Scale Matters - Lessons Learned from Large-Scale Floodplain Restoration in the Upper Grande Ronde River, Oregon

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Abstract

This paper briefly presents the Bird Track Springs (BTS) and Longley Meadows (LM) Projects located in the Upper Grande Ronde River (UGR) in NE Oregon. These large-scale floodplain restoration projects were implemented over four years by multiple project partners led by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) from 2018 through 2021. Project planning and design was completed by a multi-disciplinary team led by the U.S. Bureau of Reclamation. Projects were completed to improve habitat conditions for Snake River ESA-listed salmonids in the UGR. The scale of these projects was extensive both in planning and construction. Previous attempts at restoring channel habitats in this reach were unsuccessful as those previous attempts did not address the scale of historic impacts nor did they represent the current vision of how this and many other unconfined river corridors historically functioned. The resulting projects have re-connected large floodplains by the re-establishment of multi-thread channel networks and wetlands. In doing so, they have proven to be resilient. Pools have been maintained, floodplains remain connected, and channels functioning despite having two back-to-back large floods immediately after construction.

Introduction

History

The UGR in NE Oregon (HUC 17060104) is a historically important river for salmon production. The UGR has been impacted by human activities since European settlers arrived to trap beaver in the early 1800's. Major historic impacts to the watershed included logging with splash dams, railroad construction, road construction, livestock grazing, and beaver trapping. Historic impacts have resulted in degraded river and riparian conditions, which have contributed to a multitude of environmental effects including degraded fish habitat, reduced floodplain connectivity, increased stream temperatures, and reduced base flows. Like many present-day rivers, the simplification of the UGR has resulted in an efficient transport channel. Much of the UGR can be described as a wide-shallow-single-thread-plane-bed channel with little structure and limited pools. Floodplains in the UGR are generally disconnected from frequent high flows due to a simplified and overly wide channel. In 2014, the U.S. Bureau of Reclamation Columbia-Pacific Northwest Region (USBR) completed a tributary assessment of the UGR to prioritize reaches for habitat conservation and restoration to improve habitat conditions for ESA-listed Snake River salmonids (Reclamation 2014). The assessment resulted in prioritizing four unconfined reaches within the UGR to target for habitat improvements. The Bird Track

Springs-Longley Meadows reach (BTS-LM) was the largest of the four reaches identified and is the focus of this paper. Located between river miles 142 and 146, BTS-LM is an approximate 4-mile unconfined reach on the UGR that has a mixture of public and private ownership that contains a floodplain of approximately 800-acres.

Setting

The UGR is in the Blue Mountain ecoregion. This region consists of a mountainous watershed with relatively low elevations (ranging from approximately 2800- to 7700-ft MSL) in Eastern Oregon with a marine-influenced climate. Soils are generally shallow and consist of loess and ash overlying basalt supporting a dense and diverse shrub layer beneath a relatively open canopy of ponderosa pine and Douglas-fir (Thorson et al. 2003). Hydrology is considered snowmelt dominated with relatively low base flows and flood peaks in the late Spring from melting snow. In addition, the combination of a continental climate with a marine influence from the Pacific appears to influence dynamic hydrologic behavior. In the winter, the UGR experiences frequent ice events following cold arctic periods that can be followed by rain or rain-on-snow from the Pacific. During freeze-up, frazil ice is formed in turbulent flow conditions common throughout the simplified channel of the UGR, frazil ice freezes to shallow rocks and surface ice forming anchor ice and hanging dams which can dam the river forming ice jams that can be miles long. Warm precipitation events that follow can result in significant flood events in late winter through early spring followed by very low base flows in the summer and early fall. During break-up, rafted ice along with anchor ice can scour the mainstem river corridor, which is devoid of structure (wood) and pools. This reoccurring hydrologic process is suspected to reinforce simplified channel conditions that were established decades ago from early European settlers. Historic channelization efforts included large scale logging of the watershed along with splash-damming of the river to float log rafts to downstream mills. Historic actions have led to a single-thread-overly-wide channel that exhibits plane bed conditions throughout the UGR. Historically, large trees were abundant along the banks of the UGR and would have fallen into the channel providing both structure and pools for floating debris such as ice, flotsam, and sediment to deposit upon, which would have led to multi-threaded channel networks within unconfined depositional sub-reaches of the watershed.

Project Description

Habitat Needs

Restoration of the BTS-LM reach of the UGR was undertaken to address limiting habitat conditions for ESA-listed salmonids. ESA-listed species of concern include the UGR population of the Snake River Basin steelhead and the UGR spring Chinook salmon, both currently listed as threatened (NOAA Fisheries 2017). This project is a small part of a larger watershed planning effort to recover Snake River salmonids. Habitat limiting factors for salmonids in this reach of the UGR include high water temperatures, decreased water quantity, lack of instream structural complexity, simplified channel form, reduced riparian cover, limited large woody material (LWM) recruitment, and increased sediment erosion (NOAA Fisheries 2012).

