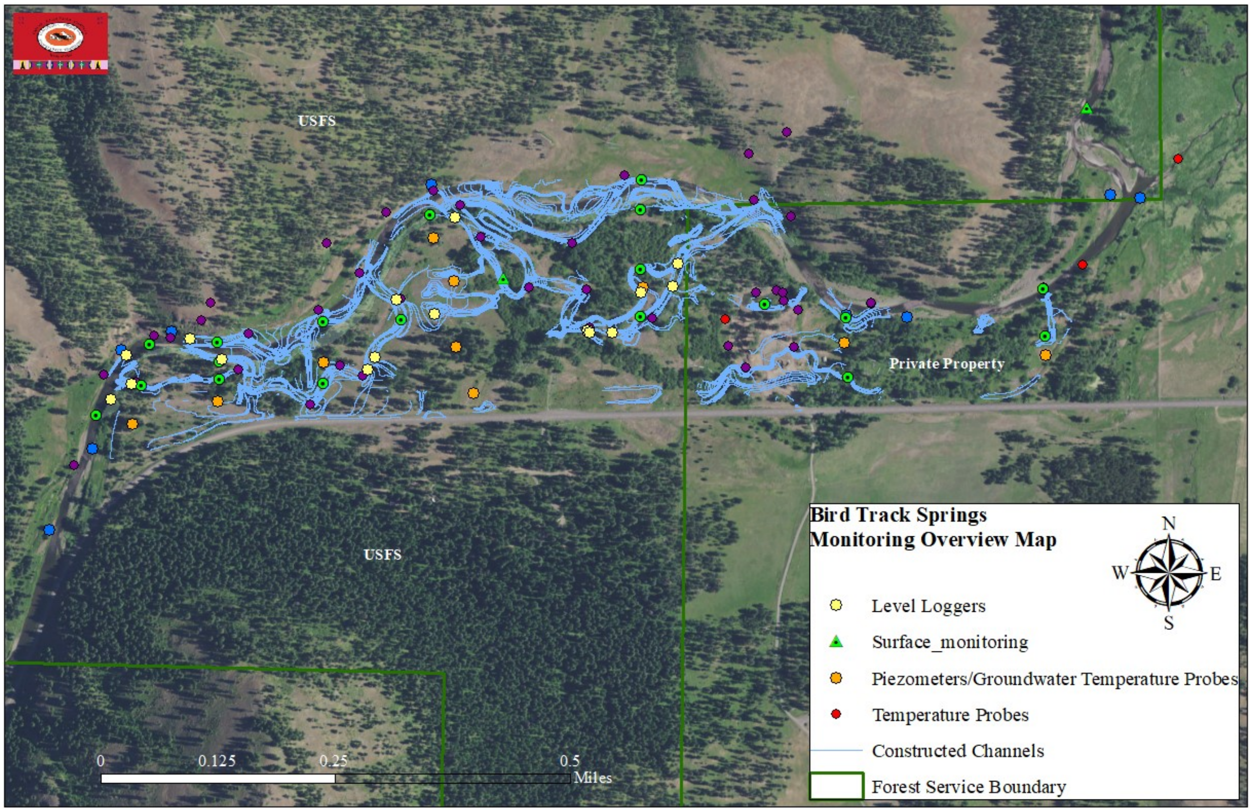
Following are descriptions of the various M&E components of the project followed by project specific monitoring results.

Groundwater Monitoring

Groundwater wells (piezometers) were installed on Forest Service and private property in November 2017 in the Bird Track Springs and Longley Meadows fish habitat enhancement project areas (Figures 37 & 38), following direction from Bureau of Reclamation (BOR) geologists (Lyons & McAfee, 2017). This action was taken as part of a larger monitoring effort in collaboration with restoration co-managers from the Pacific region and Grande Ronde Basin.

In addition to monitoring wells that will capture water levels and groundwater temperatures, 17 level loggers were installed along channel margins in the Bird Track Springs Project to monitor surface water discharge/stage in order to evaluate changes to the hydrology and temperatures associated with fish habitat enhancement activities.

FIGURE 37 MAP OF GROUNDWATER WELLS, SURFACE WATER MONITORING LOCATIONS AND TEMPERATURE PROBES FOR BIRD TRACK SPRINGS PROJECT AREA. THE BLUE LINES REPRESENT THE NEW CHANNEL ALIGNMENTS.



The Longley Meadows Fish Habitat Enhancement Project is on track to begin implementation in the summer of 2020. The following report and analysis will cover data associated with the groundwater levels and temperatures at Bird Track Springs and Longley Meadows projects. Data collected in the first year of observation is included in a discussion of planned surface water discharge monitoring sites. Collaborating partners will discuss a broader analysis including surface water temperatures in annual reports and ongoing thermal refuge studies.

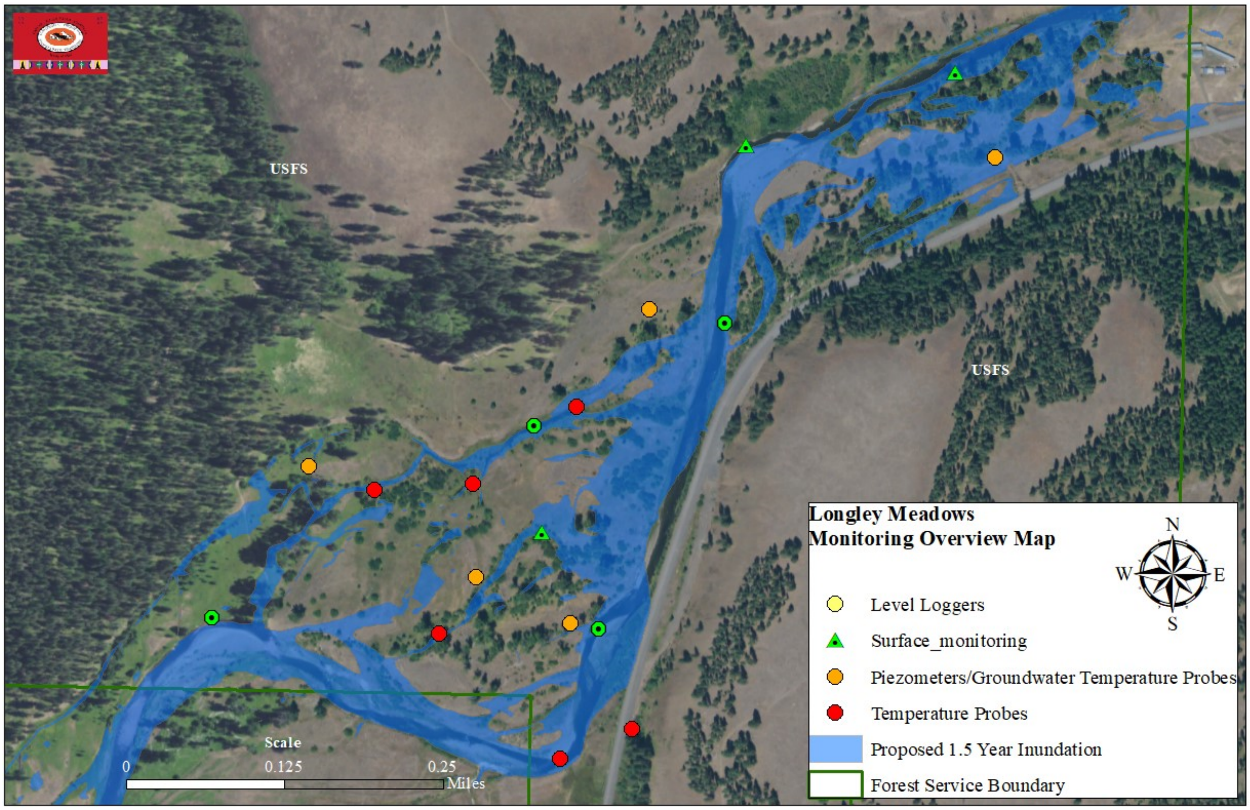
Monitoring Goals & Observations

The goal of monitoring is to evaluate the benefits to salmonid species listed on the Endangered Species act and restoring first foods according to the River Vision (Jones et al., 2008) that occur in the project areas. Objectives include: 1) monitoring changes in groundwater elevation groundwater temperature, 2) monitoring changes in stream temperature and elevation/discharge, and 3) monitoring the presence and quantity of thermal refuge and associated fish use. These efforts will be part of a larger monitoring and evaluation plan and fishery resource monitoring efforts.

Fish salvage efforts during the two phases of the Bird Track Springs project have demonstrated the presence of juvenile rainbow trout/steelhead (*Oncorhynchus mykiss*), Pacific Lamprey (*Entosphenus tridentatus*) and Western Pearlshell freshwater mussels (*Margaritifera falcata*). Despite the limited habitat and cold water refuge these species persist in a degraded environment. Restoration of hydrology and thermal heterogeneity at Bird Track Springs and

Longley Meadows will increase the available habitat for threatened species on the Endangered Species act and First Foods for the Confederated Tribes of the Umatilla Indian Reservation.

FIGURE 38 MAP OF GROUNDWATER WELLS, SURFACE WATER MONITORING LOCATIONS, TEMPERATURE PROBES FOR LONGLEY MEADOWS PROJECT AREA



Results

Average daily flucutions in water level were ploted against real-time discharge data from the gauge located near Perry, Oregon, operated by the Oregon Water Resource Department (OWRD, 2019) for the period between January-2019 to December-2019. Additionally, monthly water levels were graphed with corresponding groundwater temperatures measured over the same period. In order to stay consistent, well data are reported in metric units of Celsius and meters. For the purposes of this initial evaluation and clarity, well data were grouped by proximity and project, although it should be noted there may be many ways to interpret the following data, which will be available through the CDMS website operated by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR, 2019).

Bird Track Springs

The following graphs are organized with Bird Track Springs project wells 1-11, followed by Longley Meadows project wells 17-21. There are data patterns in common with all well sites that will be mentioned briefly, followed by a more detailed discussion of smaller groups of wells at each project site. Peaks in the average daily discharge measured at the Perry stream gage site correspond to increases in water elevation at all well sites for both project sites. However, there is a difference in the range and amplitude following the peaks in discharge between individual wells and project sites. The duration of increased water level elevation (shallow) occurs between January and June with the lowest elevations (deep) being observed from July to December. Groundwater temperatures are inversely related to water elevations, with lowest temperatures occuring during the highest water elevations and the highest water temperatures occuring in the lowest water elevations.

It is important to point out that groundwater data collected from Bird Track Springs wells 1-11 in 2019 may exhibit anomolies influenced by certain project construction activities. Year 2 construction began in early May 2019 and ended in November. Activities such as bypass channel activation, channel de-watering and reclaimation, or pumping water out onto the floodplain could account for some wells exhibiting noticable fluctuations in groundwater elevation otherwise unassociated with any natural surface flow events.

The first three wells are in the upper portion of the Bird Track Springs project area and in the vicinity of side channel 1 & 2 (Figure 39). Groundwater well 2 (GW 2) has the highest elevation of this group and shows the greatest amplitude following peaks in discharge (Figure 39). The greatest range in monthly average temperature was also observed at GW 2 (5.6-18.3°C-Figure 40). The Grande Ronde River near Perry, OR reached nearly 8,000 cfs (225 cms) on April 10, 2019. The groundwater elevations for these three wells show an almost instantaneous increase response to the river's peak flow. As the river receded through May so did the groundwater elevations at these three well locations. In late May there were two small surges in main channel surface discharge that correspond with a slightly delayed increase in groundwater elevations. Furthermore, as main channel flows drop to summer base flow levels, groundwater elevations at these three locations seem to hold steady throught the remainder of the year.

GW wells 4-7 represent a north south transect with the new channel alignment wrapping around the transect (Figure 41). This may be a good area to focus on for a more intensive thermal refugia study proposed by BOR given the potential to alter the groundwater table and how the new channel alignment may influence the transect. GW 4 has the highest water elevation despite it being farther away from the existing channel (Figures 41& 42). On another interesting note, GW 4 groundwater elevation for the duration of peak surface discharge in April 2019 seems to max out and flat-line at approximately 0.5 m below the meadow surface. Another interesting observation when comparing neighboring GW 4 and GW 5 after peak flows decline into May is the large difference in groundwater elevations (approximately 1.25 m difference) when geographically these wells are the closest to each other among all BTS wells. GW 6 had the greatest range in temperature (4.5-16.1°C-Figure 42).

