Application Name: Wilson-Haun Wallowa River Project: Restoring Natural Processes for Salmon and Steelhead

By: Trout Unlimited Inc

Offering Type: Upper Grande Ronde Initiative

Application Type: Restoration

OWEB Region: Eastern Oregon

County: Wallowa

Coordinates: 45.508909,-117.42471

Applicant:
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Budget Summary:
OWEB Amount Requested: $81,069
Total Project Amount: $1,253,915

Administrative Information

Abstract

Provide an abstract statement for the project. Include the following information: 1) Identify the project location; 2) Briefly state the project need; 3) Describe the proposed work; 4) Identify project partners.

The Wilson-Haun Wallowa River Project: Restoring Natural Processes for Salmon and Steelhead Habitat will take place in a high priority salmon and steelhead stream - Grande Ronde Basin. The restoration effort will occur on the mainsteam Wallowa River (RM 31.1-31.7). This reach includes critical spawning and rearing habitat for ESA-Threatened Snake River Steelhead (Oncorhynchus mykiss), ESA-Threatened Bull trout (Salvelinus confluentus), and ESA-Threatened Snake River spring Chinook (Oncorhynchus tshawytscha).

The river's floodplain habitats are not in proper functioning geophysical and ecological condition (hydrologic, geomorphic, and vegetative composition), due to historic anthropogenic influences including beaver trapping, overgrazing, logging (floodplain clearing and headwater), dams, altered vegetative regime, and dewatering for irrigation. The overall project goal is to set the system on a trajectory towards achieving proper geophysical and ecological form and function, and thereby improve spawning and rearing habitat for several listed fish populations, and ecosystem function for other focal aquatic and terrestrial species.

For this restoration implementation request, the project team would like to secure funding to support the construction components of the project. The project team worked with Wolfe Water Resources and other partners to develop the project design over the past year. The project will use a mix of conventional and new restoration approaches backed by scientific and expert knowledge. This includes floodplain grading, channel fill, large wood placement, low-tech process based restoration, riparian planting, and other techniques.

Trout Unlimited (TU) in partnership with the Grande Ronde Model Watershed Council (GRMW), the landowners, funders, the design firm, and local partners (Nez Perce, ODFW) will implement the project.

Location Information

What is the ownership of the project site(s)?

❑ *Public land (any lands owned by the Federal government, the State of Oregon, a city, county, district or municipal or public corporation in Oregon)*

✓ *Private (land owned by non-governmental entities)*

Please select one of the following Landowner Contact Certification statements:

● I certify that I have informed all participating private landowners involved in the project of the existence of the application, and I have advised all of them that all monitoring information obtained on their property is public record.

❍ I certify that contact with all participating private landowners was not possible at the time of application for the following reasons: Furthermore, I understand that should this project be awarded, I will be required by the terms of the OWEB grant agreement to secure cooperative landowner agreements with all participating private landowners prior to expending Board funds on a property.

Please include a complete list of participating private landowners

Heidi and Ian Wilson

❑ *Not applicable to this project*

❑ *This grant will take place in more than one county.*

Permits

Other than the land-use form, do you need a permit, license or other regulatory approval of any of the proposed project activities?

● Yes
❍ No

For Details Go to Permit Page

I acknowledge that I am responsible for verifying applicable permits, licenses, and General Authorizations required for the project, and can update information at grant agreement execution.

✓ *Yes*

Racial and Ethnic Impact Statement

Racial and Ethnic Impact Statement

❍ The proposed grant project policies or programs could have a disproportionate or unique POSITIVE impact on the following minority persons. (indicate all that apply)

❍ The proposed grant project policies or programs could have a disproportionate or unique NEGATIVE impact on the following minority persons. (indicate all that apply)

● The proposed grant project policies or programs WILL HAVE NO disproportionate or unique impact on minority persons.

Insurance Information

If applicable, select all the activities that are part of your project - These require a risk assessment tool unless otherwise noted (check all that apply).

❑*Working with hazardous materials (not including materials used in the normal operation of equipment such as hydraulic fluid)*

❑*Earth moving work around the footprint of a drinking water well*

❑*Removal or alteration of structures that hold back water on land or instream including dams, levees, dikes, tidegates and other water control devices (this does not include temporary diversion dams used solely to divert water for irrigation)*

❑*Applicant's staff or volunteers are working with kids related to this project (DAS Risk assessment tool not required, additional insurance is required)*

❑*Applicant's staff are applying herbicides or pesticides (DAS Risk assessment tool not required, additional insurance is required)*

✓*Insurance not applicable to this project*

Additional Information

❑*This project affects Sage-Grouse.*

Problem Statement

Describe the watershed problem(s) that this restoration project seeks to address.

Historic trapping, overgrazing, floodplain manipulation for agriculture, dams, logging, nonnative plants, and roads/ditches have degraded the Wallowa River watershed's geophysical and ecological form and function. The loss of functional floodplain and stream habitat adversely effects the survival and rearing of native salmonids, other fish, and wildlife species.

Beaver trapping pressure in the 19th Century almost extirpated this species in the western United States. The decrease in beaver populations has contributed to channel incision, decreased habitat complexity, altered vegetative communities, and an altered flow/temperature regime. Beaver serve as ecological engineers by building dams that decrease the velocity of peak flows and spread flows out over longer periods of time. This increase of water retention time decreases erosive forces that cause stream incision. Higher levels of surface and subsurface water retention expands riparian and wetland habitat along the stream. As beaver move in and out of systems, numerous side channels often form, and more woody vegetation ends up in the stream. This leads to increased habitat complexity for fish and wildlife.

Historic overgrazing of sheep and later cattle reduced deciduous vegetation communities on the Wallowa River floodplain. Overgrazing has also caused bank erosion, channel overwidening, and soil compaction. This has caused vertical erosion and channel incision. Channel incision has altered the Wallowa River system by lowering streambeds and groundwater tables causing a further decrease in riparian vegetation and hyporheic processes. Currently, the floodplain is excluded from domestic livestock grazing.

Historic logging practices and dam building in the upper Wallowa watershed caused a change in the hydro-geomorphic nature of the floodplain bottomlands. The removal of wood from the floodplain, dams and logging likely resulted in less in-stream large woody debris (LWD). Also, as the the channel has downcut, less riparian vegetation is set up to survive, thrive, and recruit in the floodplain.

The altered river hydrology as a result of the Wallowa Lake Dam attenuated discharge peaks during spring runoff and have resulted in loss of floodplain connection and function.

The restoration of the Wallowa River's form and function will address a combination of these interrelated problems through a physical and biological approach to river and floodplain restoration.

How have past or current land management practices contributed to the problem?

Past and current land management processes that contribute to watershed and project reach scale declines in salmon populations and their habitats in northeast Oregon include: removal of beavers through intensive trapping in the 19th century, construction of railroad, dam and irrigation infrastructure, removal of riparian vegetation, and overgrazing. These early developments and land use by European settlement reduced the capacity for the watershed to function by removing a keystone species (beavers) that drive riverine ecology. The land use confined and disconnected floodplains through railroad and irrigation development and over-allocated surface water for irrigation withdraws. Dam construction at Wallowa Lake altered the hydrology and eliminated fish passage for a natural sockeye population. The direct and indirect removal of riparian vegetation through grazing or land conversion limited wood recruitment, shading and riparian function.

Development in the floodplain during the 20th century led to widespread river channelization to protect newly constructed infrastructure, further reducing floodplain connection and resilience. Although many of these past land uses began over 100 years ago, the cumulative effects and continued operation have left a legacy of impacts that still challenge salmon recovery today. On a regional and global scale, population growth and human-caused climate change are applying additional demands on limited freshwater resources that salmon rely on for domestic and agricultural use, while at the same time adding environmental stressors such as elevated stream temperatures and reduced base flows that are not conducive to suitable habitat conditions for cold water species.

Project History

Continuation - Are you requesting funds to continue work on a project previously funded by OWEB where that work did not result in a completed project?
❍ Yes
● No

Resubmit - Have you submitted, but were not awarded an OWEB application for this project before?
❍ Yes
● No

Phased - Is proposed work in this application a phase of a comprehensive watershed restoration plan or project?
❍ Yes
● No

Plans

Salmon

Will this project benefit salmon or steelhead?
● Yes
❍ No

✓Snake River Basin - Steelhead
✓Snake River Spring/Summer-run - Chinook Salmon

How will the resulting restoration project benefit salmon or steelhead or their habitat?

The TA for Design supported funding to bring on a design firm to address many of the habitat limiting factors highlighted in the Snake River Recovery Plan and the Atlas. See 'Plans and Assessments' and the 'Proposed Solution' sections of the proposal for more information. The project team currently has an 80% design and plans to finish the design by the end of 2021. The design addresses many of the limiting factors highlighted in local and regional plans and assessments.

The project team is following through with many of the below Restoration Actions to address limiting factors for salmon contained in the Wallowa Atlas.

Restoration Activities
1. Protect Land and Water (Easement, Acquisition, Management)
3. Pool Development
5. Meander (Oxbow) Re-connect - Reconstruction
6. Spawning Gravel Cleaning and Placement
9. Restoration of Floodplain Topography and Vegetation

11. Perennial side channel
12. Secondary (non-perennial) Channel
13. Floodplain pond wetland
14. Alcove
15. Hyporheic Off-Channel Habitat (Groundwater)
16. Beaver Restoration Management
17. Riparian Fencing
18. Riparian Buffer Strip, Planting
19. Thinning or removal of understory - (juniper thinning)
20. Remove non-native plants
26. Boulder Placement
27. LWD Placement
28. Modification or Removal of Bank Armoring
30. Acquire Instream Flow (Lease- Purchase)
31. Improve Thermal Refugia (spring reconnect, other)
34. Upland Vegetation Treatment - Management
35. Road decommissioning and abandonment

In a parallel process to the proposed implementation of the habitat project, the project team is also working on an in-stream flow lease, and the landowner is working on addressing floodplain conifer encroachment issues (vegetation composition).

Does the project address a restoration action identified in a regional assessment or recovery plan?

● Yes
❍ No

Regional Assessments or Recovery Plans
ESA Recovery Plan for Snake River Spring/Summer Chinook & Snake River Basin Steelhead

For each plan chosen above, describe how your project is consistent with specific recovery/restoration actions cited in that plan.

ESA Recovery Plan for Snake River River Spring/Summer Chinook Salmon and Snake River Basin Steelhead highlights the below population and conservation status of Chinook and steelhead. The Wallowa River limiting factors are highlighted below as well.

- Chinook: Viable or Highly Viable - Status: High Risk
- Steelhead : Viable or Maintained - Status: Maintained (?)
- Wallowa River Limiting Factors: Stream Complexity, Excess Sediment, Passage Barriers, Altered/Low Flows, Water Quality/Temperature, Riparian Condition, Floodplain Connectivity, Entrainment

The project is designed specifically to address all of the listed limiting factors in this reach except for 'excess sediment, passage barriers, and entrainment. None of these factors are a known issue in this specific reach. The project is designed the boost the hydrogeomorphic form and function of the river and floodplain environments. and set the system on a trajectory towards greater ecological health. There is a strong emphasis on floodplain connectivity, stream complexity, water quality/temperature - groundwater recharge, and riparian condition. The project team expects that through this implementation process, these limiting factors will improve dramatically in this reach.

Does the project address a restoration action identified in a regional assessment or recovery plan?

● Yes
❍ No

Provide name of local plan, Watershed assessment or other locally relevant document.

Wallowa Atlas Summary - Wilson Haun Project Opportunity : The Wilson-Haun project reach is nested in the WMS-1 subwatershed (RM 18.5 to 38). The Tier 1 Priority - WMS-1 is the highest ranking for restoration based on a Tier I-III across the Wallowa Basin's subwatershed's This ranking on ability to improve geomorphic potential (lateral confinement and gradient), current and future conditions. The reaches are also scored based on use by important aquatic species (periodicity). The summary score for the WMS-1 subwatershed is the third highest in the basin.

Within the an specific project reach, restoration opportunities are scored by evaluating potential for up to 36 restoration actions. Each are scored for limiting factors, restoration action priority, climate change (future condition) and natural processes (Beechie, et al., 2010; Tetra Tech, Inc., 2017). The sum of these scores is called the Total Biological Benefit Score (TBBS). The Wilson-Haun reach is the second highest TBBS (78), within the WMS-1 subwatershed.

A Feasibilty Rating Value (FRV) is assigned that accounts for landowner willingness, partnership capacity, environmental compliance, and others. The FRV is combined with the TBBS to produce an of an overall score. The group of landowners containing the Wilson-Haun reach is the highest combined score when compared to adjacent landowner groups within the WMS-1 subwatershed.