Project Partners

In early 2015, Reclamation partnered with CTUIR, Bonneville Power Administration (BPA), the Grande Ronde Model Watershed (GRMW), and the U.S. Forest Service (USFS) to improve habitat conditions for salmonids within the river-wetland corridor of the BTS-LM reach. Ownership within the reach includes USFS lands, two private ranches and a private gun club. Reclamation provided planning and design services to the CTUIR for two large-scale floodplain restoration projects, the Bird Track Springs Project (BTS) and the Longley Meadows Project (LM).

Project Goals and Objectives

The long-term rehabilitation vision (Confederated Tribe of the Umatilla Indian Reservation's River Vision (Quaempts et al. 2018)) for the UGR is to improve physical and ecological processes by rehabilitating and restoring the river to achieve immediate and long-term benefits to Chinook, steelhead, and bull trout at all life stages. The most current critical life-stages for salmonids in the BTS-LM reach includes juvenile salmonids requiring improved summer and winter rearing conditions (Bonneville Power Administration 2017). Immediate (short-term) habitat benefits for juvenile salmonids were sought to influence habitat through construction of riffle-pool channel units and form, addition of complexity through wood placement, improved hyporheic conditions through riffle-pool development, and reduction of velocities through spreading of water into multiple channels and on the floodplain. Future (long-term) habitat benefits for salmonids included restoration of a dynamic river-wetland corridor and healthy riparian forest. Long-term benefits are expected to be realized through a focus on restoring fluvial and habitat-forming processes, floodplain, groundwater, and hyporheic connectivity, riparian and wetland plant communities, and instream complexity and diversity commensurate with the reach's natural potential. These habitat-forming processes are driven by the natural episodic disturbance regime that historically occurred prior to direct and indirect human modifications. Intermittent disturbances, such as floods, sediment delivery, wood accumulations, beaver activity, and associated channel dynamics foster and maintain a spatial mosaic and diverse range of aquatic and terrestrial habitats within a healthy river corridor.

To achieve both immediate and future goals for each project area, the project team developed specific objectives. Some of the many detailed objectives included increasing the number of high-quality pools in the reach, expanding peripheral habitats through side channel connections, increasing hyporheic connectivity by adding lateral and vertical complexity to the channel planform and bed morphology, and supporting diverse patterns of sediment sorting and deposition through the reach. Goals and objectives were evaluated through detailed surface design and 2-dimensional hydraulic modeling (SRH2D) that included evaluation of specific summer and winter juvenile salmon rearing habitat suitability (HSI) for proposed conditions. Two-dimensional modeling of various conditions also allowed the design team to visualize potential outcomes for flood and ice events. Construction of the BTS and LM projects both required two construction seasons that are dictated by in-water work periods for ESA salmonids as established by state and federal fisheries agencies. Ongoing monitoring of the projects is being performed by the CTUIR.

Project Metrics

BTS addressed 1.9-miles of the UGR that included an approximate 265-acres of floodplain. BTS was designed from 2016 through 2018 and was constructed in two phases during 2018 and 2019 with completion in December of 2019. BTS consisted of 5,000-feet of main channel where new channels were designed and constructed, and the historic channel was altered. The project also contained 9,500-feet of side channels that were constructed or re-connected from relic channel scars on the floodplain. The project had a large earth-work component with approximately 85,000-cubic yards (CY) of excavation where materials were sorted and re-utilized on-site as riffles, bars, and general fill. Approximately 4,500 trees were brought in from off-site and utilized for structure in the channels and on the floodplain (Figure 1). LM consisted of 1.9-miles of the UGR with approximately 210-acres of floodplain. LM was planned from 2018 through 2020 and was constructed in two phases during 2020 and 2021. LM consisted of 2,850 feet of main channel that was also a combination of newly constructed channel segments linking existing channels that were enhanced. The LM project had 7,250-feet of side channels that were a combination of new channels and re-connecting existing historic relic channels. The LM project had approximately 42,000 CY of excavation where materials were sorted and re-utilized on-site to form riffles, bars, and as general fill. Approximately 4,500 trees were brought in from off-site and utilized for structure in the channels and on the floodplain.