Wells 8-11 represent the downstream portion of the project area and have the most sustained high water elevation of the Bird Track Springs wells (Figure 43). Dewatering, channel reclamation, bypass channel construction, and pumping water onto floodplain associated with construction in the summer and fall of 2019 appears to have affected some readings at GW 8 & 11 (Figure 43). However, well 10 exists in close proximity to a 2018 completed portion of project and therefore exhibits a relatively stable and predictable groundwater fluctuation regime while 2019 construction activities were happening elsewhere. GW 10 had the greatest range in temperature (3.9-14.1°C-Figure 44).

FIGURE 39 AVERAGE DAILY GROUND WATER LEVELS FOR WELLS 1-3 AT BIRD TRACK SPRINGS AND DISCHARGE AT THE PERRY GAUGE, JANUARY-19 TO DECEMBER-19

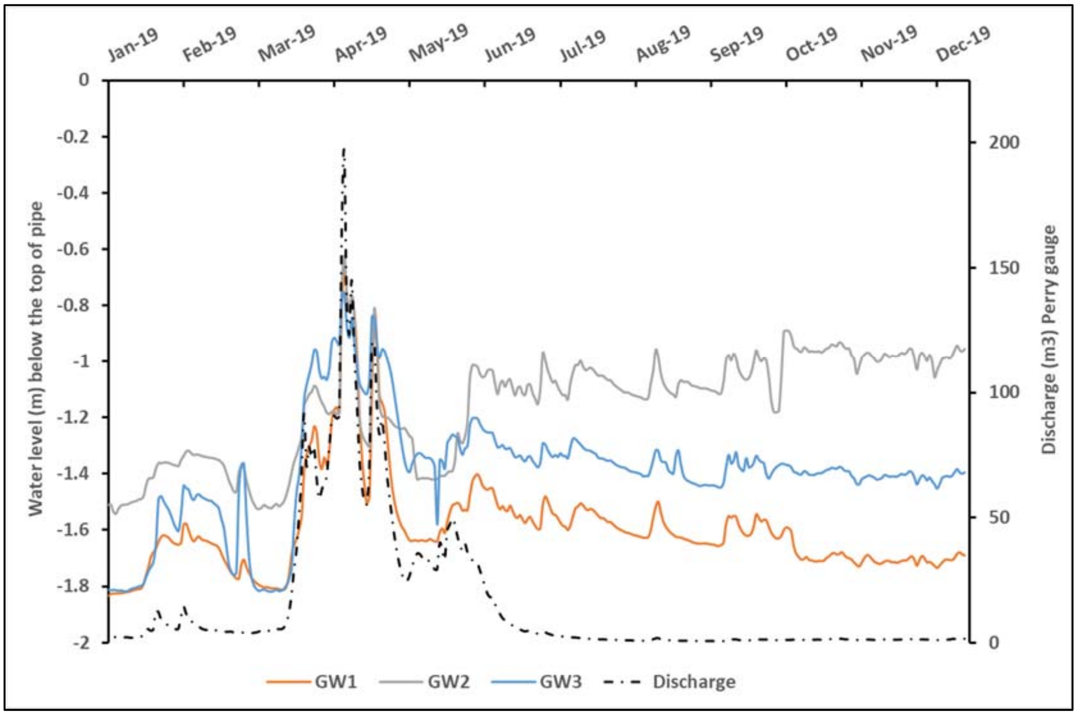


FIGURE 40 MONTHLY AVERAGE GROUNDWATER LEVELS FOR WELLS 1-3 AT BIRD TRACK SPRINGS AND CORRESPONDING GROUNDWATER TEMPERATURES, JANUARY-19 TO DECEMBER-19. COLORS FOR GROUNDWATER TEMPERATURES AND LEVELS ARE MATCHING

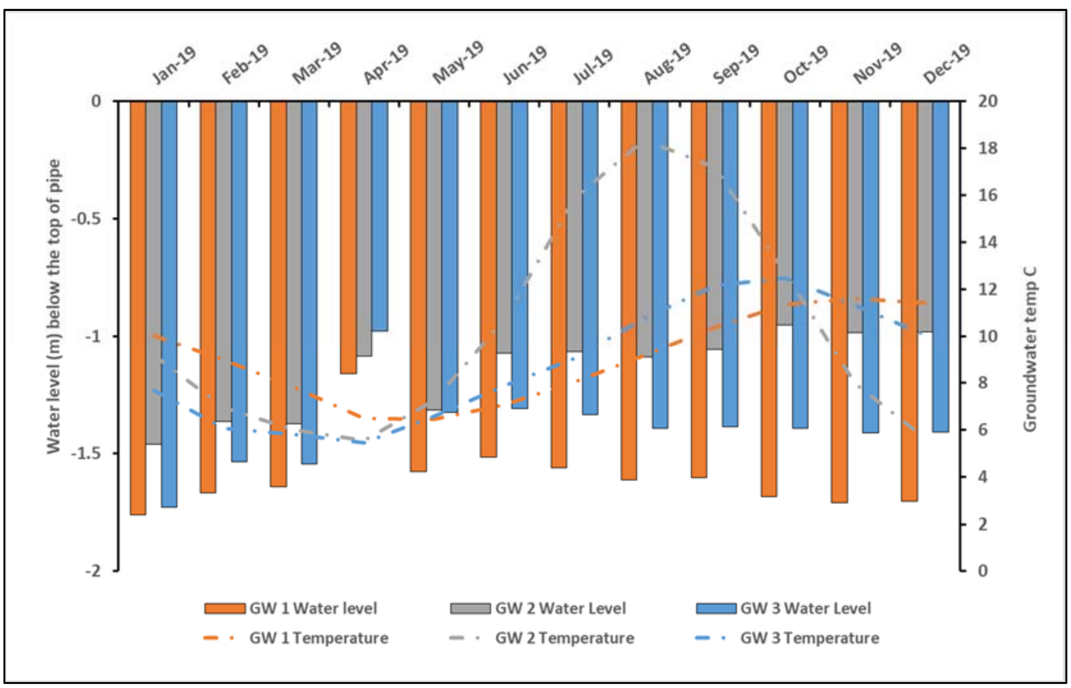


FIGURE 41 AVERAGE DAILY GROUND WATER LEVELS FOR WELLS 4-7 AT BIRD TRACK SPRINGS AND DISCHARGE AT THE PERRY GAUGE, JANUARY-19 TO DECEMBER-19

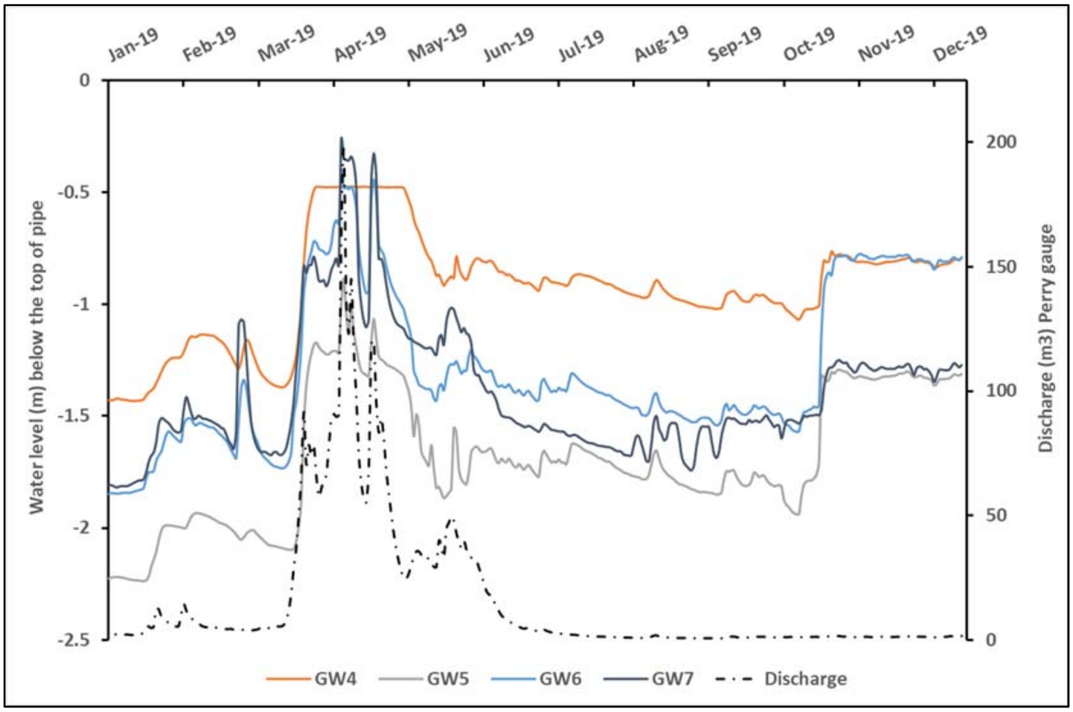


FIGURE 42 MONTHLY AVERAGE GROUNDWATER LEVELS FOR WELLS 4-7 AT BIRD TRACK SPRINGS AND CORRESPONDING GROUNDWATER TEMPERATURES, JANUARY-19 TO DECEMBER-19. COLORS FOR GROUNDWATER TEMPERATURES AND LEVELS ARE MATCHING

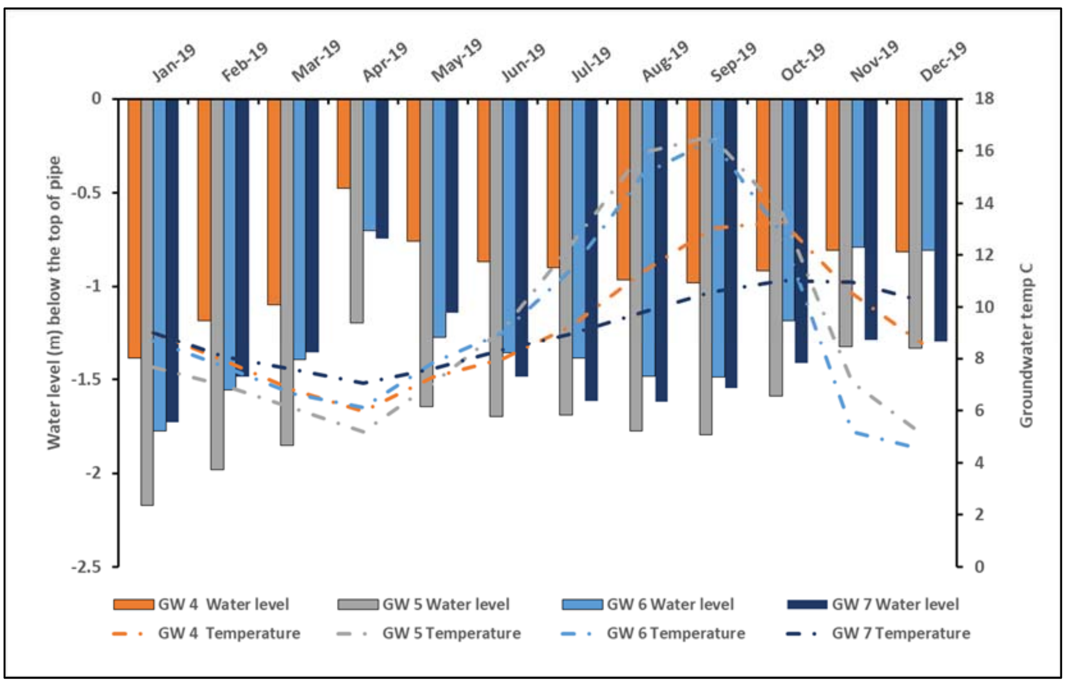


FIGURE 43 AVERAGE DAILY GROUND WATER LEVELS FOR WELLS 8-10 AT BIRD TRACK SPRINGS AND DISCHARGE AT THE PERRY GAUGE, JANUARY-19 TO DECEMBER-19