ESA Recovery Plan for Snake River River Spring/Summer Chinook Salmon and Snake River Basin Steelhead
- Chinook: Viable or Highly Viable - Status: High Risk
- Steelhead : Viable or Maintained - Status: Maintained (?)
- Wallowa River Limiting Factors: Stream Complexity, Excess Sediment, Passage Barriers, Altered/Low Flows, Water Quality/Temperature, Riparian Condition, Floodplain Connectivity, Entrainment

303 (d) Wallowa River Parameters of Concern
- Temperature, Sedimentation, pH, Habitat Modification, Flow Modification, Bacteria

Does this project address one or both of the following:

✓ *Habitat needs for one or more Endangered Species Act-listed species and/or species of concern*
✓ *Concerns identified on 303(d) listed streams*
❑ *No*

Proposed Solution

Goal, Objectives, and Activities

State your project goal. A goal statement should articulate desired outcomes (the vision for desired future conditions) and the watershed benefit.

The broad project goals are to restore floodplain hydrology and function and encourage the recovery of natural processes through restoration treatments that improve or encourage: lateral floodplain connectivity, natural water storage and hyporheic flow, water quality; in-stream large woody debris quantities, natural wood recruitment and retention; sediment transport, storage and sorting; and a resilient riparian vegetation community for adult and juvenile spring Chinook, summer steelhead, bull trout, Pacific lamprey, and other aquatic and terrestrial flora and fauna.

List specific and measurable objectives. Objectives support and refine the goal by breaking it down into steps for achieving the goal. (NOTE: If you quantify your objectives, ensure all numbers match the metrics listed in your selected habitat types.) Provide up to 7 objectives.

Objective #1

Objective

Floodplain Connectivity and In-stream Complexity: Place large wood structures, grade floodplains and place channel fill, reconnect historic channels, and build beaver dam analogues and post assisted structures to:

Maximize floodplain engagement and improve floodplain form and function while avoiding risks to people/infrastructure.

and

Reestablish a channel-floodplain system with greater complexity, reduced stream power, and active natural processes that promote dynamic habitat formation.

Describe the project activities. Activities explain how the objective will be implemented.

To meet the floodplain connectivity and habitat complexity formation objective the project team will work with construction contractors, planting contractors, and the NE Oregon Hand Crew Initiative to:

- Place 168 large wood structures and loose whole trees in the mainstem channel, and floodplain to promote aggradation, complexity, ponding, latitudinal connectivity, beaver habitat and fish habitat formation.

- Grade floodplain environments, and place channel fill (15,400 cuyd earth moved) in the floodplain, historic channels, and mainstem channel to promote mainstem aggradation, complexity, latitudinal connectivity, and fish habitat formation.

- Build 34 beaver dam analogues and 6 post assisted structures in the floodplain, historic channels, and mainstem channel to promote aggradation, complexity, ponding, latitudinal connectivity, beaver habitat and fish habitat formation.

Objective #2

Objective

To enhance and restore floodplain and wetland riparian vegetation the project team will implement a large seeding and planting plan.

Describe the project activities. Activities explain how the objective will be implemented.

To meet the riparian habitat enhancement objective the project team will work with construction contractors, planting contractors, and the NE Oregon Hand Crew Initiative to:

- Preserve existing natural vegetation communities to maintain shading, aesthetics, seed sources, future wood recruitment, wetland habitats, and wildlife habitat,
- Reestablish processes (connectivity and dynamism) that support the recruitment and growth of young willow and cottonwood. Increased floodplain inundation and shading will also reduce invasive reed canary grass monocultures, and
- Increase floodplain activation and river processes to expand wetlands and promote healthy vegetation communities

This effort will include using a variety of planting techniques like willow trenches, whole tree planting, wetland sod mats, and others. The project team will also seed the project area heavily post project in year 1 and 2.

Lastly the project team will conduct herbicide treatments on non-native weeds in year 1 and 2 post implementation.

List the major project activities and time schedule for each, including post project implementation.

Element	Description	Start Date	End Date
Secure a construction contractor	Secure a construction contractor for the project	1/2022	4/2022
Procure materials	Procure LWD, posts, boulders, and planting materials	3/2022	7/2022
Construct LWD Structures, BDAs and PALS	Construct LWD, BDAs and PALS using construction contractors and hand crews.	6/2022	10/2023
Construct floodplain and channel grading	Implement cut/fill (stage-8) restoration approach which includes notching historic channels, reconnecting large portions of floodplain and creating ponded habitats.	6/2022	11/2023
Plant native vegetation	Implement riparian planting plan	9/2022	11/2023
Seeding	Seed the project area post construction	9/2022	11/2023
Weed spraying	Spray non-native and invasive weeds post construction implementation	6/2023	11/2023

Element	Q1 2022	Q2 2022	Q3 2022	Q4 2022	Q1 2023	Q2 2023	Q3 2023	Q4 2023
Secure a construction contractor								
Procure materials								
Construct LWD Structures, BDAs and PALS								
Construct floodplain and channel grading								
Plant native vegetation								
Seeding								
Weed spraying								

Habitat Types

In which habitat type(s) are you proposing to work?

✓*Instream Habitat: below the ordinary high water mark (includes in-channel habitat restoration, bank stabilization, flow, fish screening, and fish passage) -- Details will follow.*

✓*Riparian Habitat: above the ordinary high-water mark of the stream and within the stream's floodplain. -- Details will follow.*

❑*Upland Habitat: above the floodplain and improves native habitat and watershed function.*

❑*Wetland Habitat: land or areas covered, often intermittently, with shallow water or have soil saturated with moisture.*

❑*Estuarine Habitat: tidally influenced areas.*

Instream Habitat

Select all applicable Instream categories.

❑**Bank stabilization**
❑**Fish passage improvement**
❑**Fish screening project**
❑**Instream Flow**

✓Instream habitat restoration

Select all the actions you propose to implement to address the problem.

✓*Placement of materials in channel*

Does the proposed project follow:

❑*ODFW Guidelines*

❑*NOAA Guidelines*

✓*Other*

Specify

The project team is working with engineering firm Wolf Water Resources, Inc., to compile best practices and use them in the design process for wood and gravel placement.

What types of instream habitat materials are you proposing to install? (select all that apply)

✓*Large wood*

Number of structures.

208

Average number of logs per structure.

5

Average length of logs per structure (feet)

30

Average diameter of logs per structure (feet)

1.2

✓*Boulders*

Number of structures.

2

Average number of boulders per structure.

8

Average size of boulders per structure (feet)

4

❑*Combination log/boulder*

❑*Other materials: Materials that stabilize the streambed*

✓*Channel reconfiguration and connectivity, including alcoves and side channel reconnection*

What type(s) of change are you proposing to the channel configuration and connectivity?

The project team is working on a variety of grading efforts that will reconnect historic floodplain areas at more regular hydrologic intervals. This work includes enhancing and building new alcoves, notching historic channels, grading floodplain environments, and building pond features.

Acres off-channel or floodplain habitat connected

12

Number of pools created/added
35

❑*Spawning gravel placement*
❑*Beaver reintroduction*
❑*Non-native plant control*
❑*Nutrient enrichment*
❑*Animal species removal*

Is the primary purpose of the instream habitat restoration treatment(s) to address water quality limiting factors?
❍ Yes
● No

Total miles of stream to be treated with all instream habitat restoration treatments
1

❑**Stockpiling logs**

Riparian Habitat

Select all applicable Riparian categories.
❑**Riparian road activities**
❑**Fencing and other materials for habitat protection**

✓**Vegetation establishment or management**

Select all the actions you propose to implement to address the problem.
✓*Planting*
For Details Go to Plant Page

❑*Non-native plant control*
❑*Prescribed burnings, stand thinning, stand conversions, silviculture*
❑*Juniper treatment*

❑**Livestock management**
❑**Debris and Structure Removal**

Is an objective of the riparian treatment(s) to address water quality limiting factors?
❍ Yes
● No

Total linear stream miles to be treated.
1

Total riparian acres to be treated.
5

Left streambank miles to be treated.

1

Right streambank miles to be treated.

1

Wrap-Up

Watershed Benefit

Describe the watershed or ecosystem function(s) that the project will address through the proposed restoration actions and the resulting benefits to water quality, native fish and wildlife habitat, and/or watershed health. Explain why the project is a priority for investment at this time.

The proposed restoration approach (restoration treatments) will set the project team up to address the problems (limiting factors) identified in the problem statement. The restoration approach for this project is based on a number of treatments that have been common practice in floodplain restoration for a long period of time. The project team is also bringing forth a number of newer approaches to floodplain restoration that are showing lots of promise around the State of Oregon and beyond. Both the design firm and Trout Unlimited (TU) have worked extensively in recent years to vet these approaches and visit restoration sites around the state where these type of treatments have occurred on other habitat restoration projects.

This diversity of approaches should provide the foundation for a more dynamic floodplain and riverine ecosystem and address many of the limiting factors highlighted by the Wallowa Atlas and numerous other plans and assessments (see plans and assessments section of proposal). As is the case in most modern day restoration project areas, a mix of neighboring lands with infrastructure, landowner preferences, and other factors, the project team does not expect the floodplain system to reach its full ecological potential. However, the project team does feel it has maximized its efforts to significantly improve the floodplain ecosystem in this reach. The implementation funds will help the project team take the 100% design set, and construct a restoration project that will give the WH-Reach the necessary treatment to move ecological states (State and Transition) - develop ecological resilience/integrity.

TU local program believes strongly that these projects cannot be 'one and done' efforts, and that this project could very well need some adaptive touch work in the coming years. The history of restoration practice (which is an evolving science), demonstrates this need for true adaption over time. In addition, TU and GRMW are working with the downstream landowner to potentially conduct a restoration project on their land.

This project is a priority for investment due to the numerous plans and assessments that point to this reach as a high priority reach for fish and wildlife. There are willing and enthusiastic landowners who are also working on other conservation efforts on their lands including juniper thinning and in-stream flow protection. The design is sound and uses a large suite of approaches to kickstart the system on a trajectory towards greater ecological health. All of these factors combined make this a very high priority for investment at this time.

Public Awareness

Does this proposed project include public awareness activities?
❍ Yes
● No

Design

Were design alternatives considered?
● Yes
❍ No

Describe the design alternatives that were considered and why the preferred alternative was selected.

In early project visioning and discussions, three alternative restoration strategies were identified and considered. These three alternatives involve singular treatment types to allow the design team to identify the benefits/risks/drawbacks of these treatments individually, with the expectation that the ultimate preferred alternative would mix these strategies. Therefore, the alternative analysis process was more about deciding on the relative emphasis of these individual strategies, rather than a true “selection” process as is commonly associated with engineering projects.

• Alternative 1 – Low-tech process-based restoration (LTPBR) treatments. LTPBR treatments are typically post-assisted structures (including Beaver Dam Analogues) installed by hand or with light machinery.
• Alternative 2 – Instream large wood placement. Large wood would be placed in various configurations within the river to encourage habitat formation and floodplain engagement.
• Alternative 3 – Floodplain grading and channel fill treatment. These treatments involve relatively broad lowering of high floodplain areas and fill of incised channel areas to address incision and broaden connectivity with

The preferred restoration strategy represents a mix of the alternatives considered, balancing the benefits and risks of the various strategies.

The preferred restoration strategy involves a mix of LTPBR, LWD, and floodplain grading to expand connectivity, reduce stream powers, and induce greater dynamism/habitat formation throughout the reach, while also avoiding excessive disturbance and minimizing risk to adjacent infrastructure and people. The general strategy is to not only build new habitat but also create the conditions for the
river to build habitat through time (we know the river has this capacity from habitat created in the middle section of the reach). The key elements taken from each alternative include:

• LTPBR: The preferred approach includes post-assisted log structures, beaver dam analogue structures and unballasted wood along existing and reconnected side channels, where lower stream power makes success of these structures more likely. In general, LTPBR techniques are deprioritized on the main river channel based on an expectation of minimal benefit/longevity. However, these structures are being considered as an auxiliary component to placed wood jams to enhance sediment capture and flow diversity.

• LWD: The preferred approach includes extensive wood placement throughout the channel and floodplain. These structures work in tandem with floodplain grading to encourage the maximum amount of floodplain connection possible (within site constraints and risks). One specific approach is to place structures (channel spanning, if possible) just downstream of graded floodplain connection points (i.e., “relief valves”). These configurations of wood and grading are expected to create nodes of complexity through time as they encourage flow splitting, reductions in stream energy, sediment deposition, and channel migration. LWD will also be placed to create local complexity and encourage local flow diversity and sediment sorting.