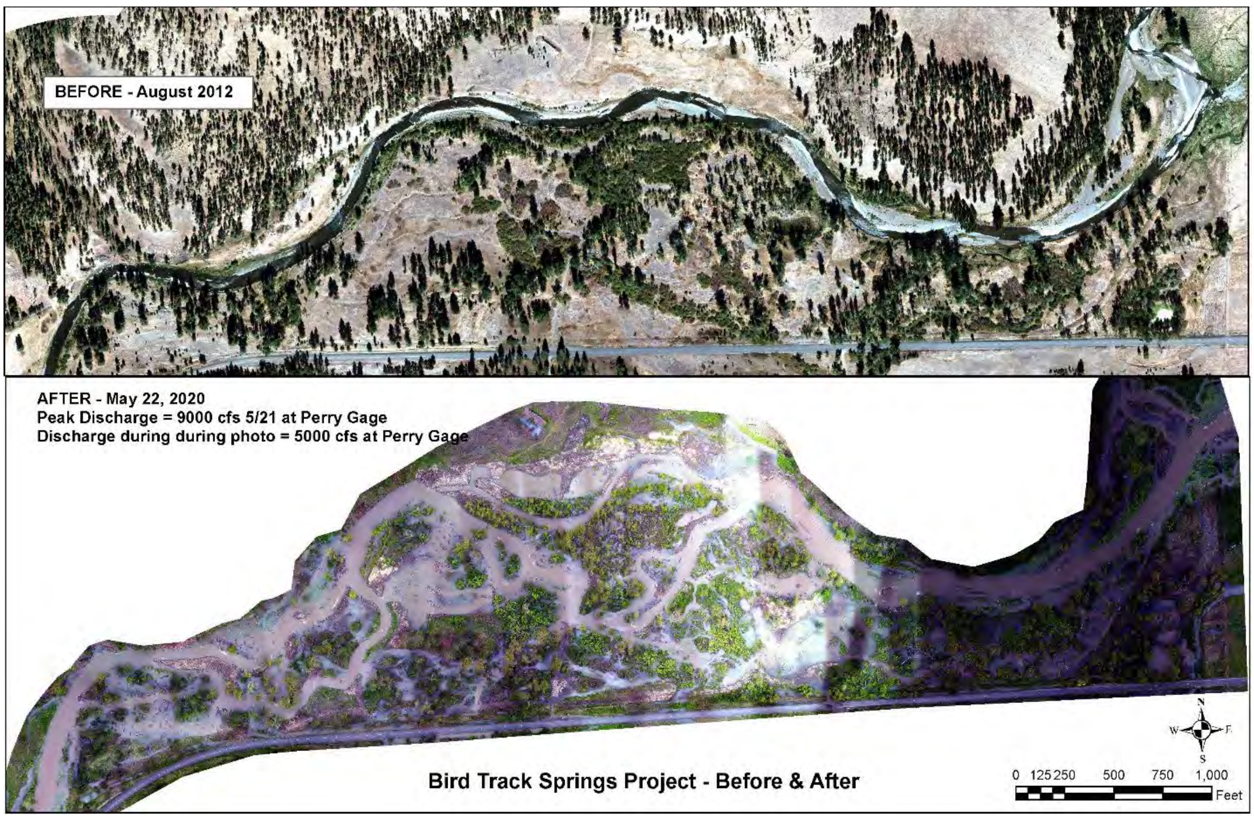

Figure 1. Bird Track Springs Project aerial photo before (August 2012) and after (May 2020).

Previous Projects

Prior to construction of the BTS and LM projects, a restoration project was completed in this reach to enhance habitat conditions for salmonids. Between 1998 and 2000 a large habitat project was completed on the BTS-LM reach of the UGR. Project partners for this historic project included the CTUIR, USFS, ODFW, NRCS, GRMW, and Oregon Department of Transportation (ODOT). Within the BTS project reach, the historic effort consisted of the placement of 1,150 cubic yards of large boulders in the form of rock weirs, vanes, and bank barbs along with the placement of 167 trees with root wads in embankments and on point bars. Goals for this historic project included enhancing instream aquatic habitat for spring Chinook salmon and steelhead through pool development, to promote bar development and to stabilize eroding stream banks (J. Webster, personal communication, October 1, 2019). The project represented the state of restoration practice during this period which consisted of the placement of instream rock and wood structures including rock weirs, rock barbs, and large wood buried in banks, but those attempts were largely unsuccessful. This is likely due in part to the scale of previous attempts considering environmental conditions and historic impacts. For the most part, pools filled in with gravels and large rocks were moved by the river resulting in loss of pool habitats and continuation of plane-bed conditions throughout the project reach. The scale of this historic project was thought to be quite large at the time of implementation given our historic baseline assumptions of how rivers functioned. More recent work in river research has offered a different view of river corridors as much more dynamic systems often with multiple channels and connected wetlands (Wohl et al. 2021). To re-establish what is now largely believed to be a functioning river-wetland corridor in a large unconfined floodplain, we needed to re-evaluate the scale of historic impacts and match that scale with a commensurate project.