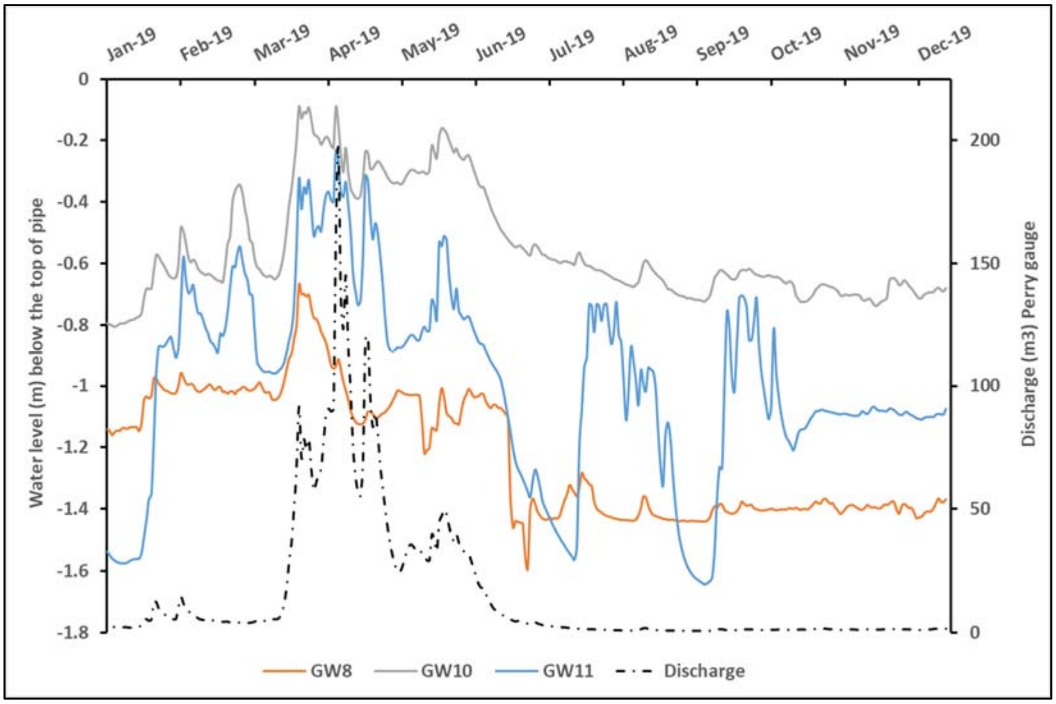


FIGURE 44 MONTHLY AVERAGE GROUNDWATER LEVELS FOR WELLS 8-10 AT BIRD TRACK SPRINGS AND CORRESPONDING GROUNDWATER TEMPERATURES, JANUARY-19 TO DECEMBER-19. COLORS FOR GROUNDWATER TEMPERATURES AND LEVELS ARE MATCHING

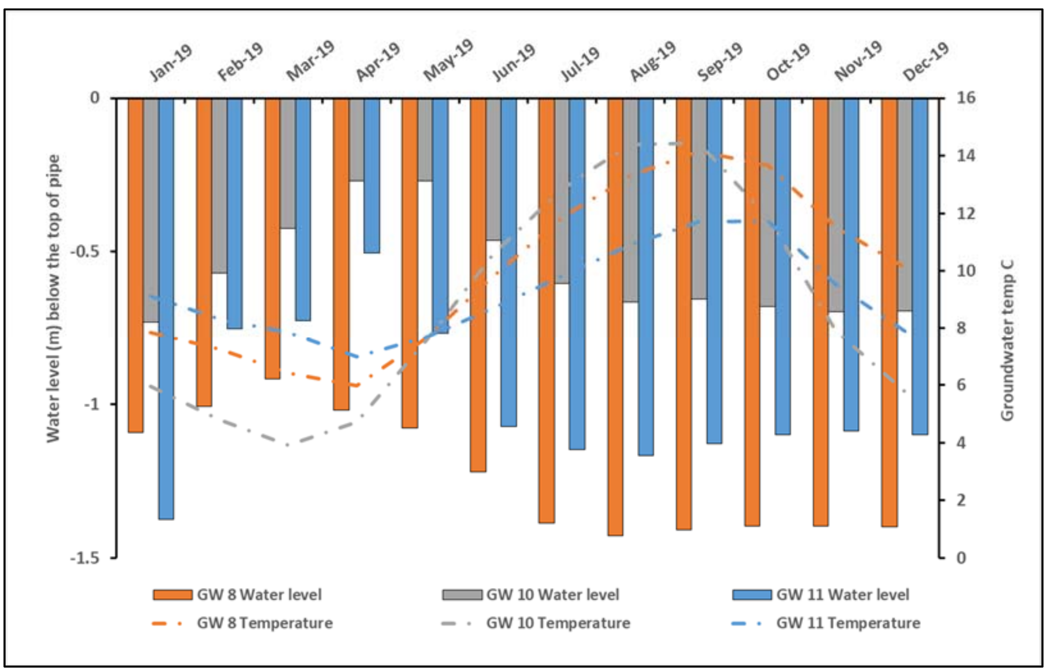


FIGURE 45 AVERAGE DAILY GROUND WATER LEVELS FOR WELLS 17-19 AT LONGLEY MEADOWS AND DISCHARGE AT THE PERRY GAUGE, JANUARY-19 TO DECEMBER-19

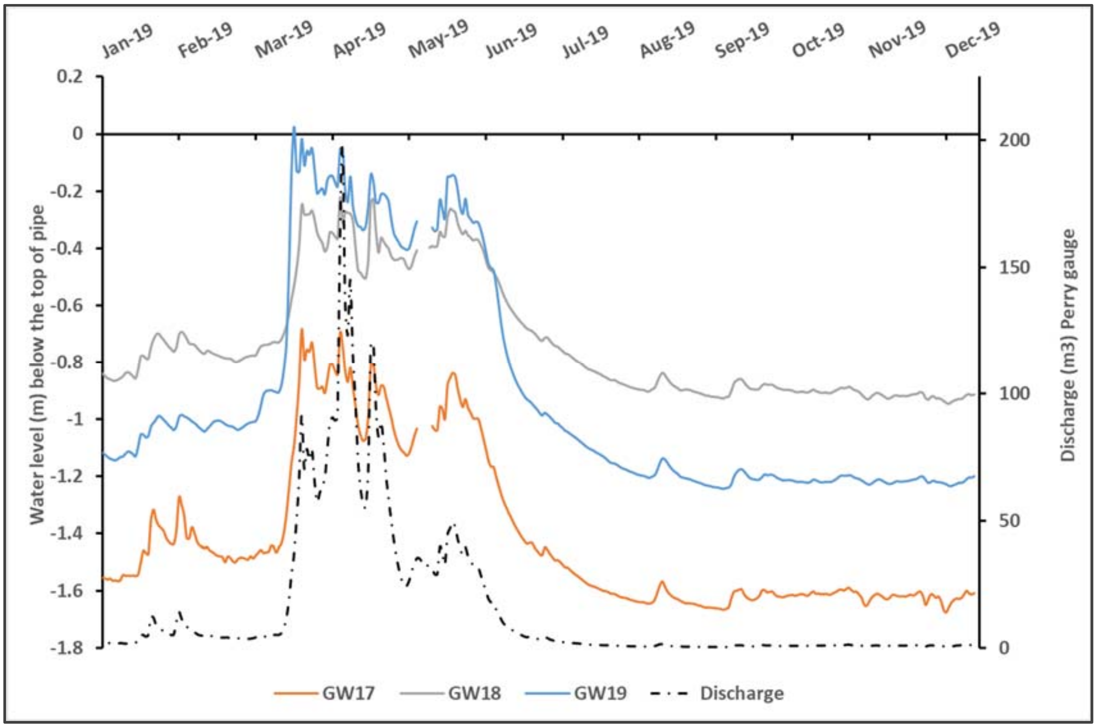


FIGURE 46 MONTHLY AVERAGE GROUNDWATER LEVELS FOR WELLS 17-19 AT LONGLEY MEADOWS AND CORRESPONDING GROUNDWATER TEMPERATURES, JANUARY-19 TO DECEMBER-19. COLORS FOR GROUNDWATER TEMPERATURES AND LEVELS ARE MATCHING

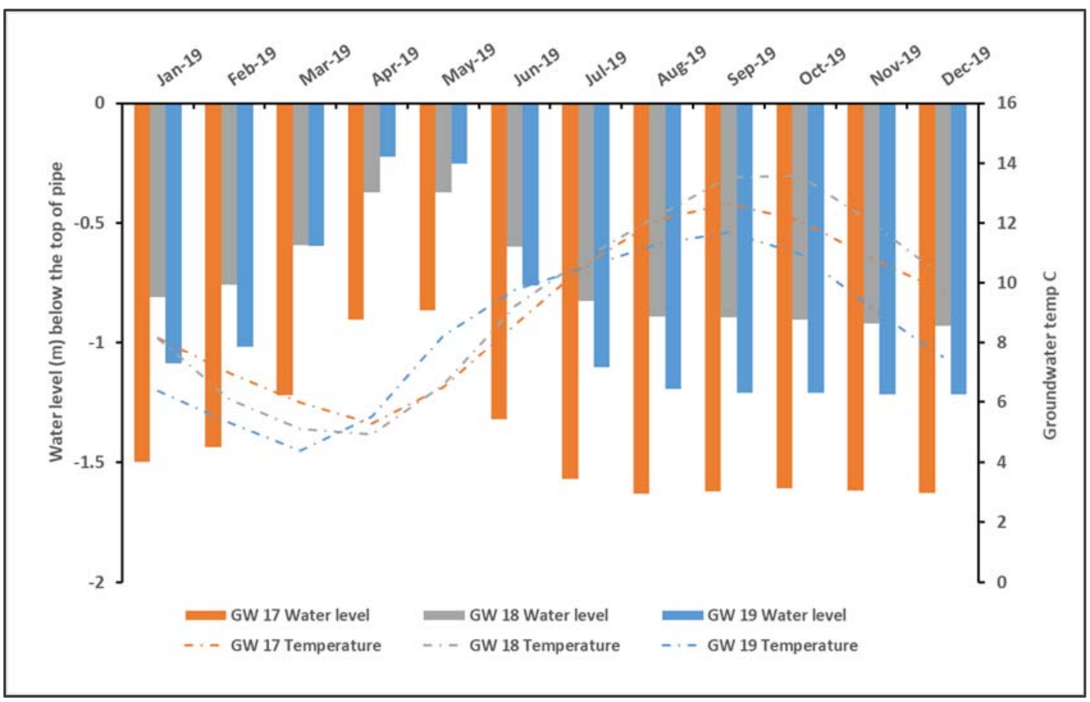


FIGURE 47 AVERAGE DAILY GROUND WATER LEVELS FOR WELLS 20-21 AT LONGLEY MEADOWS AND DISCHARGE AT THE PERRY GAUGE, JANUARY-19 TO DECEMBER-19