• Floodplain grading and targeted channel fill/gravel augmentation: The preferred approach seeks to maximize floodplain connectivity (within site constraints) with a specific objective of reducing stream power. Increases in connectivity and reductions in stream power have cascading benefits for reach-scale dynamism, vegetation recruitment, wetland and beaver habitat, and groundwater dynamics (as represented conceptually in Figure 3).

o Proposed grading areas target reconnecting naturally low-lying floodplain areas or swales to provide the best cost-benefit. At the same time, the proposed floodplain grading generally deemphasizes constructed or engineered side channels, which can be costly and often have limited lifespans. On this site, constructed side channels would require extensive earthwork and wetland disturbance, and would be deep relative to the broader floodplain because of historic stream incision. In contrast, the proposed actions seek to give the river opportunity to create its own side channels through time.

o Coarse alluvium generated from grading will be placed instream to augment instream gravel and reduce instream conveyance (supporting additional floodplain

Select the appropriate level of design for your project.

❍ No design is required.
❍ 10-30%: Conceptual design (evaluation of alternatives, concept-level plans, design criteria for project elements, rough cost estimates).
● 30-85%: Preliminary design (selection of the preferred alternative, draft plans, draft design report, preliminary cost estimates).
❍ 85-100%: Final design (final design report, plans, and specifications, contracting and bidding documents, monitoring plan, final cost estimate).

If work remains on the project's design, describe the work that remains to be done and when you expect to have it completed. If no design is required put "N/A"

The project is at 80% design review phase (as of 10/12/22). The project team plans to have the 100% complete no later than December 15, 2021.

Describe the steps you will take to minimize adverse impacts to the site and adjacent lands during and after project implementation.

The design firm worked through a risk assessment process that is outlined in the project Basis of Design Report.

Project Management

List the key individuals, their roles, and qualifications relevant to project and post project implementation. At a minimum include the following: project management, project design, project implementation, and project inspection.

Role	Name	Affiliation	Qualifications	Email	Phone
Engaged Landowners	Ian and Heidi Wilson	Ranch Owners	Land Stewards	ianwilson76@yahoo.com >	
Engineer	Steve Rodriguez	Wolf Water Resources, Inc.	Senior Engineer	SRodriguez@wolfwaterresources.com	
Project Manager	Levi Old	Trout Unlimited	Restoration Ecologist, Project Manager	lold@tu.org	
Technical Liason	Ian Wilson	Grande Ronde Model Watershed Council	Fisheries Biologist, Project Coordinator	ian@grmw.org	
Technical Team	Multiple Partners	Nez Perce Tribe, ODFW, GRMW, Wallowa Atlas Team	River restoration, fisheries and policy experts	N/A	
Geomorphologist	Nick Legg	Wolf Water Resources, Inc.	Geomorphologist	nlegg@wolfwaterresources.com	

Climate Considerations

Briefly describe your understanding of how the characteristics and functions of the watershed where the proposed project will occur are anticipated to change due to climate impacts in the future. In particular, describe how species, habitat, and/or water quality or water quantity variables relevant to the project site location are expected to be affected. Refer to Technical Resources now available on this webpage, if needed: https://www.oregon.gov/oweb/resources/Pages/Field-Tech-Guidance.aspx

The Blue Mountains Vulnerability Assessment evaluated future regional climate using Global Climate Models (GCMs) and emissions scenarios. For the PNW, every GCM projects an increase in future temperatures.2,3 As temperatures warm, the timing, rate, and amount of snowmelt and precipitation will affect snowpack volume4, streamflows5, and stream temperatures.6,7 In the Wallowa, this will dramatically impact the hydrologic regime, riparian and instream habitats, and Ground-water Dependent Ecosystems (GDEs).8,9 The predicted climate impacts coupled with past land use poses a threat to these aquatic habitats and the species that depend on them.10,11

Wildlife use riparian areas for travel corridors, nest sites, feeding and roosting areas, and microclimate refuge.12 Climate change is projected to alter aquatic flow regimes which will affect riparian habitats by reducing the recruitment and establishment of key shrub and herbaceous species.14 Functional riparian communities also provide shade and reduce stream temperatures, which benefits cold-water fish species.10,16 By restoring the hydrologic regime and increasing groundwater supplies, we can increase the resilience of riparian plant communities to climate change.

Species that indicate in-stream health include Snake River Chinook salmon, Snake River steelhead, bull trout, redband trout, and freshwater mussels. The projected changes in timing and magnitude of stream flow could affect all aquatic-dependent species.15 Between 1980 – 2009, human caused CO2 emissions have contributed to a late-summer warming trend in PNW streams; temperatures have increased 0.22C/decade.6 Climate models predict August stream temperatures to increase 2.83C on average by the 2080s.6,10

GDEs depend on annual snowpack. As snowpack decreases, these systems will be susceptible to drying out in the summer.17 The drying trend could lead to a shift in the flora and fauna species composition of GDEs.17

Contact TU for references.

How have you accounted for these climate-impact considerations in your project planning, design or implementation? Please describe briefly.

The project team is working to design and implement a stream habitat restoration project that will create more resilient ecological communities in the floodplain, riverine and surrounding upland environments. Two high priority outcomes of this project in the face of future climate impacts are the increase in groundwater and floodplain connection, and the increase in native riparian trees and shrubs. The benefits to successfully jumpstarting the increases in these two project components will lead to the most climate resilience in the future.

Are there any constraints on your ability to incorporate climate considerations into project planning? For example: Lack of information about climate impacts at the project planning scale; Gaps in understanding what nursery or seed stock to use given potential climate impacts; Gaps in accessing these stocks; Lack of methods to quantify climate benefits; Uncertainty about how to define a baseline for assessing potential change; Metrics for understanding climate resilience are not well-defined.

❍ Yes
● No

Climate benefits from OWEB project activities can broadly be categorized into three types: (1) Carbon sequestration benefits (2) Mitigation benefits and (3) Adaptation benefits. Project activities may offer multiple climate benefits. Please review these categories below, select all the apply, and provide specific examples where possible:

✓ *Carbon sequestration (Capturing, securing and storing carbon dioxide from the atmosphere), including:*

Sequestration benefits from habitats: Project activities that avoid natural habitat conversion, or increase plant biomass within the habitat area, may contribute sequestration benefits. Select any that apply:

❑ *Upland forest*
✓ *Riparian*

❑ *Grassland*

✓ *Wetland*

❑ *Estuary*
❑ *Other habitat*

❑ *Sequestration benefit through fire management/fuels reduction. Activities that help manage fire frequency and severity will help provide sequestration benefits, because catastrophic wildfires reduce the sequestration potential of upland habitats.*
❑ *Other sequestration benefit*

❑ *Mitigation through reduced emissions*

✓ *Adaptation Benefits. Project activities may offer multiple climate adaptation benefits for species, habitats and communities, and there may be some overlap in the terminology used to describe these benefits. Check all that apply below, and provide additional and more specific description if possible.*

❑ *Fish passage*

✓ *Instream flow*

Optional description:

The project is meant to create climate resilience in the landscape.

❑ *Irrigation efficiency*
✓ *Wildfire risk reduction*
Optional description:

The risk of wildfire will be reduced by creating greater hydrologic connection.

❑ *Forest-health treatments*

✓ *Wildlife habitat connectivity*
Optional description:

Functioning floodplains are key to habitat connectivity and often the basis for the key components in connectivity modeling. The project seeks to create a higher functioning floodplain.

✓ *Wetland/floodplain reconnection*

Optional description:

The project is a floodplain reconnection and wetland enhancement effort.

✓ *Water temperature mitigation through shading, removal of inline ponds or other action*
Optional description:

Yes.

✓ *Protection or creation of cold-water refugia for aquatic species*
Optional description:

Yes, the project seeks to improve cold-water refugia through floodplain reconnection.

✓ *Aquifer recharge*
Optional description:

The state of the aquifer is unknown.

❑ *Drinking water security*

❑ *Food system resilience, including activities that maintain abundance of tribal first foods*

❑ *Other Benefit*

The State of Oregon is committed to identifying ways it can reduce impacts from harmful emissions. While the overall outcomes of OWEB funded projects may have many climate benefits, some necessary activities that occur during projects will result in increased emissions. To help us understand the current situation, please check all of the following that might apply to your project:

✓ *Driving gas-powered automobiles, including trucks and All Terrain Vehicles (ATVs)*

✓ *Operating gas-powered machinery other than automobiles (for example, chainsaws or other hand-held equipment)*
✓ *Operating gas-powered machinery larger than automobiles (for example, excavators)*

❑*Boats*
❑*Other*
❑*Not applicable to project activities*

Are you considering alternative approaches that could reduce emissions (e.g., use of electric chainsaws or motors)?

-

● Yes
❍ No

If Yes, Optional: Please explain

We have some electric chainsaws. They require energy to charge the batteries, but we will likely use them.

A very large carbon saving for Trout Unlimited on this project will be able to stay in Wallowa County, versus driving back to Baker County. TU only has one staff in the region for habitat restoration efforts and they are based in Baker.

Optional Monitoring

OPTIONAL: Restoration Project Monitoring

- ❑ *Salmonid Monitoring*
- ❑ *Non-salmonid biological monitoring*
- ❑ *Water (quantity) flow monitoring*
- ❑ *Water quality monitoring*
- ❑ *Rangeland monitoring*
- ❑ *Onsite*
- ❑ *Downstream*
- ❑ *Upstream*
- ❑ *Upslope*

Will effectiveness monitoring be conducted for this project?

❍ Yes
● No

Budget

Item	Unit Type	Unit Number	Unit Cost	OWEB Funds	External Cash	External In-Kind	Total Costs
Salaries, Wages and Benefits							
TU Project Manager	Hours	900	$46.00	$0	$26,680	$14,720	$41,400
			Category Sub-total	$0	$26,680	$14,720	$41,400
Contracted Services							
Mobilization (large wood procurement, implementation, rehab)	Each	1	$78,000.00	$0	$78,000	$0	$78,000
Water Management & Temp Stream Diversion & Plan	Each	1	$78,000.00	$0	$78,000	$0	$78,000
Erosion & Pollution Control	Each	1	$24,000.00	$0	$24,000	$0	$24,000
Construction Engineering Support - Staking and Oversight	Each	1	$40,000.00	$0	$40,000	$0	$40,000
Clearing and Grubbing	Each	1	$3,500.00	$0	$3,500	$0	$3,500
Floodplain Excavation (Cut/Fill - Stage-8 Restoration)	Cubic yards	13900	$14.00	$0	$194,600	$0	$194,600
Large Wood Structure Log Procurement and Construction (Deflector, Apex, Sweeper, Floodplain, Spanner, Apex)	Each	1	$288,300.00	$0	$288,300	$0	$288,300
Brush trench (includes willow harvest, equip, labor)	Each	50	$250.00	$0	$12,500	$0	$12,500
Beaver Dam Analogues (BDAs)	Each	44	$1,800.00	$0	$79,200	$0	$79,200
Post-Assisted Log Structures (PALS)	Each	10	$2,400.00	$0	$24,000	$0	$24,000
Habitat Boulders	Each	100	$50.00	$0	$5,000	$0	$5,000
Excavator/Operator Time and Materials	Hours	60	$195.00	$0	$11,700	$0	$11,700
Riparian and Floodplain Restoration (Planting and Browse Protection)	Acres	6.8	$15,000.00	$0	$102,000	$0	$102,000
Upland Planting and Floodplain Restoration (Planting and Browse Protection)	Acres	2.3	$8,000.00	$0	$18,400	$0	$18,400
Seeding (Materials, Equipment, Labor)	Acres	9.1	$3,500.00	$0	$31,850	$0	$31,850
Weed Spraying (Year 1 and 2)	Each	2	$2,500.00	$0	$5,000	$0	$5,000
1200 C Permit (Apply through contractor)	Each	1	$6,000.00	$0	$6,000	$0	$6,000
Construction Contingency (approx. 12%) (Unit: Lump Sum)	Each	1	$120,246.00	$0	$120,246	$0	$120,246
			Category Sub-total	$0	$1,122,296	$0	$1,122,296
Travel and Training							
Overnight: GSA - $96/night; M&IE: - GSA $59/night	Each	50	$155.00	$0	$7,750	$0	$7,750
			Category Sub-total	$0	$7,750	$0	$7,750
Materials and Supplies							
Handheld Turbidity Meter	Each	1	$1,400.00	$0	$1,400	$0	$1,400

			Category Sub-total	$0	$1,400	$0	$1,400
Equipment							
			$0	$0	$0	$0	$0
			Category Sub-total	$0	$0	$0	$0
Other							
			$0	$0	$0	$0	$0
			Category Sub-total	$0	$0	$0	$0
			Modified Total Direct Cost Amounts	$0	$1,158,126	$14,720	$1,172,846
Indirect Costs							
Federally Negotiated Indirect Cost Rate	Override Amount			$81,069	$0		$81,069
			Total	$81,069	$1,158,126	$14,720	$1,253,915

* = OWEB funds excluded from indirect.