Results

Determining the success of the more recent BTS and LM projects is ongoing. So far, the projects have shown remarkable resilience to ever-changing hydrologic and climatic conditions. The BTS project was immediately tested, two months after project completion the first of two historic floods occurred. In February of 2020 a warm precipitation event hit the Blue Mountain Region of Northeast Oregon and Southwest Washington. This "pineapple express" event was historic for many adjacent watersheds with widespread damage. Within the UGR, a flood peak of 8,720 cfs was recorded at the nearest downstream gage (USGS gage 13318960 – Grande Ronde River near Perry, OR). The flood peak was near the 40-year peak discharge for the UGR for the period of record 1904-2020. In May of 2020 another major flood occurred as a result of warm rain on the remaining high elevation snowpack. The peak of 9,160 cfs as measured at USGS gage 13318960 on May 20, 2020, was the second highest peak ever recorded on the UGR. The May 2020 flood event had a peak equaling the 50-year discharge. Floods that occurred in the UGR immediately after construction of the BTS project represented two of the largest five floods ever recorded at USGS gages downstream in the UGR. Oregon Highway 244, which is adjacent to the UGR, was damaged by the floods in many channelized reaches upstream and downstream of the BTS-LM reach. Despite experiencing two major floods immediately after construction, the BTS project exhibited remarkable resilience by spreading water out across the large floodplain. The project area collected trees and woody debris from upstream sources while only shedding a few pieces of wood to a downstream floodplain. Bar features were created and enhanced with native sediments in a wide spectrum of sizes ranging from silts to cobbles. Large wood structures withstood floods and collected additional flotsam making them appear more natural. Some erosion occurred as well as a few minor head-cuts leading to newly forming channels on the floodplain (indicating natural geomorphic processes have been restored). Highway 244 experienced some minor toe erosion on the upstream end of the project that was repaired. Of concern was that nearly all the placed seed and mulch for the phase 2 project area was washed away and some of the potted plants were up rooted.

Despite having record-breaking floods in the UGR in February and May of 2020, Eastern Oregon has been in a moderate to extreme drought since construction was completed (NOAA-NCEI 2020; NOAA-NCEI 2021; NOAA-NCEI 2022). In the first growing season post construction (2020), drought conditions during the late summer months resulted in stream flows as low as approximately 10-12 cfs at the BTS project. 2021 was even worse as the Pacific Northwest experienced the hottest June-July and second driest March-July and March-August in the 127-year record (NOAA-NCEI 2021). The drought peaked in late August to early September with flows at the project as low as approximately 6 cfs. Floods in 2020 that had uprooted many potted plantings and washed away much of the seed and mulch were followed by extreme heat and low base flow conditions which resulted in poor riparian plant revegetation success at many locations in the project. The Spring and Summer of 2022 offered a glimmer of hope with late season spring snow that resulted in a prolonged 2-year flood in June. As a result, the UGR was slower to recede to base flow conditions in 2022 allowing more time for plants to take hold. Riparian plants have had a hard time but are beginning to show signs of growth through both original planting efforts and from natural recruitment. Deep pools have been maintained, side channels connect each year, a diversity of channel units now exists with a large array of sediment sizes. Natural geomorphic processes have been restored as evidenced by new channels forming on the floodplain and large wood being recruited to the river along with signs of beaver returning to the area.

Conclusions

Restoration of active river-wetland corridors requires taking a different view of the river than our historically dominant view of a single-thread channel meandering through the landscape (Wohl et al. 2021). Active river-wetland corridors are often messy and consist of multi-threaded channels and geomorphic processes that are dynamic. Restoring conditions that allow for dynamic geomorphic processes to occur often requires bold plans that can match the scale of historic disturbances. Previous efforts in the BTS-LM in the early 2000's were thought to have been bold and represented the state of restoration practice at the time. Those previous restoration efforts fell short of their objectives. The BTS and LM projects remain recent, and time will tell if these much larger efforts at restoration of river-floodplain processes meet original objectives. Currently, the BTS and LM projects have indicated that physical objectives are being met despite extreme climatic conditions, which indicates a trajectory towards success at meeting original intents. Channels will continue to change at BTS and LM as large wood and ice processes dictate but so far these large projects have shown that we can restore natural river-floodplain processes that are crucial to salmonids and other wildlife when we can give them some space. This type of project requires collaboration, communication, planning and patience and would not have been successful without the unique partnerships that have developed in the UGR.

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