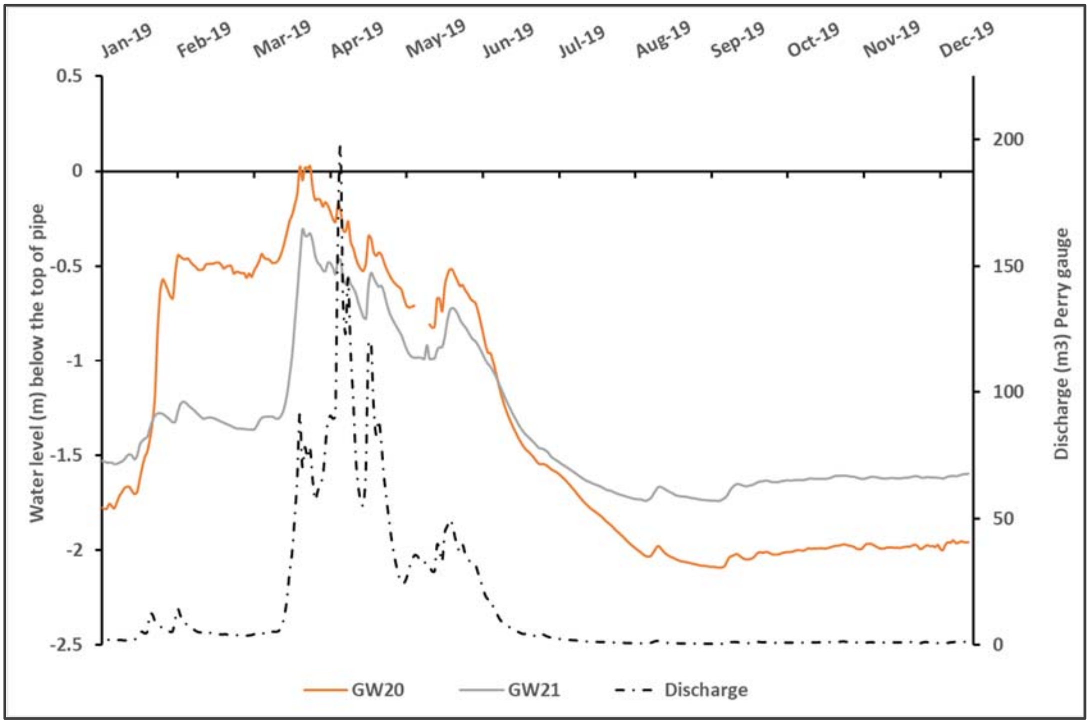
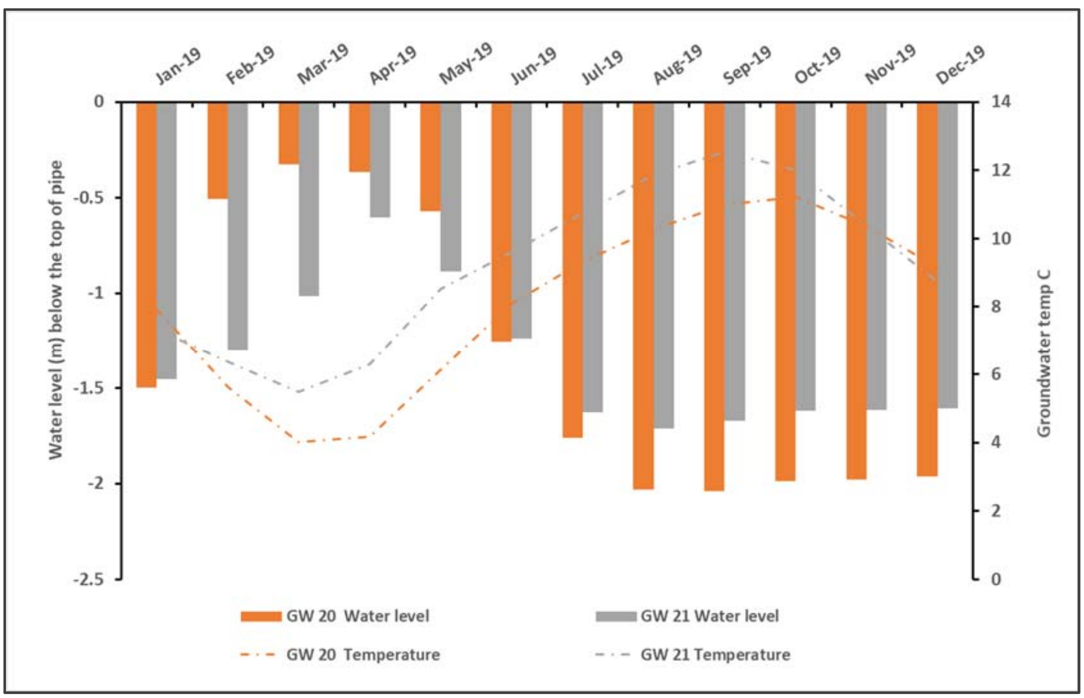


FIGURE 48 MONTHLY AVERAGE GROUNDWATER LEVELS FOR WELLS 20-21 AT LONGLEY MEADOWS AND CORRESPONDING GROUNDWATER TEMPERATURES, JANUARY-19 TO DECEMBER-19. COLORS FOR GROUNDWATER TEMPERATURES AND LEVELS ARE MATCHING



Longley Meadows

Wells 17-18 represent the upstream portion of Longley Meadows Fish Habitat Enhancement Project, orientated in a northwest transect (Figure 45). Interestingly, the closest well to the river (GW 17) has the lowest water elevation, and the well furthest from the river (GW 18) has the highest groundwater elevation (Figure 45). In fact, GW 18 water elevation before peak flows was the same distance below the meadow surface as GW 17 reached at its peak. GW 18 had the greatest range of temperature (4.9-14.8°C) and had the highest average water level elevation for the year (Figure 46).

The downstream portion of Longley meadows has two wells (20-21; Figure 47). Groundwater well 20 had a water elevation near the surface in March-19 (Figure 47). Well 20 also has a higher water elevation through the spring but a lower water elevation through summer, fall, and winter compared to GW 21. Wells 20 had the greatest water elevation range 0.01-2 m and a slightly larger temperature range (3.8-10.8°C).

Discussion

Understanding groundwater data is complicated by several variables such as geology and hydrology, and often monitoring wells may be inadequate in number or location. However, groundwater wells also provide measurable outcomes of how stream restoration projects can influence groundwater elevation and temperature. Increasing the amplitude and duration of cold water elevations and corresponding influence of temperature is a desired outcome of fish habitat restoration activities. Combined with monitoring surface water elevation, 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.

Photo Point Monitoring

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.

During 2019 photo points were taken at 4 separate projects. A total of 76 photos were taken, and GPS coordinates were recorded at each photo point site. Each photo point site is marked with a green T-133 post or a 1 foot rebar stake. Photo points are located at sites along project reaches with good visibility of stream-bank vegetation and areas where morphological changes are likely to occur. Photo points are typically taken every year; however, some project photo points are taken every other year. 16 photo points were taken at CC 44 Southern Cross, McCoy Creek, Meadow Creek, and McCoy/Meadow Creek enclosures.

Representative samples are provided in Figure 36. Of particular note are stark differences in recruitment of riparian vegetation between enclosed and exposed areas in the McCoy Creek/Meadow Creek complex. This project is subject to intense browsing pressure from wild ungulates resulting in extremely limited release of riparian vegetation in untreated areas. This contrast is readily seen when comparing photo points of protected and unprotected areas of the project (Figures 49 and 50).

FIGURE 49 UNPROTECTED REACH ON MCCOY CREEK, JULY 2017

FIGURE 50 PROTECTED ELK ENCLOSURE ON MCCOY CREEK AND RECENT BEAVER ACTIVITY, DECEMBER, 2018

FIGURE 51 PRE AND POST PROJECT PHOTO POINTS

Southern Cross Pre-Project 2015 | Southern Cross Post-Project 2019

Southern Cross Pre-Project 2015

Southern Cross Post-Project 2019

McCoy Meadows Enclosures 2011

McCoy Meadows Enclosures 2019

Rock Creek Pre-Project 2016

Rock Creek Post-Project 2019

Bird Track Springs Pre-Project 2016

Bird Track Springs Post-Project 2019

2019 Water Temperature Monitoring

Water Temperature 2019 Summary

During 2019, sixty-two temperature probes were deployed within the Grande Ronde Basin, all recording at 1-hour intervals. A review of existing monitoring efforts and planned future project monitoring lead to a temporary reduction of twenty nine temperature loggers in 2018 within the Grande Ronde River and Catherine Creek.. The primary objectives of monitoring stream temperatures are to track changes at existing or proposed habitat restoration projects before and after work are completed.

Summary statistics were calculated for each probe that included the number of records when temperatures were at or exceeded the DEQ lethal limit of 25ºC, the number of records when temperatures were at or exceeded 20ºC, and when temperatures were within a range of 10ºC to 15.6ºC (the optimal growth for juvenile Chinook salmon – as cited by (McCullough, 1999). The number of days when the mean temperature was at or exceeded the DEQ standard of 17.8ºC was also calculated. Diurnal fluctuations in water temperature were also plotted.

Temperature probes deployed are Onset HOBO© Pendant 64k or TidbiTv2 loggers set to record at 1-hour intervals. Pendant 64K probes are housed in a metal tube that is anchored to the streambed and cabled to a post or tree on the bank, while Tidbit v2 probes can be installed in the aforementioned manner or housed in a PVC bushing and cap and installed with underwater epoxy (Isaak, Horan, & Wollrab, 2013). Probe locations have been consistent from 2009 to 2016 and when possible, the same probes are deployed at each site during this period. Each year prior to deployment probes are tested in an ice bath and verified with an NIST certified thermometer.

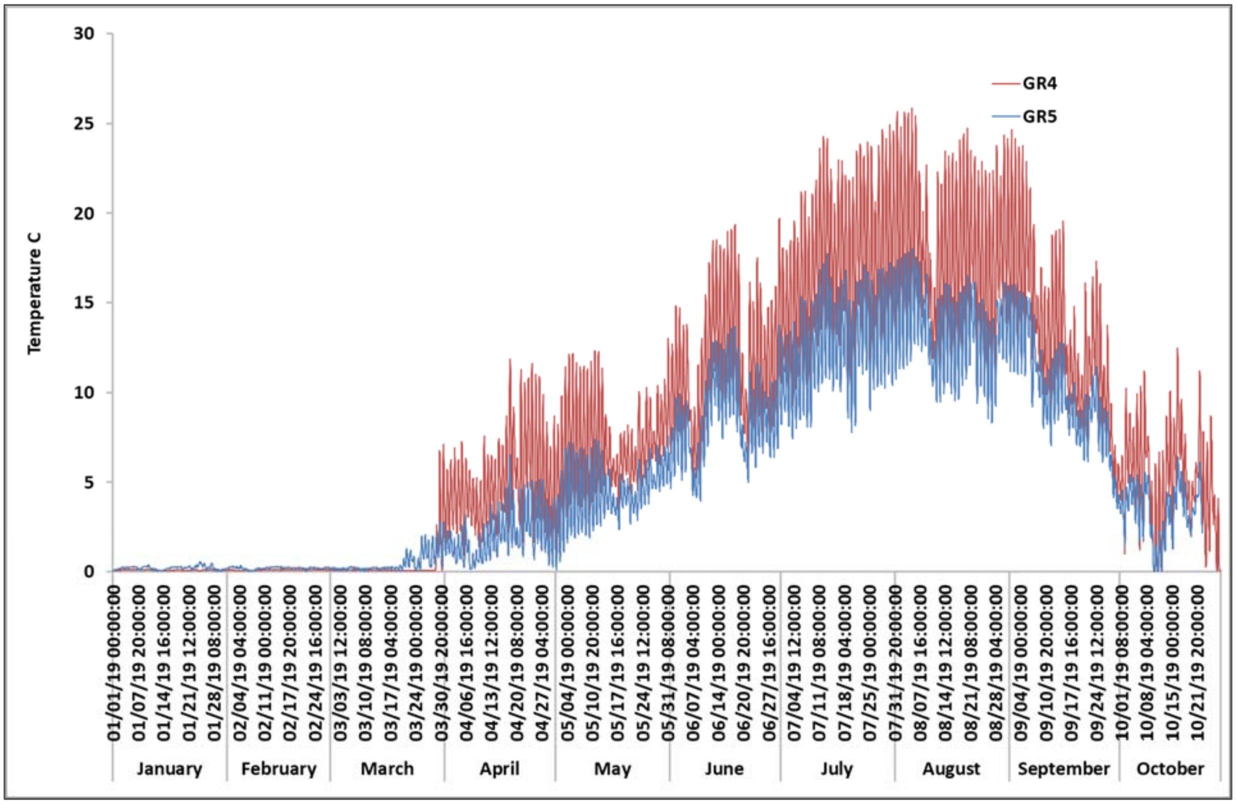
The following summary of water temperature data will be broken down into an overview of each sub-watershed area which includes: the Upper Grande Ronde River, Meadow Creek, McCoy Creek, Dark Canyon Creek, Rock Creek, and Catherine Creek. A summary of temperature metrics for the Upper Grande Ronde and sub-watersheds can be seen in Table 7.

Grande Ronde Watershed

Thirteen probes were deployed along the Upper Grande Ronde River from Hilgard State Park to the mine tailings upstream of Vey Meadows. During 2019 these probes recorded data for 190-301 days (between 1/1/2019 and 10/29/2019). There were 43 records removed from the dataset due to either a probe being out of the water or similar reported problems, leaving 83,497 hours logged for analysis. During 2019 there were 14 records at the site below Vey Meadows (GR4) for temperatures >= 25°C, down from 86 in 2018. There were 497 records of temperatures >= 20°C at the same site which also experienced a decline from 567 records the year prior.

The probe below the Vey Ranch (GR4) had 9 hours of lethal limits recorded compared to 0 at the probe above the acclimation facility (GR5). There were 497 records of temperatures >=20°C at GR4 and 0 records at GR5. Approximately 19.3% of the deployment period at GR4 site was in 10-15.6 °C range compared to 21.8% at GR5, and GR4 had 34 days recorded with a mean >= 17.8 °C compared to 0 at GR5. GR5 had 0 hours with temperatures >=20ºC in 2018 and in 2019 compared to 60 hours in 2015 and 0-14 in other years. The percentage of time in the 10-15.6ºC range was the lowest in 2018 than all other years since records began in 2009 but increased some in 2019.