Provide context and justification for how your budget was developed. Explain how project costs and/or rates were determined.

Additions to 80% Cost Estimate: Additional Beaver Dam Analogues and Post-Assisted Structures have been added to the 80% cost estimate so the project team can build an adapt these structures in the second year of the project. This is critical to adaptive management efforts. TU and the engineers decided to increase the cut/fill cuyd estimate based on local rates from recent projects. The rehab plan increased cost for the expected need for professional planting services and fencing services. Metal prices and contractor prices were very high in 2021.

Staff Costs: Trout Unlimited staff will need to commit significant time to the project. TU projects spending over two months on the ground for the project over a 1-2 year period. This includes construction contract management (RFPs and Site Tours), wood staging, off-channel implementation, in-channel implementation, rehab (planting, seeding, spraying), and adaptive management (monitoring and low-tech work). This requires travel to the region, overnight lodging, daily expenses, and mileage.

Indirect: TU received a waiver to charge 1/2 NICRA indirect on this construction project. These are not easy to get and we feel fortunate we were able to secure one.

Does the budget identify a contingency amount for specific line item(s) within the Contracted Services and/or Material and Supplies budget category?

❍Yes

●No

Funding and Match

Fund Sources and Amounts

Organization Type	Name	Source Note	Contribution Type	Amount	Description	Status
Non-Governmental Organization	Trout Unlimited	Trout Unlimited planning funds	In-Kind - Labor	$14,720	TU Staff Time	Pending
Federal	Bonneville Power Administration	BPA F&W Program	Cash	$1,163,395	BPA Funding Ask	Pending
Fund Source Cash Total			$1,163,395	**Fund Source In-Kind Total**		$14,720

Match

Contribution Source-Type: Description	Amount
Trout Unlimited-In-Kind - Labor: TU Staff Time	$0
Bonneville Power Administration-Cash: BPA Funding Ask	$1
Match Total	$1

Do match funding sources have any restrictions on how funds are used, timelines or other limitations that would impact the portion of the project proposed for OWEB funding?

❍ Yes
● No

Do you need state OWEB dollars (not Federal) to match the requirements of any other federal funding you will be using to complete this project?

❍ Yes
● No

Does the non-OWEB cash funding include Pacific Coast Salmon Recovery Funds?

❍ Yes
● No

Uploads

Map: WilsonHaun_Tier1APE.pdf - Overview Map

Project Design: W2r_WH_Wallowa Plans_80pct_overview reduced.pdf - Proposed Conditions Overview

Project Design: W2r_WH_Wallowa_BDR_80pct.pdf - BDR Report 80%

Planting Details: Planting Details for Proposal.pdf - Planting Details from BDR

Federally Negotiated Indirect Cost Rate Plan: FY21-22 TU Indirect Cost Rate Agreement.pdf - TU NICRA

Road Page

Road Questions

Select all the Road Activities you will be doing.

❑**Road closures/decommissioning for the purpose of restoration**
❑**Road Obliteration**
❑**Road Relocation**
❑**Road drainage system improvement**
❑**Road Surface Improvement**

Total miles of road treated

Plant Page

Planting Questions

Relationship to other conservation programs

❑ *This project will use OWEB funds to increase the planting density on CREP acres.*

Planting Activities

Describe the current condition of the site(s) to be planted.

Existing vegetation is mixed but dominated by dry riparian and upland species, (conifer) and mature deciduous species. The mature deciduous species include canopy trees and understory tree/shrubs. There is evidence of compensatory growth in riparian species and a lack of early stage vegetation. There is an existing lack of riparian vegetation recruitment due to floodplain disconnection, lack of channel dynamism, and a legacy of grazing. Prevalent Reed canary grass (RCG) limits recruitment throughout the site.

Describe how you will prepare the site(s) prior to planting and how those activities are appropriate considering the site conditions described in the previous question.

The project team is working diligently to plan for the restoration of native floodplain plant communities on the Wilson-Haun Wallowa River Project. Riparian plant communities on the project site are departed from their historic state. This occurred due to land management practices both local to the site and throughout the watershed. Stands of remnant plant communities do exist on site, which provides the project team with a solid foundation to understand the historic species dynamics, and to plan, restore, and enhance these communities.

The landowners recently initiated a robust multi-year effort to recover these native communities. To date, this included discontinuing domestic livestock grazing in the floodplain, removing encroaching junipers from the floodplain, spraying invasive weeds, and conducting several light planting efforts. Landowner efforts are showing dividends across various sites on the landscape. For instance, cottonwood and aspen saplings are developing in areas where older stable homogenous stands previously developed due to historic land management. Young stems of alder (Alnus incana) species are emerging through thick reed canary grass (RCG) (Phalaris arundinacea) ground cover. The landowner-initiated practices present an excellent springboard for the project team to build from and set the floodplain plant communities up to regain their long-term ecological form and function.

The project team discussed extensively the plant recovery challenges presented by hydrologically disconnected floodplains (groundwater and surface water exchange), nonnative and invasive RCG, and intense ungulate browse/rubbing. The team would like to address each of these challenges in various ways by executing our riparian recovery plan. The effort will use both tried and true mechanisms to recover communities and limited actions will be on an experimental basis. The team is using best available science, technical resources, and expert opinion to develop our plan. Below are several of the broad themes the team will fine-tune as we transition from the 30% to 100% design phase.

Biomic Approach1(Castro and Thorne, 2019): The project's overall holistic approach centers around treating the core drivers of ecosystem degradation by addressing key elements of the floodplain and riverine environment's geomorphology, hydrology and biology. Plant communities fall into the latter category from a planning perspective but are intertwined closely with hydrology and geomorphology. By treating each of these key elements and understanding their interrelationships, the plan will lead to the successful recovery of native floodplain plant communities.

Design Hydraulics and Post-Construction Elevations: The project team will use the restoration treatment types, final projected elevations, and hydraulics data to design the placement and densities of plant species and nursery stock products (e.g., wetland sod mats, whips, brush trench, willow clumps, deep rooted, seeding, etc.).

Core Area Approach: The project will use conservation biology and restoration strategies such as core areas and connectivity to assess where to actively plant and in what densities, and where to promote passive approaches to recovery. The team started to make observation and will continue to map ground-based observations to target core plant community types for restoration. For example, one clear observation is that much of the river right floodplain and valley flank contains remanent native plant communities likely robust enough to warrant a more passive plant recovery approach. Limited actions such as the planting of more willow species, pruning to mimic natural stand heterogeneity, fencing, and installing small amounts of wetland sod mats near fresh channel notching areas will be most appropriate for this side of the valley bottom. Alternatively, the river left floodplain is likely to need a more active and even aggressive approach in certain areas. The left floodplain was likely more heavily used historically by humans and domestic livestock. On this valley flank there are several small pockets of native sedge and rush communities, an aspen stand, and some cottonwoods, but overall this side of the stream is lacking desirable vegetation and community heterogeneity (Figure 13).

Existing native plant communities: Preserving and enhancing existing native communities is a key strategy. To date, the project team has started a plant list to document native and non-native species on the project site. Research into local vegetative community guides is ongoing. Through this research the team identified several communities of note that likely existed at the project site historically. Examples include:

Black Cottonwood/Common Snowberry Community Type, Black Cottonwood/Mountain Alder-Red Osier-Dogwood Plant Association, Willow/Aquatic Sedge Plant Association, Coyote Willow Plant Association, Willow/Aquatic Sedge Plant Association, Ponderosa Pine/Common Snowberry Plant Association, Quaking/Aspen Aquatic Sedge Plant Community Type, and others (Crowe and Clausnitzer, 1997).

Reeds Canary Grass (RCG): RCG is abundant on the project site. The project team conducted several conversations concerning this invasive, rhizomatous grass. The team consulted technical resources and experts on how to address the challenges this ground cover presents for a restoration project, and the recovery of native riparian plant communities. It is clear to the project team that eradicating this grass is not an option. The team would like to use a diverse planting approach to try to diversify our native plant communities and further marginalize RCG. There are strategies to reduce the stronghold this species presents that range from very aggressive to more passive approaches. The project will include passive approaches like shading out RCG and developing areas where more perennial flow exists to the point where RCG is no longer tolerant of inundated conditions. More aggressive/costly approaches will include placing down thick wetland sod mats post-earthwork to compete against RCG invasion, spray-scrape-replant methods, willow clump/large tree planting, and others (Figure 14).

Fill out the table below. Identify the vegetation communities you plan on planting in, the acres each vegetation community encompasses, and the density of your planting.

Vegetation Community	Acres	Density
Black Cottonwood/Common Snowberry Community Type	1	10%
Coyote Willow Plant Association,	3	20%

Fill out the table below for each vegetation community listed in the table above, provide the common and scientific names of up to five plants that will be planted, the form(tree, shrub, grass), type of plant (bare root, cutting, etc) and the planting timing.

Vegetation Community	Plants: Common Name	Plants: Scientific Name	Form	Type	Year	Month
Black Cottonwood/Common Snowberry Community Type	Black Cottonwood	Populus balsamifera ssp. trichocarpa	Tree	Rooted	2022	October
Black Cottonwood/Common Snowberry Community Type	Snowberry	Symphoricarpos albus	Shrub	Rooted	2022	October
Coyote Willow Plant Association	Coyote Willow	Salix exigua	Shrub	Rooted	2022-23	October

Plant Stewardship

After the plantings are installed, will you conduct plant stewardship ("free to grow")?

- ❍ Yes
- ● No

Explain

The project team is exploring the idea of watering the plants for several years during the late summer season. This decision may hinge on the available allocated water on the property and the proposed in-stream flow transaction.

Measures of Planting Success

Use the table below to explain how you will document and determine success for the plantings.

Vegetation Community	Parameter	Percentages
Black Cottonwood/Common Snowberry Community Type	Percent Survival	70%

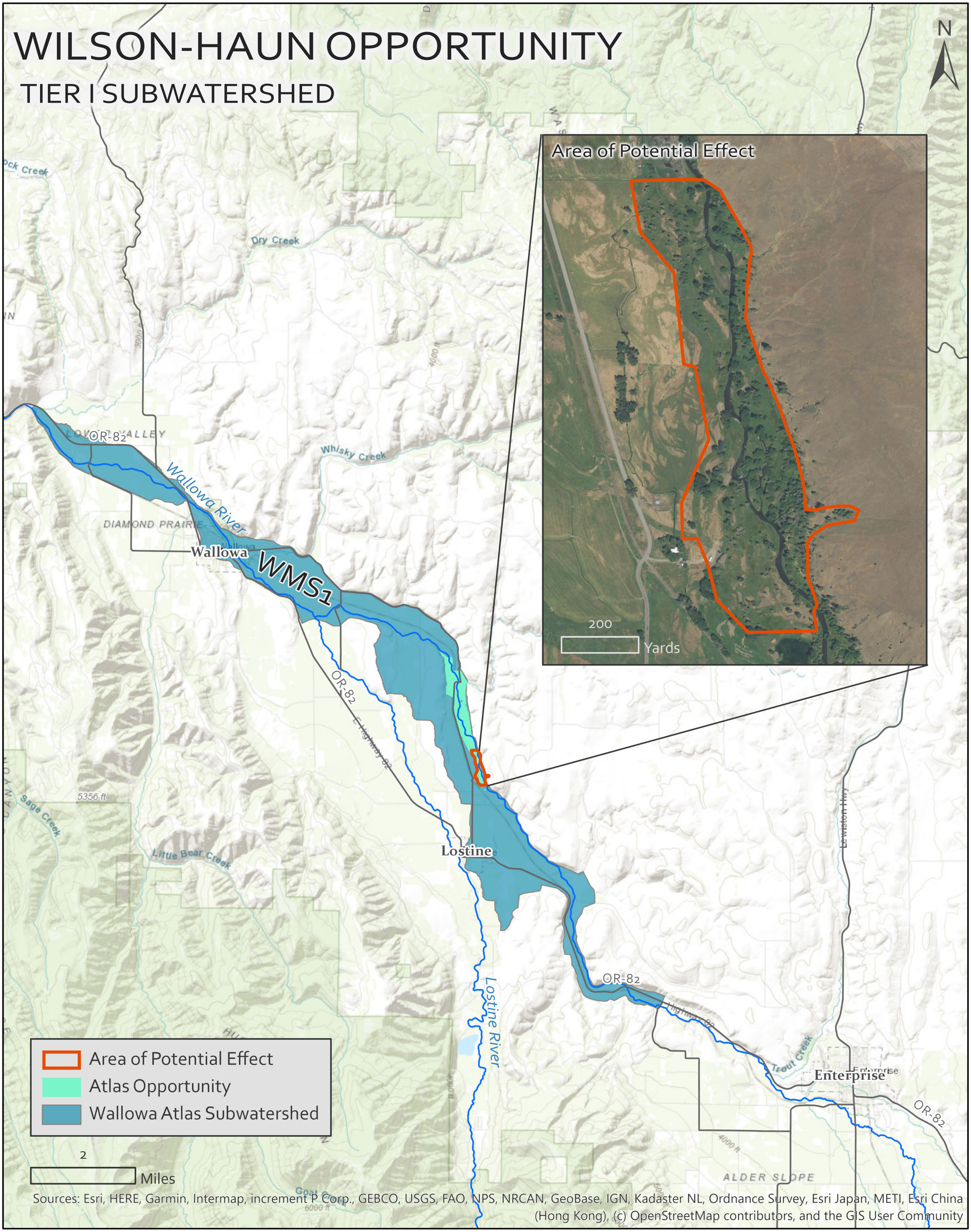
If, in the course of the 3-5 years following planting, the success rate falls below your standard, what is your plan?