FIGURE 52 DIURNAL FLUCTUATIONS IN WATER TEMPERATURE ALONG THE GRANDE RONDE RIVER DURING 2019, ABOVE (BLUE) AND BELOW (RED) VEY MEADOWS



Bird Track Springs, Longley Meadows and Upper Grande Ronde River

CTUIR and Grande Ronde Basin partners recently implemented fish habitat improvements on private and public land on the Grande Ronde River (RM 142-164.2). One of the primary objectives of fish habitat enhancement projects is to restore thermal heterogeneity to stream temperatures within project reaches. Traditionally, this has been monitored by installing temperature loggers upstream and downstream of a project reach and monitoring pre and post project construction to detect changes in stream temperatures related to restoration activities. Recently, CTUIR habitat personnel have used alternative methods to detect change, support project design and project locations. This has been done through a combination of; 1.) using existing temperature probes in the Grande Ronde River that bracketing project areas, 2.) documenting cold water habitat in the Grande Ronde River and off channel habitats with additional temperature probes, 3.) longitudinal temperature profiles, and .) deployment of novel loggers following completion of a restoration project.

Results will be presented in a format that includes: 7 day average daily maximum temperatures with 10-15.6°C optimum feeding range for juvenile Chinook and 18°C non-core rearing for juvenile salmonids (McCullough, 1999) (EPA, 2003) and a longitudinal temperature profile of stream temperature captured over a 4 hour period of time.

The results demonstrate:

- Important cold-water refugia in off-channel habitats in or near Bird Track Springs and Longley Meadows (Figures 53 & 55)
- There is a cooling trend through the upper Grande Ronde River from downstream of Vey Meadows to the confluence with Fly Creek (Figure 56)

FIGURE 53 7 DAY AVERAGE DAILY MAXIMUM TEMPERATURES (7DADM) FOR BIRD TRACK SPRINGS PROJECT AREA, YEARS 2017 TO 2019. BLUE BOX IS THE OPTIMAL FEEDING TEMPERATURES FOR JUVENILE CHINOOK (10-15.6°C) AND RED DASHED LINE IS NON CORE REARING FOR SALMONIDS (18°C)

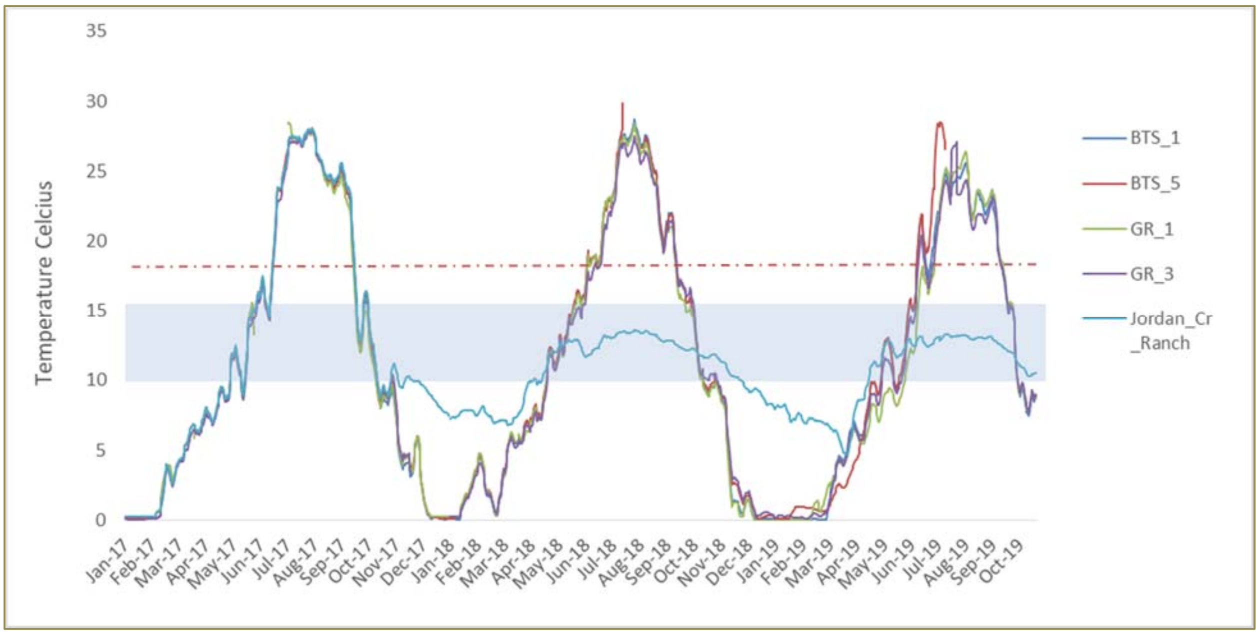


FIGURE 54 MAP OF BIRD TRACK SPRINGS AND LONGLEY MEADOWS PROJECT AREA WITH EXISTING AND FUTURE PLANNED TEMPERATURE PROBES

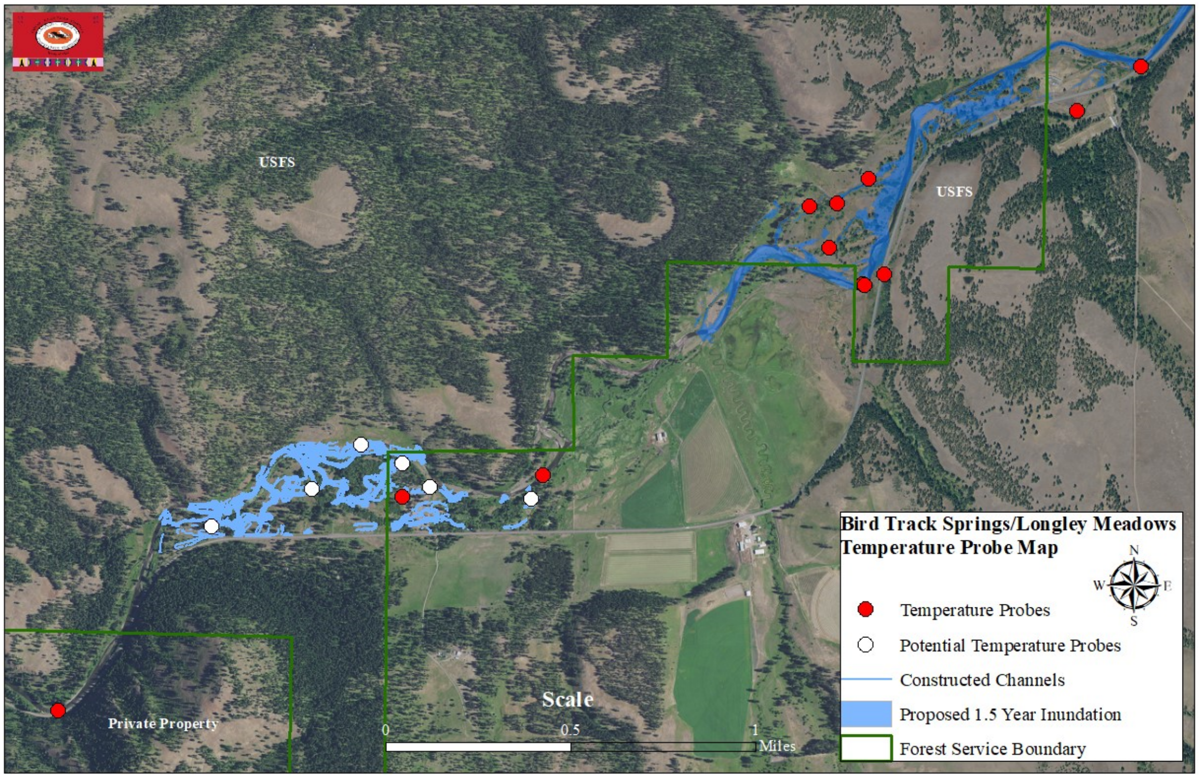


FIGURE 55 7 DAY AVERAGE DAILY MAXIMUM TEMPERATURES (7DADM) FOR LONGLEY MEADOWS PROJECT AREA, YEARS 2017 TO 2019. BLUE BOX IS THE OPTIMAL FEEDING TEMPERATURES FOR JUVENILE CHINOOK (10-15.6°C) AND RED DASHED LINE IS NON CORE REARING FOR SALMONIDS (18°C)

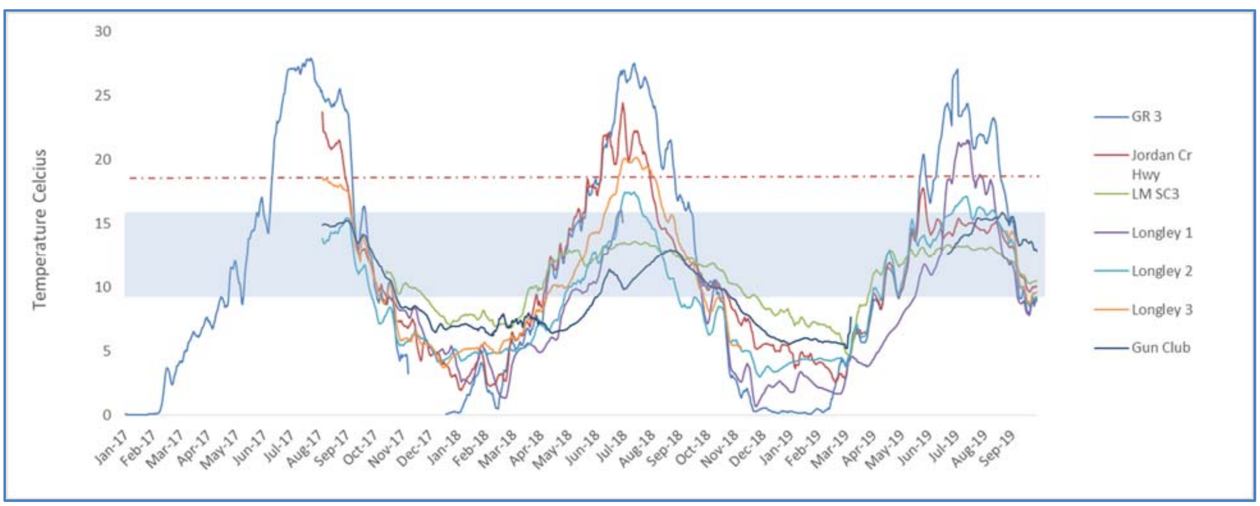
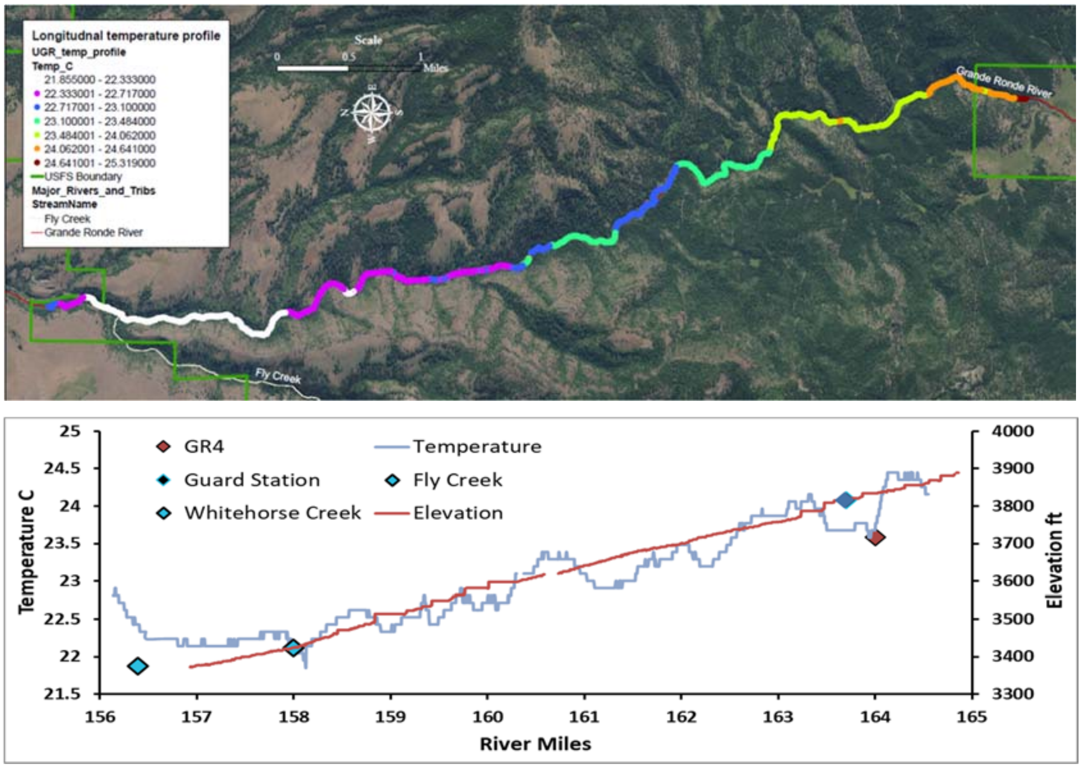


FIGURE 56 STREAM TEMPERATURE PROFILE OF UPPER GRANDE RONDE RIVER ON AUGUST 29, 2017 BETWEEN RIVER MILES 156 AND 165 WHERE ADDITIONAL RESTORATION WORK BEGAN IN 2019



Additional information on cold water analysis in the Upper Grande Ronde River can be found in a technical report on the Pisces web page at:

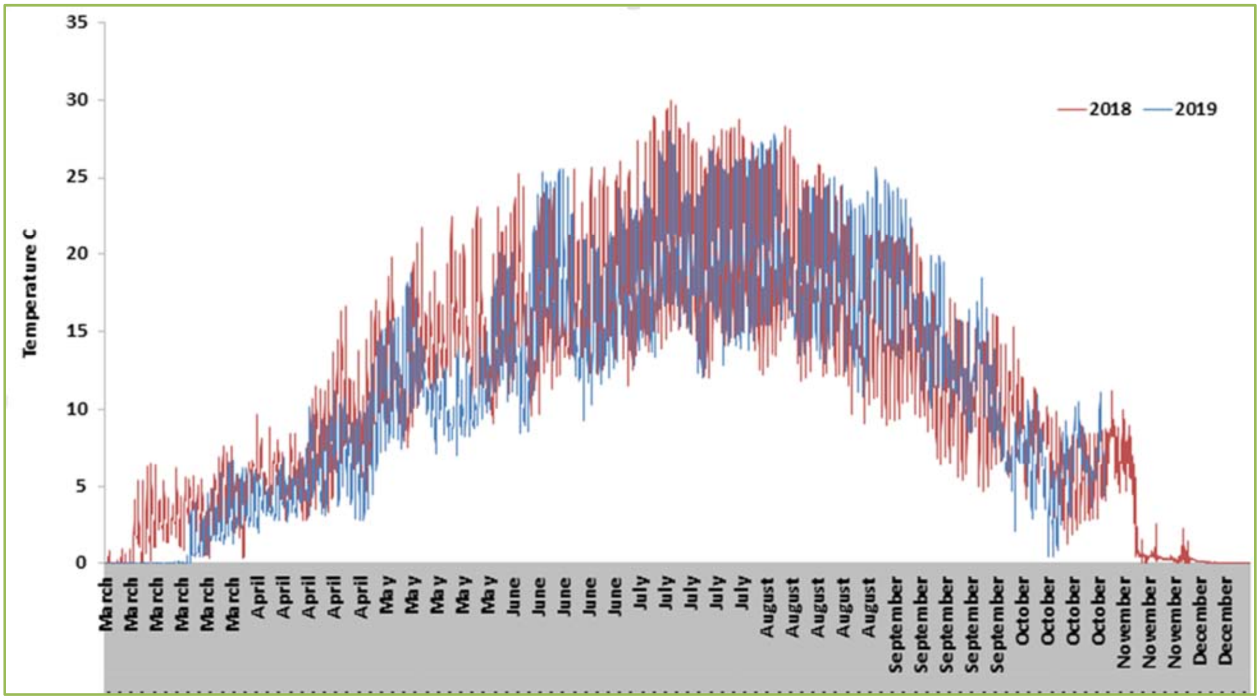
https://www.cbfish.org/Document.mvc/DocumentViewer/P165232/cold-water-analysis-upper-grande-ronde-river.pdf

Meadow Creek Watershed

The CTUIR Fish Habitat Project had two probes deployed in 2019 within the Meadow Creek Watershed monitoring two streams – Meadow Creek and Dark Canyon Creek.

The Meadow Creek probe at river mile 2.9 (MEADOW1) was deployed for 296 days between 1/1/2019 and 10/23/2019 and recorded a total 7092 hours of data for the analysis. The Dark Canyon Creek probe at river mile 0.1 (DC1) was deployed for 310 days between 1/1/2019 and 11/6/2019 but only recorded a total 1159 hours of data for analysis.

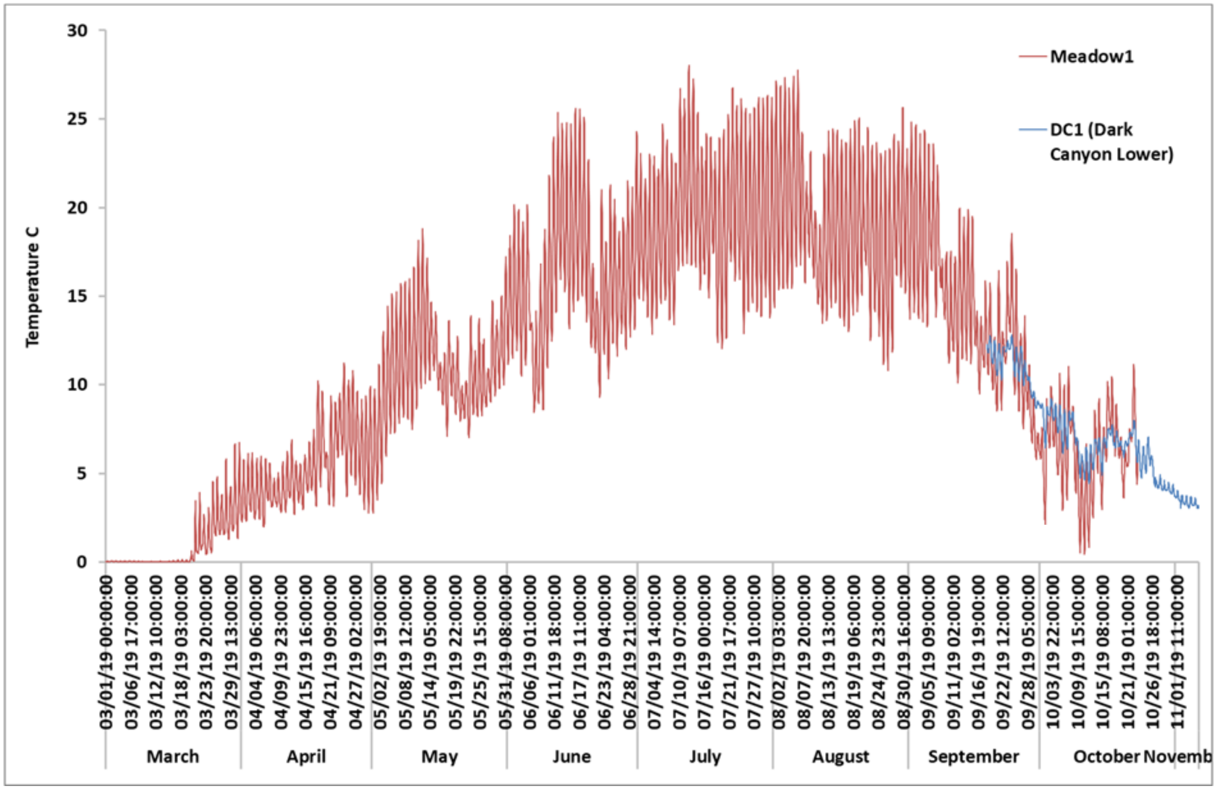
FIGURE 57 DIURNAL FLUCTUATIONS IN WATER TEMPERATURE ALONG MEADOW CREEK COMPARING 2018 AND 2019 AT MEADOW1 PROBE LOCATION



From the above (Figure 57), comparing 2018 data (in red) with 2019 data (in blue) shows us a couple interesting features. The first is that compared to 2018, the month of May in 2019 was much cooler with 2019 maximums barely reaching the lower limits of temperatures from the year prior. Again, as temperatures seasonally peak through July, 2019 was consistently cooler than the previous year through the summer months. The only instance where 2019 temperatures at MEADOW1 were noticeably higher than 2018 data was the beginning of September.

From the below (Figure 58) , comparing MEADOW1 to the data from probe at lower Dark Canyon Creek nearby, we see a similar temperature decline through the fall months September-October 2019. Diurnal fluctuations in Meadow Creek exhibit much more polarized highs and lows compared to the shallower amplitude seen at Dark Canyon Creek. One reason contributing to this difference could be that Dark Canyon Creek receives significantly less solar input as it runs its course through the deep and narrow North-South canyon compared to Meadow Creek which winds its way through much wider valleys and meadows with less shade. Groundwater interactions may be more frequent in Dark Canyon than with Meadow Creek, which may influence the buffered temperature regime seen from Dark Canyon data.

FIGURE 58 DIURNAL FLUCTUATIONS IN WATER TEMPERATURE ALONG MEADOW CREEK COMPARING 2018 AND 2019 AT MEADOW1 PROBE LOCATION



Rock Creek

Beginning in 2013, a multi-phased restoration effort was started on Rock Creek, and tributaries of Rock Creek by CTUIR with the final phase completed in 2018. One of the primary objectives is to reduce summer peak temperatures for all life stages of ESA-listed salmonids. Five temperature probes were installed on Rock Creek and Graves Creek, starting in 2011. 2019 data from the most downstream probe (Rock 1) were unavailable due to a malfunctioning probe. All other probes are located above the final phase of the Rock Creek Restoration Project. Rock 3, at river mile 3, had a maximum temperature of 23.7 °C, and logged 0 hours, and 104 hours where temperatures exceeded 25 °C, and 20 °C respectively. On Graves Creek, tributary to Rock Creek, entering at river mile 1.7, Graves 1 (RM .5) had a maximum temperature of 24.6 °C and logged 0, and 154 hours where temperatures exceeded 25 °C, and 20 °C respectively. Rock 3, and Graves 1 are plotted (Figure 59) to exhibit diurnal, and seasonal fluctuations, and to highlight a shift in the temperature regime occurring on Graves Creek during mid-summer. In mid-July Graves Creek (at Graves 1 site) shifts to a more buffered diurnal swing with maximum temperatures remaining under 16 °C for the remainder of the summer (Figure 60).