The project team will document planting success via observation 2x annually.

The project team is in discussion about a future project that will directly address Reeds Canary Grass on the property. This could be a follow up effort. The project team is also looking at measures to potentially decrease overall browse in the project area. These are all future adaptive management steps that can be taken if the initial planting plan does not work well.

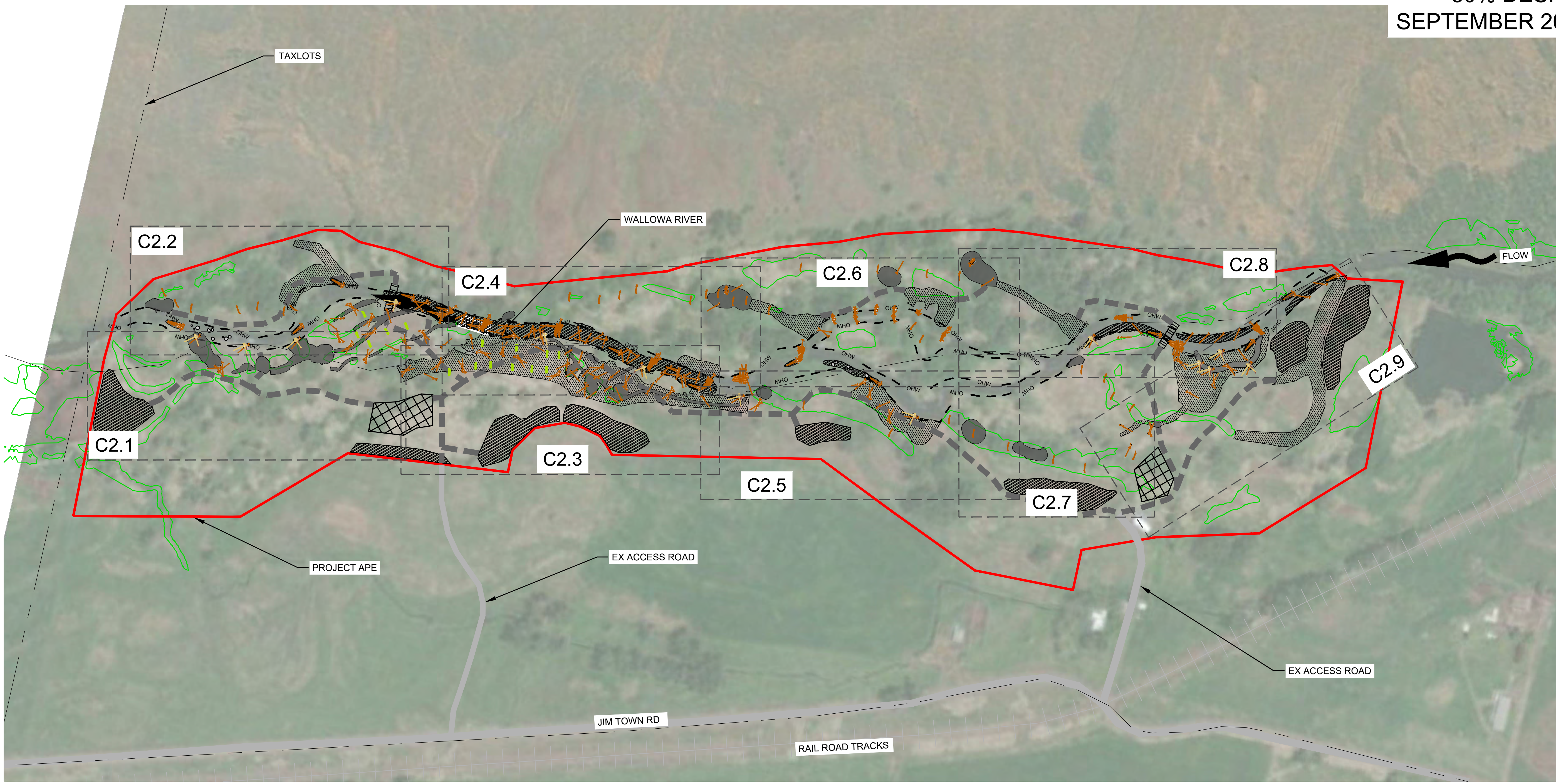
Permit Page

Project Activity Requiring a Permit or License	Name of Permit or License	Entity Issuing Permit or License	Status
All activities	HIP IV Programmatic	Bonneville Power Administration	Working through the steps
In-stream wood and fill placement	Removal/Fill Permit	Oregon DSL and ACOE	Applying Fall 2021
Ground disturbance with federal funding	Cultural Resources Clearance	BPA, SHPO, Tribal Review	no significant findings Rprt 1/2022
In-stream Construction	1200c	DEQ	Apply Fall 2021 or with Construction Contractor



Author: Alexandra Towne (GRMW) - Date: 12.9.19 - Datum: WGS84 UTM Zone 11N

80% DESIGN
SEPTEMBER 2021



PROPOSED CONDITIONS SITE PLAN

LEGEND

- APE
- TYPICAL YEARLY HIGH WATER EXTENT
- WETLAND BOUNDARY
- TAXLOTS
- EXISTING ROAD
- RAIL ROAD
- ACCESS ROAD
- STAGING AREA
- APPROX GRADING AREA LIMIT
- PROPOSED CUT
- PROPOSED FILL
- PROPOSED EXCAVATED ALCOVE, SIDE CHANNEL, OR POND
- WHS TYPE 1 - MARGIN JAM
- WHS TYPE 2 - SMALL APEX JAM
- WHS TYPE 3 - SWEEPER LOG
- WHS TYPE 4 - FLOODPLAIN WOOD (1 LOG)
- WHS TYPE 5 - FLOODPLAIN WOOD (2 LOGS)
- WHS TYPE 6 - CHANNEL SPANNING JAM
- WHS TYPE 7 - APEX JAM
- LOOSE FLOODPLAIN WOOD W/ OR W/O ROOTWAD
- WILLOW TRENCH
- BDA
- CHANNEL SPANNING PALS
- BANK ATTACHED PALS
- MID CHANNEL PALS

SCALE
150 0 75 150 300
SCALE FEET

NOT FOR CONSTRUCTION

WOLF WATER RESOURCES, INC.
1001 SE WATER AVE, SUITE #180
PORTLAND, OR 97214
503.207.6688

TROUT UNLIMITED
TROUT UNLIMITED
2210 18TH ST
BAKER CITY, OR 97814
541.408.3770

TROUT UNLIMITED, INC.
WILSON-HAUN WALLOWA RIVER
WALLOWA COUNTY, OREGON

PROPOSED SITE PLAN & OVERVIEW

REVISION NUMBER

No.	Date	Revision

Date 9/17/2021	Designed By SR
Drawn By RW	Checked By SR

SCALE 0 1"

JOB NO. 20200035

SHEET NO. C1.2

7 OF 31

DWG: Z:\Shared\W2r\CAD\20200035-Wilson-Haun Wallowa River\DWG\SHEETS\C2.0 - PROPOSED SITEOVERVIEW.dwg USER: rwilson
DATE: Sep 17, 2021 5:19pm XREFS:X-TB-W2r-22x34 X-MAP X-AERIAL2 X_SURVEY X-DESIGN-LINEWORK X-WHS X-LEGEND

Wilson-Haun Wallowa River Project Design

Wallowa River, NE Oregon

Basis of Design Report
80% Design

Wilson-Haun Wallowa River Project Area GRMW

PREPARED FOR:

Trout Unlimited

2210 18th St
Baker City, OR 97814

PREPARED BY:

Wolf Water Resources, Inc.

1001 SE Water Avenue, Suite 180
Portland, OR 97214

September 2021

TABLE OF CONTENTS

1.0 PROJECT BACKGROUND

Trout Unlimited (TU) and Grande Ronde Model Watershed (GRMW) are leading restoration of the Wilson-Haun Reach of the Wallowa River from River Miles 31 – 31.7. Levi Old (TU) is the project manager. Wolf Water Resources (W2r) has been contracted by TU to design channel and floodplain improvements to this ecologically important reach. The project is sponsored by Trout Unlimited, supported by the Wilson-Haun family (landowners) and Grande Ronde Model Watershed (GRMW), and funded by Bonneville Power Administration (BPA).

The Wallowa River is a major tributary of the Grande Ronde River in Wallowa County, Oregon (Figure 1). The main goal of this project is to improve salmonid habitat and overall function of the Wallow River floodplain near Lostine, Oregon. The broader Wallowa River valley's development history has resulted in simplification and degradation of instream and floodplain habitat. Many of the historic impacts occurred outside the reach but still impact habitat within the reach. Some of these historic impacts include beaver trapping/removal, overgrazing, dams and diversions, and channelization. This project aims to improve habitat complexity and floodplain connectivity through a mix of floodplain grading, large wood, and low-tech process based restoration (LTPBR) techniques.

This basis of design report (BDR) summarizes existing conditions information and restoration design progress through the 30% design phase (Appendix 1 contains 30% engineering design plans). The 15% design phase included existing conditions analyses, alternatives development, and preferred alternative selection. At the 15% design phase, BPA provided comments under the BPA Habitat Improvement Program (HIP) programmatic Restoration Review Team (RRT) process. A summary of the 15% review is in Appendix 6.

PROJECT GOALS AND OBJECTIVES (15%).

1.0.1 GOALS

The broad project goals are to restore floodplain hydrology and function and encourage the recovery of natural processes through restoration treatments that improve or encourage: lateral floodplain connectivity, natural water storage and hyporheic flow, water quality; in-stream large woody debris quantities, natural wood recruitment and retention; sediment transport, storage and sorting; and a resilient riparian vegetation community for adult and juvenile spring Chinook, summer steelhead, bull trout, Pacific lamprey, and other aquatic and terrestrial flora and fauna.

1.0.2 OBJECTIVES (15%)

Project objectives are based on biological limiting factors:

- *Floodplain connectivity*: Maximize floodplain engagement and improve floodplain form and function while avoiding risks to people/infrastructure.
- *Instream complexity*: Reestablish a channel-floodplain system with greater complexity, reduced stream power, and active natural processes that promote dynamic habitat formation.
- *Riparian vegetation*:
    - Preserve existing natural vegetation communities to maintain shading, aesthetics, seed sources, future wood recruitment, wetland habitats, and wildlife habitat.
    - Reestablish processes (connectivity and dynamism) that support the recruitment and growth of young willow and cottonwood. Increased floodplain inundation and shading will also reduce invasive reed canary grass monocultures.
- *Wetlands*: Increase floodplain activation and river processes to expand wetlands and promote healthy vegetation communities

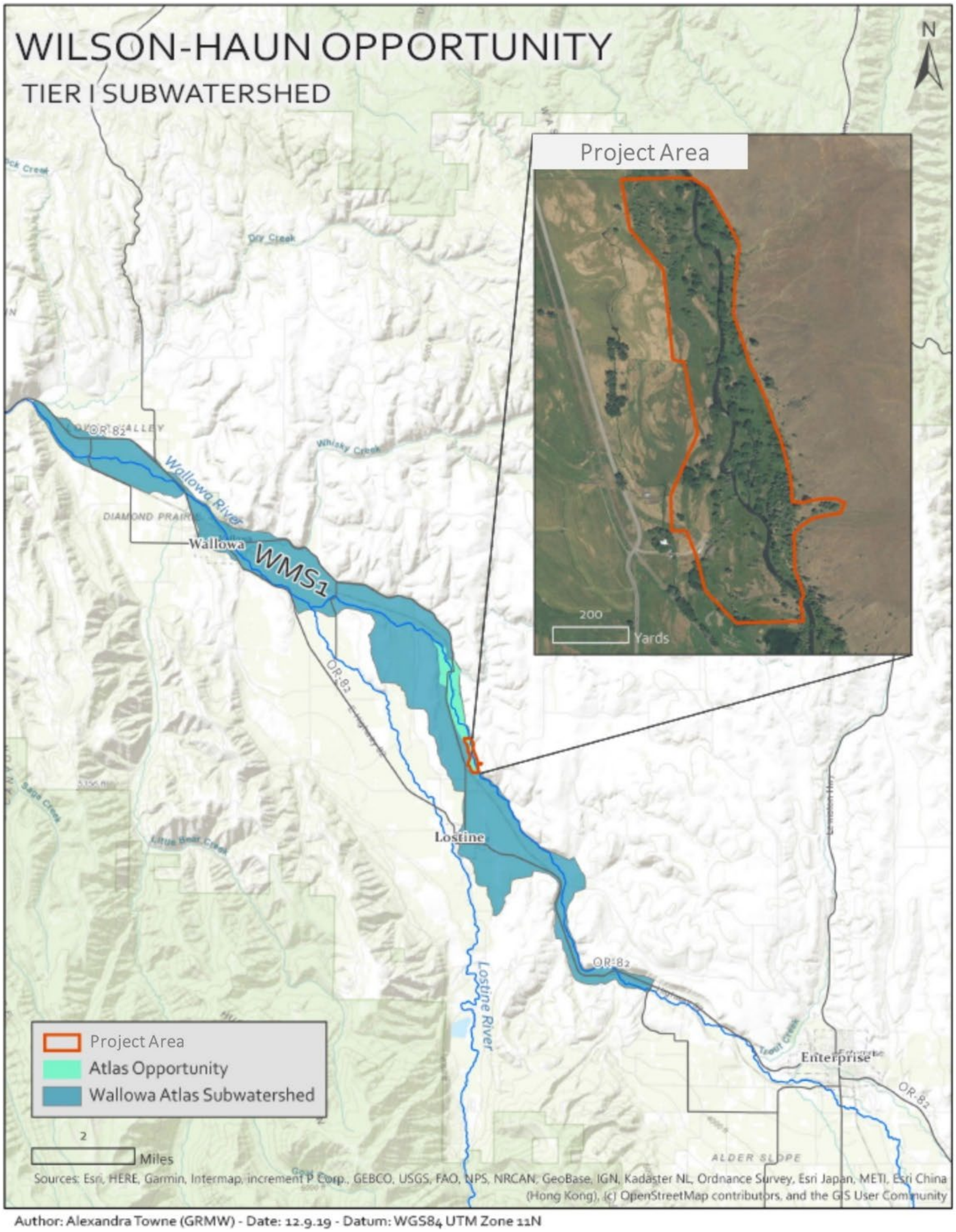


Figure 1 Project area map showing the project area relative to the containing Atlas sub-watershed (WMS1) and general vicinity. Figure source: GRMW.

- *Groundwater Connectivity and Hyporheic Processes*: Increase instream complexity, dynamism, and floodplain engagement to promote groundwater recharge, form diverse hyporheic flow paths, and reconnect historic floodplain wetlands.
- *Risk to Infrastructure and People*: Avoid increased flood risk to infrastructure. Meet County flood (no-rise) requirements.
- *Longevity of treatments and benefit*: Project results in ecosystem benefits that last decades and ideally generates long-term self-sustaining natural processes.

1.0.3 ABBREVIATED PROJECT HISTORY AND VISION

The restoration of the river and floodplain through instream work is only one part of a larger vision to restore natural processes in a riverine and upland habitat on the Wilson-Haun property. Beginning in 2017, cattle grazing was removed in the river floodplain and adjacent upland habitat to allow for native vegetation recovery, including: native grasses, sedges, rushes, shrub, and tree species. A more aggressive approach to controlling noxious and invasive species has been taken. The landowners have used chemical treatments, hand removal and the introduction of fire on the landscape to control non-native vegetation. In addition, a NRCS-funded juniper removal program was initiated to address floodplain conifer encroachment and provide wood for instream restoration. The juniper removal is expected to release aspen stands and other native riparian vegetation that have faced competition from junipers.

The vision also includes continued opportunities to catch and release rainbow trout and whitefish, support native fauna, implement a conservation easement, and provide future opportunities for outreach and education.

1.0.3 GENERAL LIST OF PROPOSED RESTORATION ELEMENTS AND GENERAL EXTENTS

The following activity categories, as defined under the BPA Habitat Improvement Program (HIP) programmatic were identified during the 15% review by the Restoration Review Team (RRT):

- 1c – Headcut and grade stabilization
- 2a – Improve Secondary and Floodplain Connectivity
- 2d – Install Habitat-Forming Instream Structures
- 2e – Riparian and Wetland Vegetation Planting (including exclusion fencing)
- 2f – Channel Reconstruction

1.1 NAME AND TITLES OF SPONSOR, FIRMS AND INDIVIDUALS RESPONSIBLE FOR DESIGN (15%).

Project Sponsor – Trout Unlimited (TU)
Design Engineer – Wolf Water Resources (W2r)
Land Owner/Manager – Ian Wilson

1.2 LIST OF PROJECT ELEMENTS THAT HAVE BEEN DESIGNED BY A LICENSED PROFESSIONAL ENGINEER.

The proposed project elements have been designed by a licensed engineer and are summarized below:

- Place large wood structures and individual large logs throughout the project area to increase habitat complexity in channels and in the floodplain, and increase floodplain connectivity;

- Grade/excavate floodplain areas to increase floodplain connectivity;
- Place excavated materials in main channel to increase floodplain connectivity, habitat complexity; and
- Place low-tech small wood structures in side channels and off channel habitats to increase habitat complexity, and floodplain connectivity;

The outcomes expected from the preferred alternative include:

- Improved connectivity of the floodplain and adjacent wetland complexes;
- Improved access and suitability of off-channel networks and shallow-water habitat for juvenile salmonids;
- Reduce overall stream power, allowing for significant natural habitat formation;
- Expansion of existing wetlands;
- Increased pool and cover habitat;
- Increased diversity and extent of native riparian and wetland species;
- Improved groundwater dynamics based on raised bed level, enhanced floodplain inundation, and accelerated geomorphic processes.

1.3 EXPLANATION AND BACKGROUND ON FISHERIES USE (BY LIFE STAGE - PERIOD) AND LIMITING FACTORS ADDRESSED BY PROJECT (15%).

The project area is utilized by Spring Chinook, Steelhead, Bull Trout, Lamprey, and numerous other aquatic and upland wildlife species. The periodicity and timing of use by key life stages are outlined in Figure 2. Through the Atlas process, the following limiting factors were identified (with associated priorities of high, medium, and low): anthropogenic barriers (M), riparian vegetation (H), side channel and wetland conditions (H), floodplain condition (H), instream complexity/structure (H), sediment quantity (M), temperature (M), and water quantity (H). Based on initial site assessments, the limiting factors most directly addressable within the reach are riparian vegetation, side channel/wetland/floodplain conditions, instream complexity/structure, and to a degree sediment (in general, this reach of the Wallowa River appears sediment-limited based on the presence of Wallowa Lake upstream).

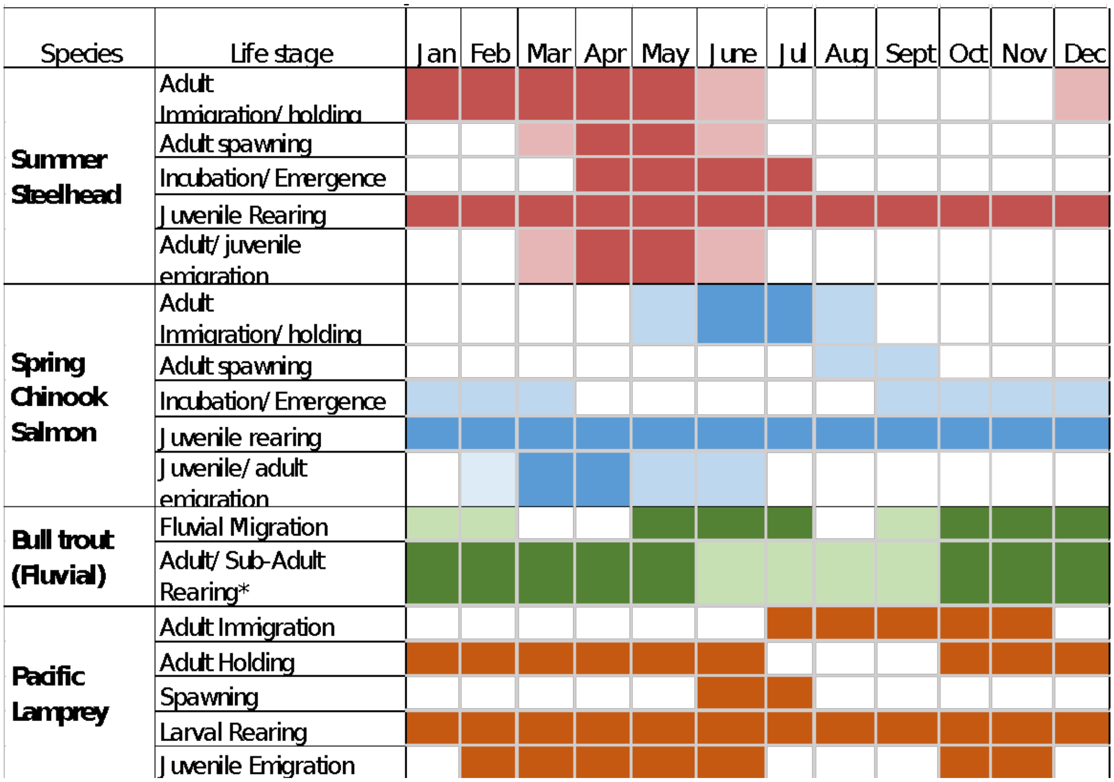


Figure 2 Life stage and fish use periodicity in the WMS-1 sub-watershed as assembled through the Atlas Prioritization Framework. Dark and light red bars indicate relative certainty in the use timing as identified by the Atlas team.

1.4 LIST OF PRIMARY PROJECT FEATURES INCLUDING CONSTRUCTED OR NATURAL ELEMENTS.

- Improve Secondary Channels – wood addition (throughout reach)
- Floodplain Grading (throughout reach)
- Install Habitat-Forming Natural Structures – large wood, beaver dam analogues and individual logs (throughout reach and floodplain environments)
- Riparian Planting and Invasive Vegetation Control (throughout reach)
- Channel Reconstruction – Fill (strategically placed throughout reach)

1.5 DESCRIPTION OF PERFORMANCE / SUSTAINABILITY CRITERIA FOR PROJECT ELEMENTS AND ASSESSMENT OF RISK OF FAILURE TO PERFORM, RISK TO INFRASTRUCTURE, POTENTIAL CONSEQUENCES AND COMPENSATING ANALYSIS TO REDUCE UNCERTAINTY (15%).

The design and construction of the project incorporate the following to reduce or eliminate potential risk and consequences:

- The project will be designed and constructed to result in no rise of 100-year floodplain upstream or downstream of the project.
- Wetlands will be preserved to the greatest extents possible. No fill will be added to wetlands. Wetlands will be improved by adding wood only.
- Stream power will be re-distributed and floodplain connectivity increased by lowering perched floodplains and placing that material in degraded portions of the channel.
- A project monitoring and adaptive management plan (MAMP), as required by BPA's HIP process, will be developed in collaboration with TU and GRMW.

- No damage to infrastructure is anticipated as a result of this project. Evaluation of all project elements will ensure floodplain structures and bridges will not be affected as a result of this project.

1.6 DESCRIPTION OF DISTURBANCE INCLUDING TIMING AND AREAL EXTENT AND POTENTIAL IMPACTS ASSOCIATED WITH IMPLEMENTATION OF EACH ELEMENT (15%).

This project will include:

- Excavation of floodplain and placement of excavated material in the main channel;
- Placement of log jams/large wood in the main channel and side channels;
- Placement of individual logs and small log structures on floodplain; and
- Invasive vegetation species treatment; and
- Revegetation and browse protection.