FIGURE 59 DIURNAL FLUCTUATIONS IN WATER TEMPERATURE ON ROCK CREEK AND GRAVES CREEK DURING 2019

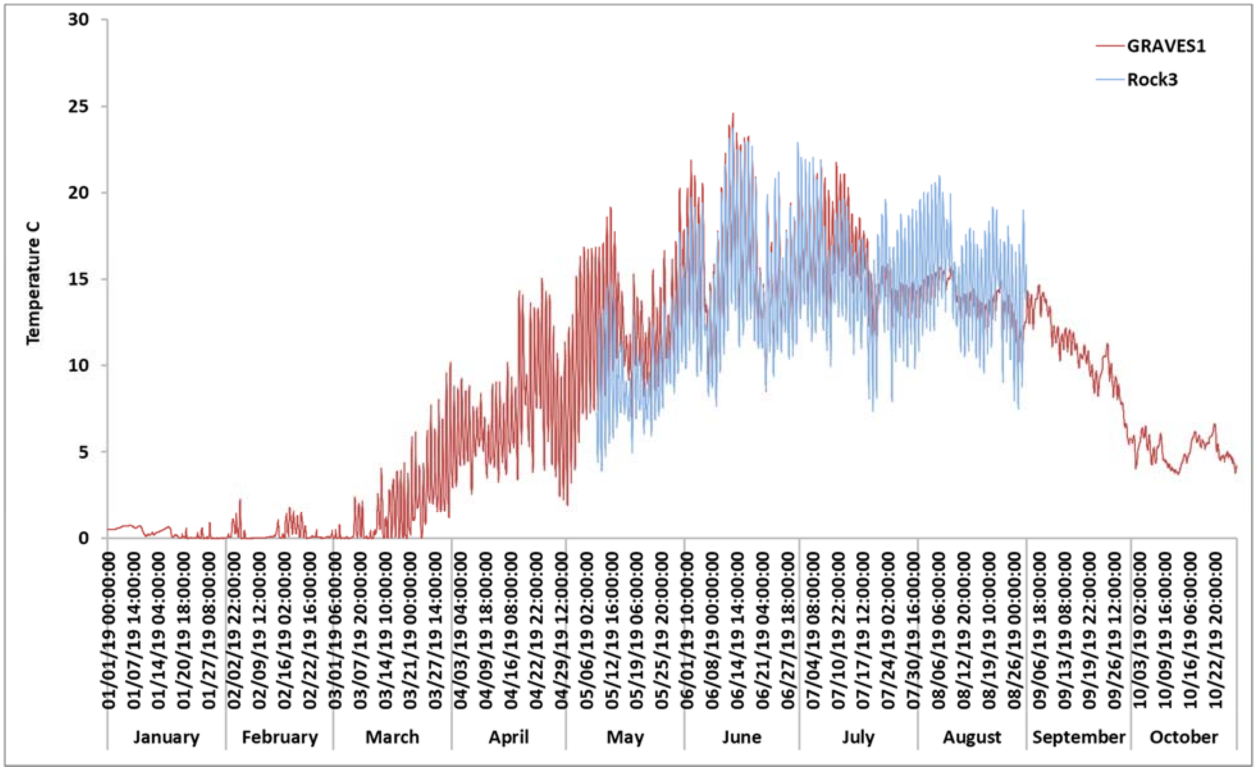
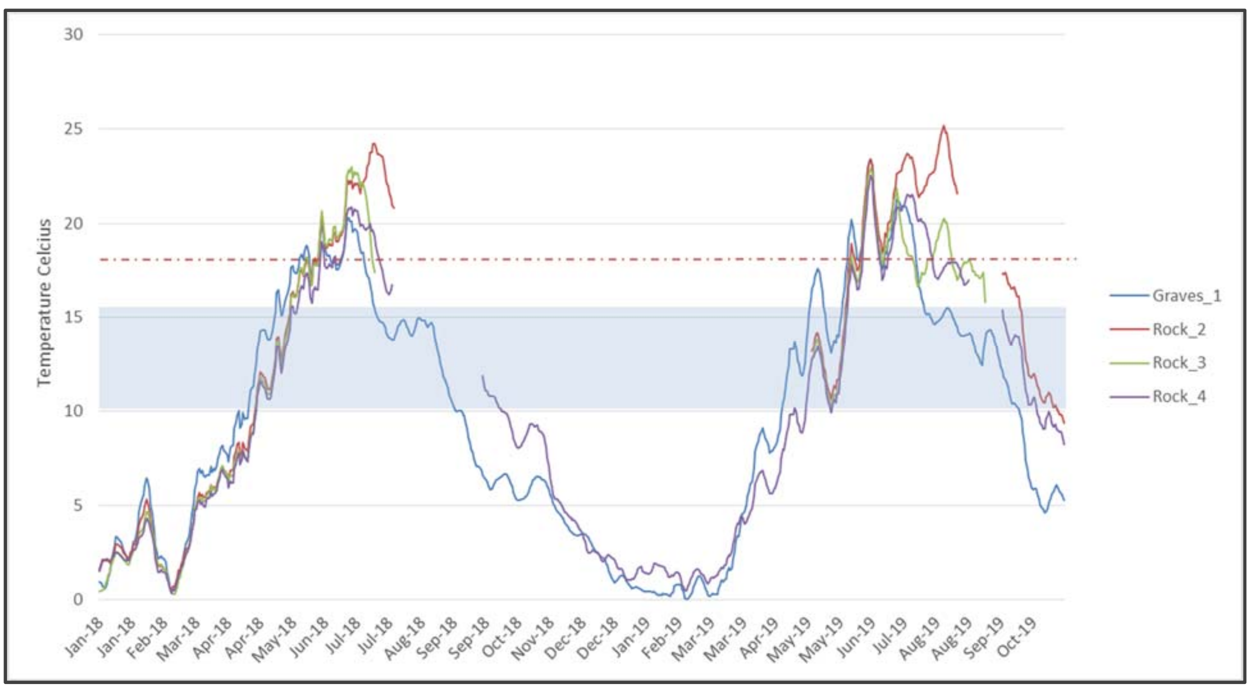


FIGURE 60 7 DAY AVERAGE DAILY MAXIMUM TEMPERATURES (7DADM) FOR ROCK CREEK AND GRAVES CREEK, 2018-2019. BLUE BOX IS IDEAL FEEDING TEMPERATURES FOR JUVENILE CHINOOK (10-15.6°C) AND RED DASHED LINE IS UPPER LIMIT FOR JUVENILE REARING (18°C)



Catherine Creek 44

To monitor water quality (temperature) within the Catherine Creek River Mile 44 (CC44) Project area, CTUIR deployed 13 Hobo Pendant temperature probes within the boundaries of several property owners. The probes were deployed from 1/1/2019 to 10/24/2019 with a range of 239-297 days and a total of 79,660 hours recorded for analysis. There were 175 records in 2019 in which stream temperatures exceeded the lethal limit of 25 degrees C.

In 2017, CTUIR and basin partners completed a fish habitat enhancement project on Catherine Creek near river mile 44. The design and floodplain connectivity allowed for a great opportunity to restore thermal diversity within the project reach. A network of temperature loggers were deployed following the completion of the project to monitor main-stem and off channel habitats for stream temperature changes. The following results demonstrate the benefit of these off-channel habitats when compared to the main-stem for reducing summer peak temperatures and increasing winter low temperatures, both benefiting ESA-listed salmonids in Catherine Creek basin.

FIGURE 61 DIURNAL FLUCTUATIONS IN WATER TEMPERATURE ON CATHERINE CREEK (CC44) DURING 2019. RED INDICATES MAIN CHANNEL TEMPERATURES, AND BLUE REPRESENTS DATA COLLECTED FROM A NEARBY OFF-CHANNEL HYPORHEIC POOL

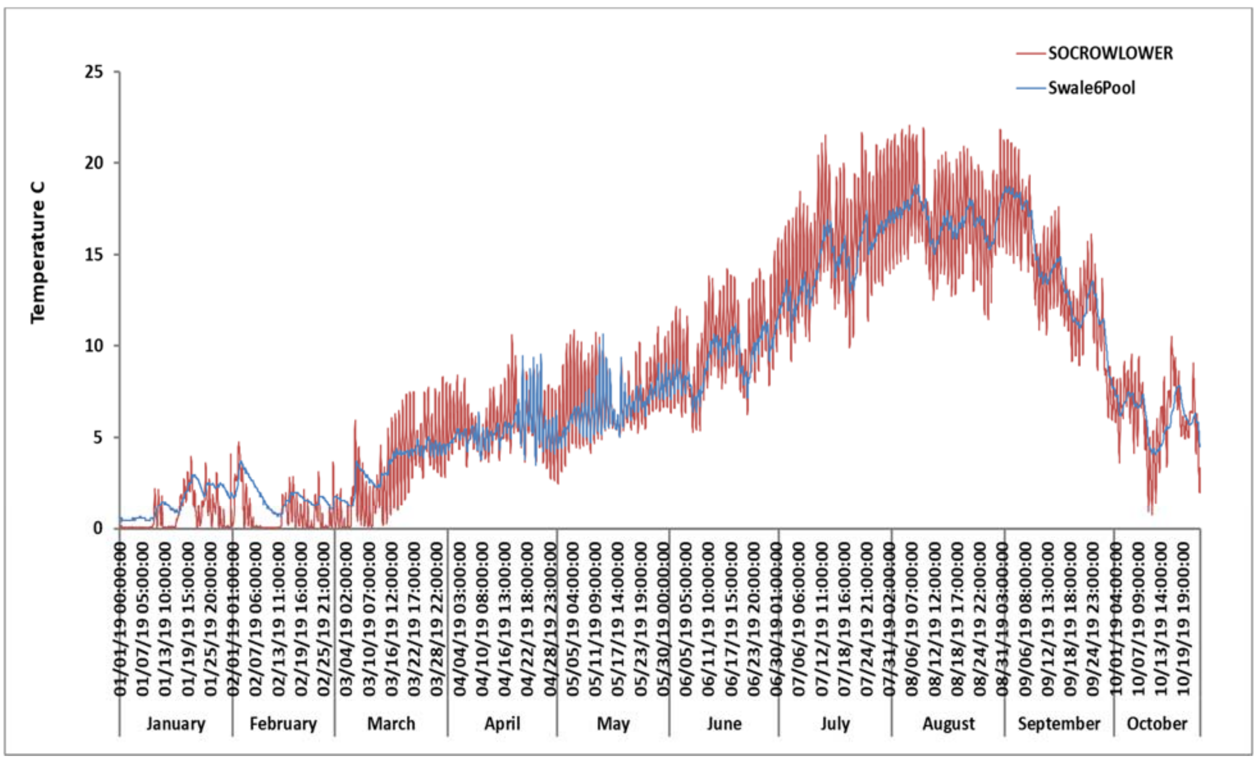


Figure 61 above compares 2019 diurnal fluctuations of water temperatures on Catherine Creek RM 44. The red data plots represent temperatures from the main channel on the lower end of Southern Cross ranch. Note as the year progresses and main channel temperatures climb into summer months that the daily highs and nighttime lows show greater divergence. The blue dataset represents temperatures recorded in an off-channel hyporheic-fed pool in a swale nearby the lower main channel probe. Comparing the two locations shows that the main channel temperatures exhibit greater extremes between diurnal highs and lows, as the off-channel pool location displays much more muted extremes in diurnal swings. This could be due to the pool only receiving groundwater, which has been shown to buffer temperature extremes (stays cooler in daytime – and summer – and warmer at night – and winter – relative to surface water). One last thing to notice are the two spikes in the off-channel pool data occurring around April-May. This time of year is when Catherine Creek often sees its peak flows, and is shown in the data as increased temperature due to slightly warmer over-banking surface water from the main channel interacting with slightly cooler groundwater in the off-channel pool during high flow events.

FIGURE 62 7 DAY AVERAGE DAILY MAXIMUM TEMPERATURES (7DADM) FOR MAIN CHANNEL CATHERINE CREEK (RED) AND ALCOVE (BLUE) LOCATIONS, YEARS 2018-2019. BLUE BOX IS IDEAL FEEDING TEMPERATURES FOR JUVENILE CHINOOK (10-15.6°C) AND RED DASHED LINE IS UPPER LIMIT FOR JUVENILE REARING (18°C)

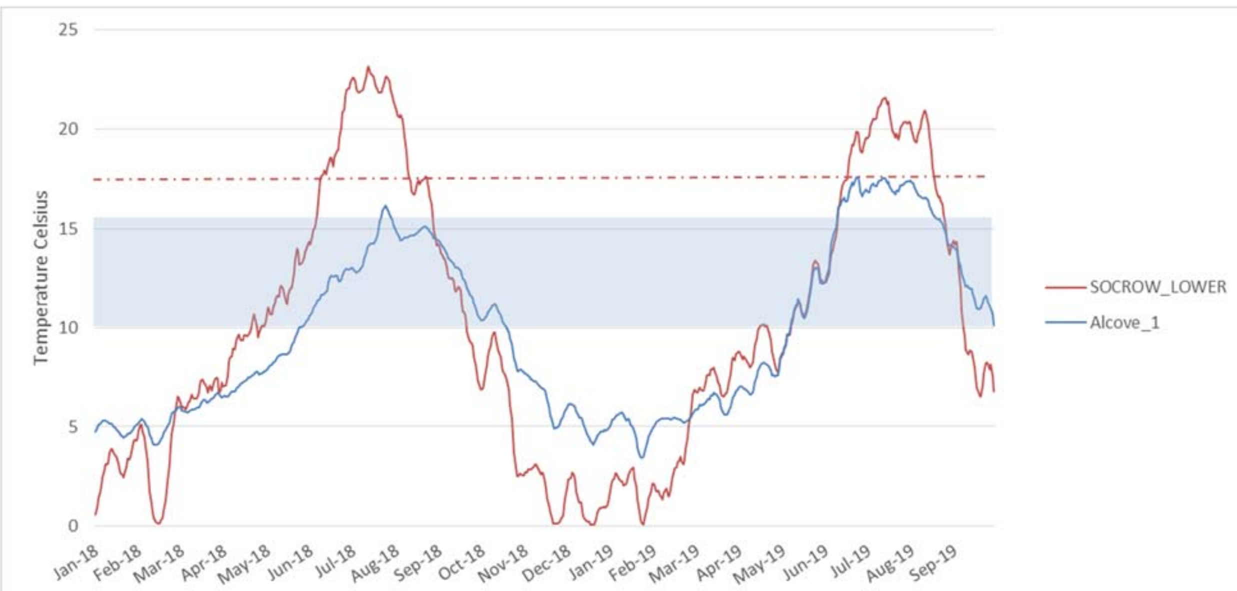


Figure 62 above provides a 7-day rolling average of daily maximum temperatures at two locations on Catherine Creek Southern Cross ranch for years 2018-2019. The data from the location in red comes from a probe located in the main channel, and blue is data collected from a probe located in a backwater alcove that also receives hyporheic groundwater from an upstream swale. As was the case in the previous comparison of main channel with off-channel swale pool water temperatures, the muting of seasonally extreme high and low temperatures are can be seen. Main channel temperatures come close to the lethal limit of 25 degrees C in summer for juvenile chinook, and freeze in the winter. Alcove temperatures that are buffered by groundwater influence remained in the blue optimal feeding range box for 31.5% of 2019 and never got above the upper limit of 18 degrees C for juvenile rearing. Expanding off-channel, groundwater connected habitats is important for buffering seasonal and diurnal temperatures, lowering summer temperatures, as well as raising temperatures during winter while maintaining open unfrozen water in which fish can occupy and feed.