Equipment will be tracked to individual grading and installation sites along existing floodplain access routes or through invasive vegetation (reed canary grass). Disturbance to existing native vegetation will be minimized. Construction of project elements below Ordinary High Water (OHW) will be carried out during the in-water work window for the Wallowa River. Timing of excavation at the site will coincide with site hydrology.

No damage to infrastructure is anticipated as a result of this project. Project areal extents include the riparian area of the Wallowa River on the Wilson property as shown in the design drawings in Appendix 1.

2.0 RESOURCE INVENTORY AND EVALUATION

2.1 DESCRIPTION OF PAST AND PRESENT IMPACTS ON CHANNEL, RIPARIAN AND FLOODPLAIN CONDITIONS (15%).

The Wallowa area was originally home to the Nez Perce tribe. This area, along with portions of Washington and Idaho were originally protected from encroachment from European settlers. This changed in 1860 when gold was found in northeast Oregon. European settlers quicky moved to the area which led to the Nez Perce War from June-October 1877 that culminated when Chief Joseph of the Nez Perce tribe surrendered. Remaining members of the tribe were led to Kansas by Nelson A. Miles (Kennaly).

The Haun family was one of the first to settle in the Wallowa Valley, making their home at the project area in 1878. They settled the project reach and were instrumental in establishing the town of Evans (the small collection of residences surrounding the site to the southwest). The first documentation of river and floodplain conditions available is a historic image taken in the early 1900s of the surrounding valley and project site (Figure 3). Although much of the valley had been cleared at the time, the image depicts a nearly continuous riparian corridor along the Wallowa River. That riparian corridor was dominated by deciduous species with localized conifers along the toe of the eastern hillslope. These conditions contrast with the more discontinuous and mixed conifer-deciduous riparian vegetation of today. From a review of aerial imagery dated 1946, 1959, and 1984, the riparian corridor was gradually reduced in width over the 20th century.

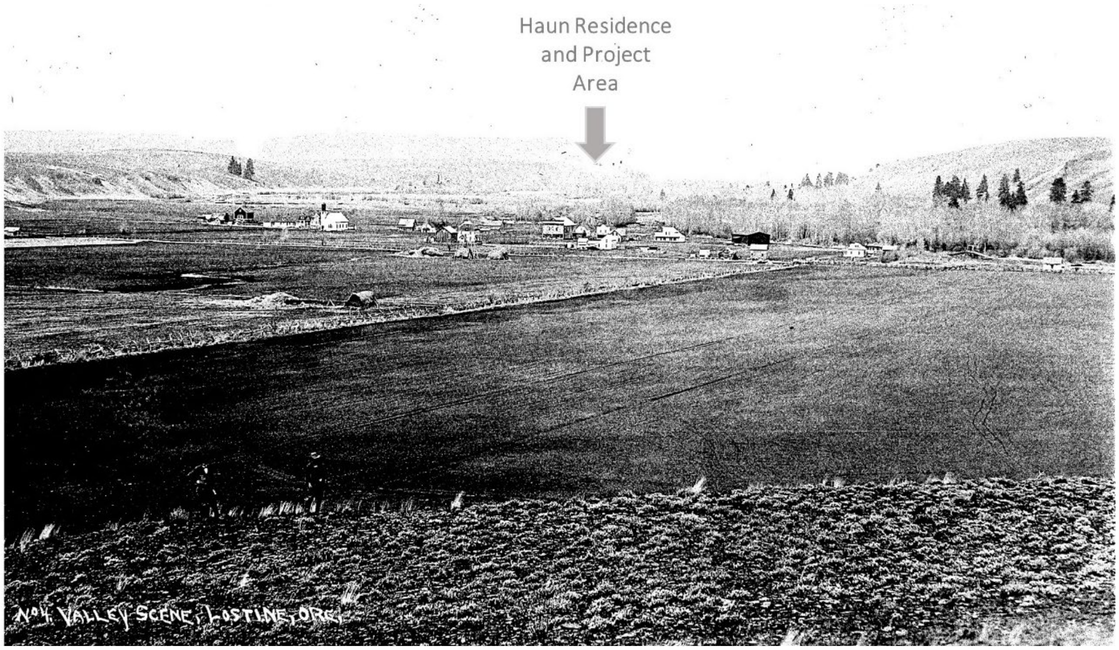


Figure 3 Historic image from early 1900s of project vicinity. Looking generally north. Also note the historic floodplain cottonwood galleries on the right side of the photo.

Subsequently in the middle 20th century (1950s-60s), much of the Wallowa River was straightened throughout the valley by the US Army Corps of Engineers to reduce flooding and promote agricultural production. Review of aerial imagery dated 1946, 1959, and 1984 indicate no obvious straightening except for a small segment in the upper most project reach sometime between 1959 and 1984. Regardless of the degree of straightening in the project reach itself, stream incision was one likely response from the broader efforts throughout the valley. That incision likely would have migrated through and impacted channel conditions within the project reach.

Additionally, the flow regime of the Wallowa River was modified by the construction of the Wallowa Lake Dam in 1918. The dam was raised in 1929 to a level of 35 feet above the natural lake elevation, and again reconstructed in 2006 to reinforce the structure (Bingman, 2007). The dam and its operations directly influence the hydrology of the Wallowa River downstream.

The floodplain and riparian area vegetation has largely been altered by invasive vegetation establishment, predominantly reed canary grass. Additionally, juniper (which are native but not necessarily typical of well-connected floodplains) have apparently encroached over time, suggesting a shift toward a dryer vegetation regime. Sparse cottonwood trees, ponderosa pine and aspen also populate the floodplain.

2.2 INSTREAM FLOW MANAGEMENT AND CONSTRAINTS IN THE PROJECT REACH.

2.3 DESCRIPTION OF EXISTING GEOMORPHIC CONDITIONS AND CONSTRAINTS ON PHYSICAL PROCESSES (15%).

The project reach lies in a broad and unconfined valley bottom of the Wallowa River. The most active portion of the geomorphic floodplain (approximately 600 ft wide) is bounded laterally on the east by a bedrock hillside and on the west by relict floodplain and fluvial terraces that are on the order of 10 feet above the active river level (Figure 4). Although the river channel is almost fully alluvial in nature, it does impinge upon the bedrock valley wall and adjacent alluvial fan deposits locally (particularly near the upper and lower ends of the reach). Overall, slope in the reach averages about 0.27%, with local slopes steepening from upstream (~0.22%) to downstream (~0.29%).

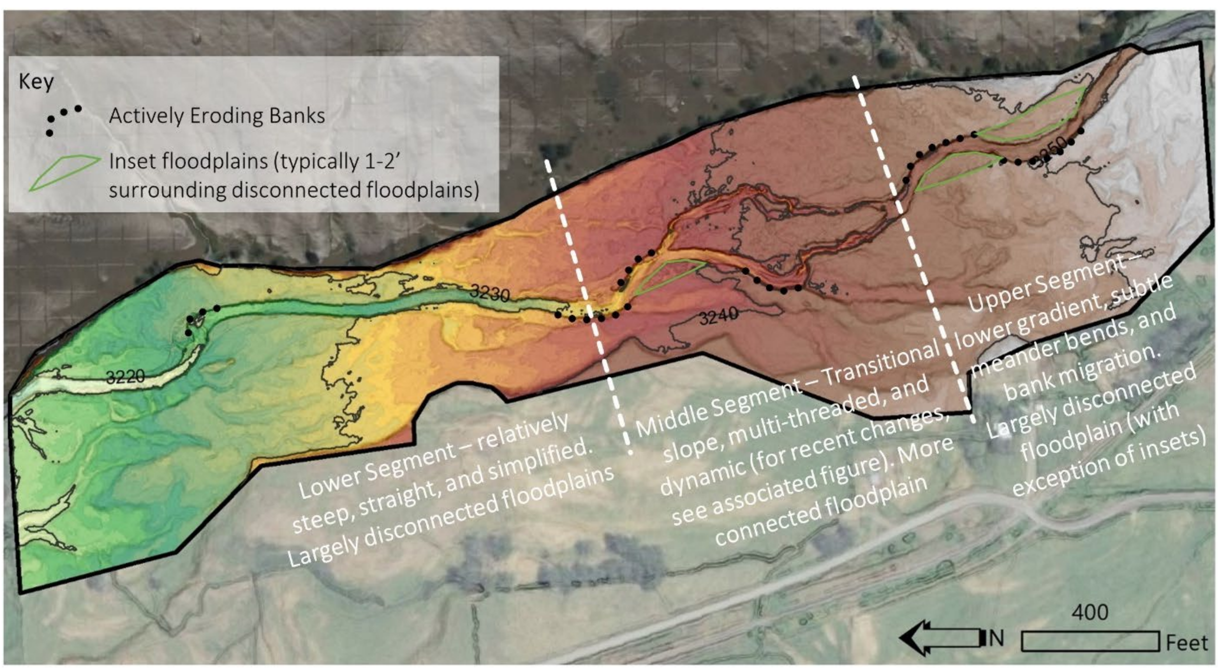


Figure 4 Annotated geomorphic terrain map with composite LiDAR terrain as a basemap.

The reach is conveniently divided into three segments for geomorphic description and interpretation (Figure 4). The upstream most segment is single-threaded with subtle meanders and actively eroding cutbanks. Gravel bars are limited. When present, they are generally downstream of eroding banks. Floodplains in this segment are largely disconnected with exception of small inset floodplains on the inside of bends. The middle segment is multi-threaded with greater floodplain engagement. Gravel bars are most abundant in this segment, probably reflecting reduced stream power as well as lateral stream dynamics in recent decades (see subsequent discussion and figure). The lower most segment is nearly straight, relatively steep, and is highly simplified with plane bed morphology (with exception of a single pool associated with a logjam and eroding bend). Gravel bars are almost completely absent in this lower segment.

2.3.1 SEDIMENT SUPPLY AND TRANSPORT

Overall, gravel bars are notably limited in the reach. The gravel bars that are present are most extensive in the middle segment and in association with local zones of bank erosion and channel change, implying that the local sources are largely responsible for observed deposits.

Gravel bars are dominated by coarse gravel with minor proportions of cobble as well as medium and fine gravels. One representative pebble count (Figure 5) reveals about 65% coarse gravel (16-64 mm), 14% medium gravel (8-16 mm), 12% cobble (64-256 mm), and 8% fine gravel (2-8 mm). Key grain percentiles (D##) include the D16, D50, and D84s of 12 mm, 29 mm, and 58 mm, respectively. In general, gravel bars were observed to be generally finer than the bed, reflecting the fact that gravel bars are more actively transported by the river.

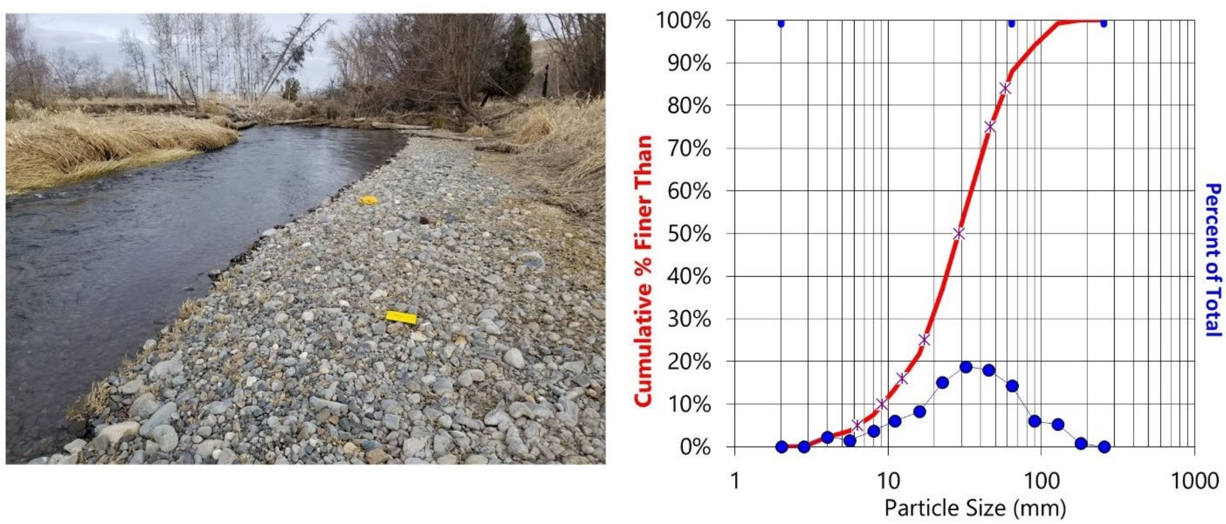


Figure 5 Sediment gradation of existing gravel bar in the reach. The gravel bar shown is located near the upstream end of the middle segment on the right bank of the main channel. Gravel bars typically reflect the bed material in active transport. The broader bed was observed to be generally coarser than gravel bars.