FIGURE 63 MAP OF SELECTED TEMPERATURE LOGGERS MONITORED ON CATHERINE CREEK FISH HABITAT ENHANCEMENT PROJECT 2016-2019

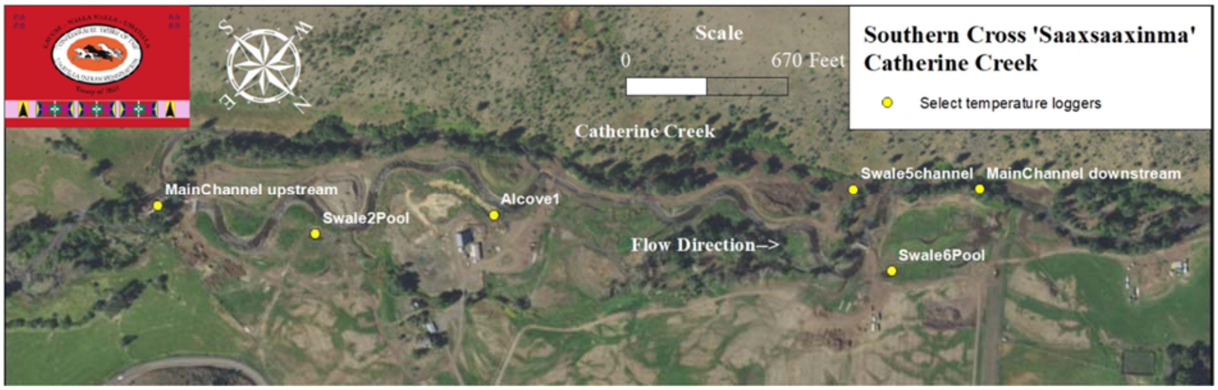


FIGURE 64 7 DAY AVERAGE DAILY MAXIMUM STREAM TEMPERATURE IN CATHERINE CREEK MAINSTEM (RED) AND FLOODPLAIN FEATURES (BLUE) FOR YEARS 2018-2019. NOTE STREAM TEMPERATURE ATTENUATION IN FLOODPLAIN FEATURES DURING SUMMER PEAK TEMPERATURES AND WARMER TEMPERATURES DURING WINTER. . BLUE BOX IS OPTIMUM FEEDING TEMPERATURES FOR JUVENILE CHINOOK (10-15.6°C) AND RED DASHED LINE IS UPPER LIMIT FOR CORE JUVENILE REARING

Additional temperature and dissolved oxygen monitoring of floodplain dynamics, including lagging and buffering can be found at:

https://www.cbfish.org/Document.mvc/DocumentViewer/P165231/southern-cross-temperature-analysis.pdf

https://www.cbfish.org/Document.mvc/DocumentViewer/P165233/dissolved-oxygen-analysis.pdf

TABLE 9 WATER TEMPERATURE STATISTICS FOR CATHERINE CREEK WATERSHED IN 2019.

Stream	Location Name	River mile	Year	Start date	End date	# of Days Deployed	# Hours in Deployment Period	# of Hours for Analysis	Max Temperature (° C)	Hours >=25 ° C	Hours >=20 ° C	Hrs. at 10 - 15.6 ° C	% at 10 - 15.6 ° C	Mean daily >=17.8 ° C (# days)
Catherine Creek	Alcove 1	n/a	2019	1/1/2019	10/24/2019	296	7115	7115	18.9	0	0	2241	31.5	0
Catherine Creek	CC44LOWER	40	2019	1/1/2019	10/24/2019	296	7119	7119	22.1	0	186	1382	19.4	18
Catherine Creek	CC44UPPER	44	2019	1/1/2019	10/24/2019	296	7115	1587	14.6	0	0	153	9.6	0
Catherine Creek	SCMID	41.2	2019	1/1/2019	10/24/2019	296	7117	7115	22.0	0	181	1411	19.8	13
Catherine Creek	Side_Channel1	41	2019	1/1/2019	10/24/2019	297	7117	7117	24.1	0	276	1551	21.8	20
Catherine Creek	SOCROWLOWER	40.9	2019	1/1/2019	10/24/2019	297	7117	7114	22.1	0	180	1406	19.8	13
Catherine Creek	SOCROWUPPER	41.6	2019	1/1/2019	10/24/2019	296	7115	6815	21.8	0	146	1433	21.0	9
Catherine Creek	Swale1Channel	n/a	2019	1/1/2019	8/28/2019	239	5745	4980	27.8	16	134	644	12.9	11
Catherine Creek	Swale2Pool	41.4	2019	1/1/2019	10/24/2019	296	7115	7115	19.8	0	0	1743	24.5	2
Catherine Creek	Swale4channel	n/a	2019	1/1/2019	10/24/2019	297	7118	5744	30.6	104	449	823	14.3	34
Catherine Creek	Swale5channel	n/a	2019	1/1/2019	10/24/2019	296	7116	3624	11.8	0	0	63	1.7	0
Catherine Creek	Swale6channel	n/a	2019	1/1/2019	10/24/2019	296	7116	7107	30.3	55	637	1315	18.5	50
Catherine Creek	Swale6Pool	41	2019	1/1/2019	10/24/2019	296	7116	7108	18.8	0	0	1295	18.2	10

TABLE 10 WATER TEMPERATURE STATISTICS FOR GRANDE RONDE RIVER WATERSHED IN 2019.

Stream	Location Name	River mile	Year	Start date	End date	# of Days Deployed	# Hours in Deployment Period	# of Hours for Analysis	Max Temperature (° C)	Hours >=25 ° C	Hours >=20 ° C	Hrs. at 10 - 15.6 ° C	% at 10 - 15.6 ° C	Mean daily >=17.8 ° C (# days)
Grande Ronde River	Alcove	152.9	2019	1/1/2019	10/23/2019	296	7093	7093	18.9	0	0	3561	50.2	0
Grande Ronde River	BTS1	144.6	2019	1/1/2019	10/23/2019	296	7094	7094	27	46	836	1132	16	68
Grande Ronde River	BTS5	143.9	2019	1/1/2019	7/9/2019	190	4551	4551	30	46	191	693	15.2	13
Grande Ronde River	FS_coldwater	156.2	2019	1/1/2019	10/23/2019	295	7092	7092	17.5	0	0	2902	40.9	0
Grande Ronde River	GR1	146.4	2019	1/1/2019	10/23/2019	296	7093	7093	27.3	81	712	1117	15.7	59
Grande Ronde River	GR10	138.7	2019	1/1/2019	10/23/2019	296	831	831	19.4	0	0	264	31.8	0
Grande Ronde River	GR11	156.3	2019	1/1/2019	10/23/2019	295	7092	7092	24	0	333	1435	20.2	27
Grande Ronde River	GR12	155.5	2019	1/1/2019	10/23/2019	295	7091	7091	24.3	0	414	1414	19.9	37
Grande Ronde River	GR3	143.3	2019	1/1/2019	10/23/2019	296	7093	7088	26.3	11	822	1067	15.1	68
Grande Ronde River	GR4	163.9	2019	1/1/2019	10/29/2019	301	7233	7210	25.9	14	497	1388	19.3	33
Grande Ronde River	GR5	170.8	2019	1/1/2019	10/23/2019	295	7090	7090	18	0	0	1543	21.8	0
Grande Ronde River	GR9	152.1	2019	1/1/2019	10/29/2019	301	7092	7092	26.9	66	603	1410	19.9	49
Grande Ronde River	Gun Club	142.2	2019	1/1/2019	10/23/2019	296	7095	7080	18.8	0	0	3206	45.3	0
Grande Ronde River	Jordan Cr_hwy	n/a	2019	1/1/2019	10/23/2019	296	7094	7093	13.7	0	0	4091	57.7	0
Grande Ronde River	LM_SC3	n/a	2019	1/1/2019	10/23/2019	296	7095	2544	22.8	0	79	1208	47.5	0

Stream	Location Name	River mile	Year	Start date	End date	# of Days Deployed	# Hours in Deployment Period	# of Hours for Analysis	Max Temperature (° C)	Hours >=25 ° C	Hours >=20 ° C	Hrs. at 10 - 15.6 ° C	% at 10 - 15.6 ° C	Mean daily >=17.8 ° C (# days)
Grande Ronde River	Longley 1	n/a	2019	1/1/2019	10/23/2019	296	7095	7095	17.2	0	0	2856	40.3	0
Grande Ronde River	Longley 2	n/a	2019	1/1/2019	10/23/2019	296	831	831	15.4	0	0	325	39.1	0
Grande Ronde River	Longley 3	n/a	2019	1/1/2019	10/23/2019	296	7095	5283	16.5	0	0	2519	47.7	0
Grande Ronde River	Longley Air	n/a	2019	1/1/2019	10/23/2019	295	7095	7095	37.2	n/a	n/a	n/a	n/a	n/a
Meadow Creek	MEADOW1	2.9	2019	1/1/2019	10/23/2019	296	7092	7092	28	118	821	1415	20	71
Dark Canyon Creek	DC1	0.1	2019	1/1/2019	11/6/2019	310	7436	1159	12.8	0	0	231	20	0
Dark Canyon Creek	DC2	1.9	2019	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Rock Creek	ROCK1	0.2	2019	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Rock Creek	ROCK2	1.7	2019	1/1/2019	10/29/2019	301	7233	3835	26.3	21	620	1371	35.7	49
Rock Creek	ROCK3	3	2019	1/1/2019	8/29/2019	241	5772	2699	23.7	0	104	1402	52	1
Rock Creek	ROCK4	4.5	2019	1/1/2019	10/29/2019	310	7232	7216	25.6	1	147	2013	27.9	2
Graves Creek	GRAVES1	0.5	2019	1/1/2019	10/29/2019	301	7233	7093	24.6	0	154	2453	34.6	8

Lessons Learned/Adaptive Management

The Grande Ronde Subbasin is one example of efforts to learn and adapt management programs through time. Historically, basin partners developed projects in an opportunistic approach. Projects were largely identified and developed with willing landowners based on coarse scale planning established through the Grande Ronde Subbasin plan completed in 2004. In 2013, basin partners initiated a strategic planning process (ATLAS) for Catherine Creek and the Upper Grande Ronde watershed based on salmon and steelhead life history requirements and geomorphic potential to stratify individual watershed by biological significant reaches, assign relative importance of limiting factors, define key actions to address limiting factors, and develop a ranking and prioritization system to clearly identify geographic and reach priorities and both short and long term strategies to focus watershed restoration actions in areas with the most biological need and the highest probability of benefit.

The process engaged multiple basin partners and leveraged the best available science and local expertise available to develop a road map that all partners can utilize to identify, develop, and implement strategic watershed and fish habitat restoration and enhancement projects. Transitioning opportunistic to strategic planning may be one of the most important adaptive management changes employed in the basin for prioritizing and strategizing work in Catherine Creek and the Grande Ronde river to address survival gaps for Snake River Spring-Summer Chinook and Summer Steelhead populations in the Grande Ronde Subbasin.

Additionally, the CTUIR Grande Ronde Fish Habitat Project continues to monitor and evaluate performance of projects and conservation measures developed to improve watershed and fishery resources in the Grande Ronde Subbasin. Post project construction and monitoring data, along with staff experience and collaboration with basin partners, collectively informs and helps improve our understanding of how different techniques and approaches to watershed and habitat restoration respond as well as develop new and innovative approaches to addressing habitat limiting factors for salmon and steelhead populations.

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