The supply rate (flux) of gravel from upstream is a major question that sets our expectation for habitat formation rates and process. Wallowa Lake upstream is known to be a major sediment trap that prevents gravel passage downstream and provides a general explanation for the limited extent of gravel present in the reach. Because Wallowa Lake existed naturally (even prior to artificial lake level raising), the gravel scarcity is at least, in part, a natural condition. In the absence of available bedload measurements, gravel fluxes to the reach were estimated using an empirical relationship between watershed slope and bedload yield (developed for Western Oregon by O'Connor et al. (2014)) applied over the segments of watershed upstream and downstream of Wallowa Lake. This calculation reveals that the watershed area upstream of Wallowa Lake generates on the order of 1,800 tons per year (1,200 cubic yards per year, all of which is trapped in the lake), and the area contributing downstream of the lake generates about 600 tons per year (400 cubic yards per year). Although the area upstream of the lake is less than 20% of the watershed area contributing to the reach, it disproportionately generates sediment based on its steep slopes and mountainous terrain. The estimated 400 cubic yards of sediment that do make it to the reach are probably sourced from Hurricane Creek, the primary high relief tributary entering the Wallowa River below the lake.

Overall, the reach observations and analysis of lake-influenced watershed conditions point to limited gravel supply and the importance of local sediment sources introduced via lateral migration. The limitation of sediment has a consequence of generally slower habitat formation through processes like lateral migration, wood recruitment, and bar formation. However, side channel and other off-channel features are likely to persist for longer once created (by the river or through restoration actions), thus representing a possible opportunity from a fish habitat standpoint.

2.3.2 REACH-SCALE DYNAMICS AND HISTORIC INCISION

In the context of limited sediment and other reach observation, geomorphic changes through time inform the nature and rates of habitat formation. The middle segment of the reach has the most notable complexity and connectivity with multiple active threads and greater abundance of gravel bars, woody debris, and local off-channel features. This segment has also experienced the most obvious changes in recent decades, as documented in Figure 6. This sequence of aerial imagery reveals an evolution from a single thread channel of the early 1990s to the multi-threaded configuration of present day. These images demonstrate that the relatively dynamic and connected conditions of today can be traced back to disturbance in the late 1990s (a period with notably large and long duration floods). During this period, deposition of a large gravel bar initiated flow splitting and side channel formation, setting the stage for multiple channel switches through time. From these images, we can see that at least some of that gravel bar was sourced from bank erosion in the upper segment.

Historic channel incision is another dynamic that lies at the root of reach-scale degradation because of the associated losses in complexity, connectivity (lateral and vertical), and riparian vegetation health (Cluer and Thorne, 2014). In the project reach, inset floodplains (mapped in Figure 4) help us to understand the degree of historic incision as well as the likely stage of stream evolution and recovery according to the Stream Evolution Model (Figure 7). The noted inset floodplains are almost exclusively located at the inside of migrating meander bends and are 1-2 feet below adjacent and higher (presumably disconnected) floodplain surfaces. These inset floodplains are interpreted to have formed after historic incision, at or near the active river level. A likely history explaining their formation includes stream incision in response to some historic disturbance (likely the historic river straightening in the mid-20^{th} century), followed by bend migration and floodplain widening that resulted in the formation of these incipient floodplain areas on the inside of bends. Thus, the river has likely progressed into widening phases of stream evolution (approximate stage 5 as shown in Figure 7). The implied vertical incision of 1-2 feet, while seemingly not extreme, resulted in a major loss in floodplain connectivity when considering that the current difference between the 2- and 10- year flood profiles is only about 1 foot.

Figure 6 **Sequence of recent aerial imagery from 1994-2016 (sourced from Google Earth) showing recent channel changes in the approximate upper half of the reach. Flow direction is up in the photo with the upstream end of the reach located at the photo bottom.**

2.3.3 SUMMARY OF GEOMORPHIC CONDITIONS WITH RESPECT TO STREAM RECOVERY

Together the geomorphic analysis indicates a reach with relatively limited gravel inputs, active but slow channel migration that locally supplies gravel to the reach, and isolated areas of connected habitat (in the middle segment) formed through disturbance and sediment dynamics starting in the late 1990s. The stream appears to be progressing toward widening phases of stream evolution in response to 1-2 feet of historic incision. Together the overlay of stream evolution and fundamental geomorphic processes (sediment delivery and migration, see Figure 7) help to contextualize potential recovery (restoration) targets and pathways for the actions considered in this project.

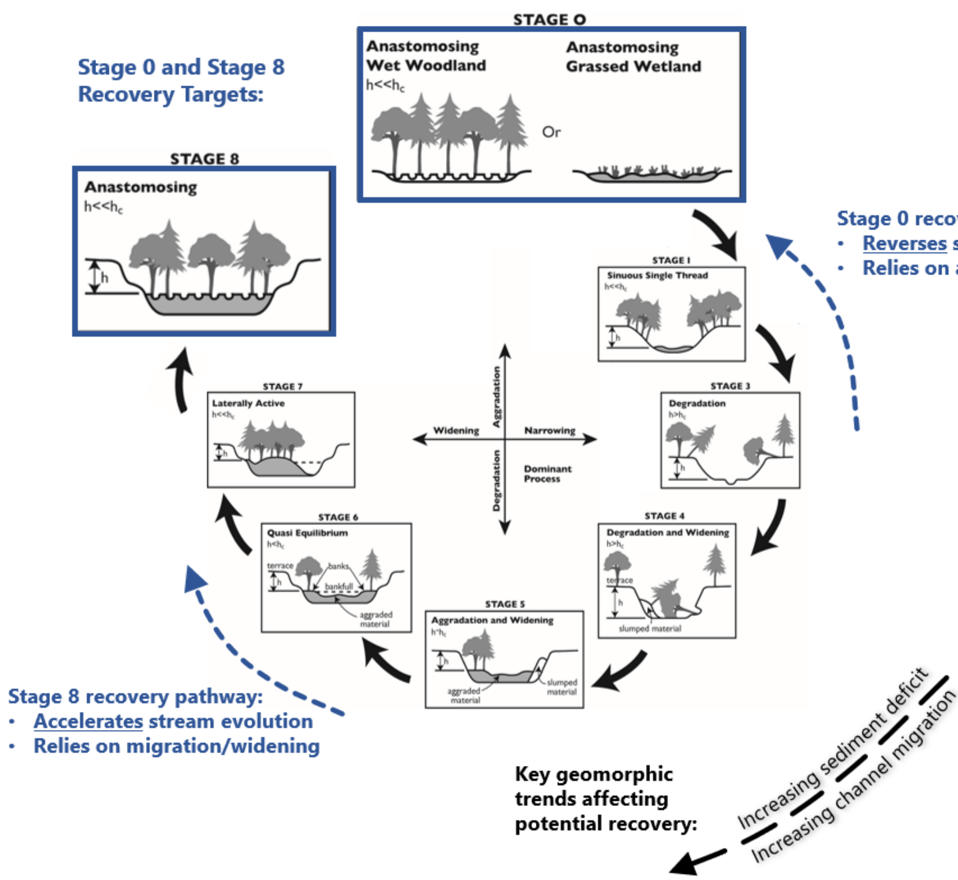


Figure 7 **Stream Evolution model (SEM) of Cluer and Thorne (2014) modified to show recovery pathways, recovery targets, and key geomorphic considerations/processes in stream evolution.**

2.4 DESCRIPTION OF EXISTING RIPARIAN CONDITION AND HISTORICAL RIPARIAN IMPACTS (15%).

The existing riparian community is a mix of deciduous and conifer species. Deciduous tree species include mature cottonwood, isolated aspen stands, and localized patches of aspen and willow (young). The most predominant conifer species include juniper (many of which have recently been girdled as part of an NRCS restoration agreement) and ponderosa pine Reed canary grass is pervasive across much of the site, with exception of wetland areas where native grasses and sedges are more common. Also see Section 2.1 for description of historical impacts.

2.5 DESCRIPTION OF LATERAL CONNECTIVITY TO FLOODPLAIN AND HISTORICAL FLOODPLAIN IMPACTS (15%).

The river is marginally incised and tends towards further incision near the downstream reach. Also see Section 2.1 and 2.3 for description of historical impacts and resultant losses in connectivity.

2.6 TIDAL INFLUENCE IN PROJECT REACH AND INFLUENCE OF STRUCTURAL CONTROLS (DIKES OR GATES).

Not applicable.

3.0 TECHNICAL DATA

3.0.1 RESTORATION ALTERNATIVES CONSIDERED AT CONCEPTUAL (15%) PHASE

In early project visioning and discussions, three alternative restoration strategies were identified and considered. These three alternatives involve singular treatment types to allow the design team to identify the benefits/risks/drawbacks of these treatments individually, with the expectation that the ultimate preferred alternative would mix these strategies. Therefore, the alternative analysis process was more about deciding on the relative emphasis of these individual strategies, rather than a true "selection" process as is commonly associated with engineering projects.

- Alternative 1 – Low-tech process-based restoration (LTPBR) treatments. LTPBR treatments are typically post-assisted structures (including Beaver Dam Analogues) installed by hand or with light machinery.
- Alternative 2 – Instream large wood placement. Large wood would be placed in various configurations within the river to encourage habitat formation and floodplain engagement.
- Alternative 3 – Floodplain grading and channel fill treatment. These treatments involve relatively broad lowering of high floodplain areas and fill of incised channel areas to address incision and broaden connectivity with these paired actions. Cut and fill is paired with wood placement, enhancing roughness.

3.0.2 ALTERNATIVES EVALUTION AND SELECTION

An alternative matrix was developed to assess expected effectiveness relative simplified project objectives and limiting factors (Table 1). This matrix is entirely qualitative, capturing rationale as developed early in the project (primarily through discussions with landowners, project sponsors, and design consultants). Documenting this rationale in matrix fashion allowed for relative prioritization of these strategies not only in a general sense but at specific locations and sections of the project reach.

The preferred restoration strategy represents a mix of the alternatives considered, balancing the benefits and risks of the various strategies.

The preferred restoration strategy involves a mix of LTPBR, LWD, and floodplain grading to expand connectivity, reduce stream powers, and induce greater dynamism/habitat formation throughout the reach, while also avoiding excessive disturbance and minimizing risk to adjacent infrastructure and people. The general strategy is to not only build new habitat but also create the conditions for the river to build habitat through time (we know the river has this capacity from habitat created in the middle section of the reach). The key elements taken from each alternative include:

- *LTPBR:* The preferred approach includes post-assisted log structures, beaver dam analogue structures and unballasted wood along existing and reconnected side channels, where lower stream power makes success of these structures more likely. In general, LTPBR techniques are deprioritized on the main river channel based on an expectation of minimal benefit/longevity. However, these structures are being considered as an auxiliary component to placed wood jams to enhance sediment capture and flow diversity.
- *LWD:* The preferred approach includes extensive wood placement throughout the channel and floodplain. These structures work in tandem with floodplain grading to encourage the maximum amount of floodplain connection possible (within site constraints and risks). One specific approach is to place structures (channel spanning, if possible) just downstream of graded floodplain connection points (i.e., "relief valves"). These configurations of wood and grading are expected to create nodes of complexity through time as they encourage flow splitting, reductions in stream energy, sediment

deposition, and channel migration. LWD will also be placed to create local complexity and encourage local flow diversity and sediment sorting.

- *Floodplain grading and targeted channel fill/gravel augmentation:* The preferred approach seeks to maximize floodplain connectivity (within site constraints) with a specific objective of reducing stream power. Increases in connectivity and reductions in stream power have cascading benefits for reach-scale dynamism, vegetation recruitment, wetland and beaver habitat, and groundwater dynamics (as represented conceptually in Figure 8).
    - Proposed grading areas target reconnecting naturally low-lying floodplain areas or swales to provide the best cost-benefit. At the same time, the proposed floodplain grading generally deemphasizes constructed or engineered side channels, which can be costly and often have limited lifespans. On this site, constructed side channels would require extensive earthwork and wetland disturbance, and would be deep relative to the broader floodplain because of historic stream incision. In contrast, the proposed actions seek to give the river opportunity to create its own side channels through time.
    - Coarse alluvium generated from grading will be placed instream to augment instream gravel and reduce instream conveyance (supporting additional floodplain engagement and channel migration). This strategy also supports a balanced cut and fill, which saves costs and material stockpile requirements.
- *Riparian Planting:* The project will involve robust planting of native species throughout the floodplain (especially in reconnected and disturbed areas).

The 15% design concept representing these elements is attached in Appendix 2.

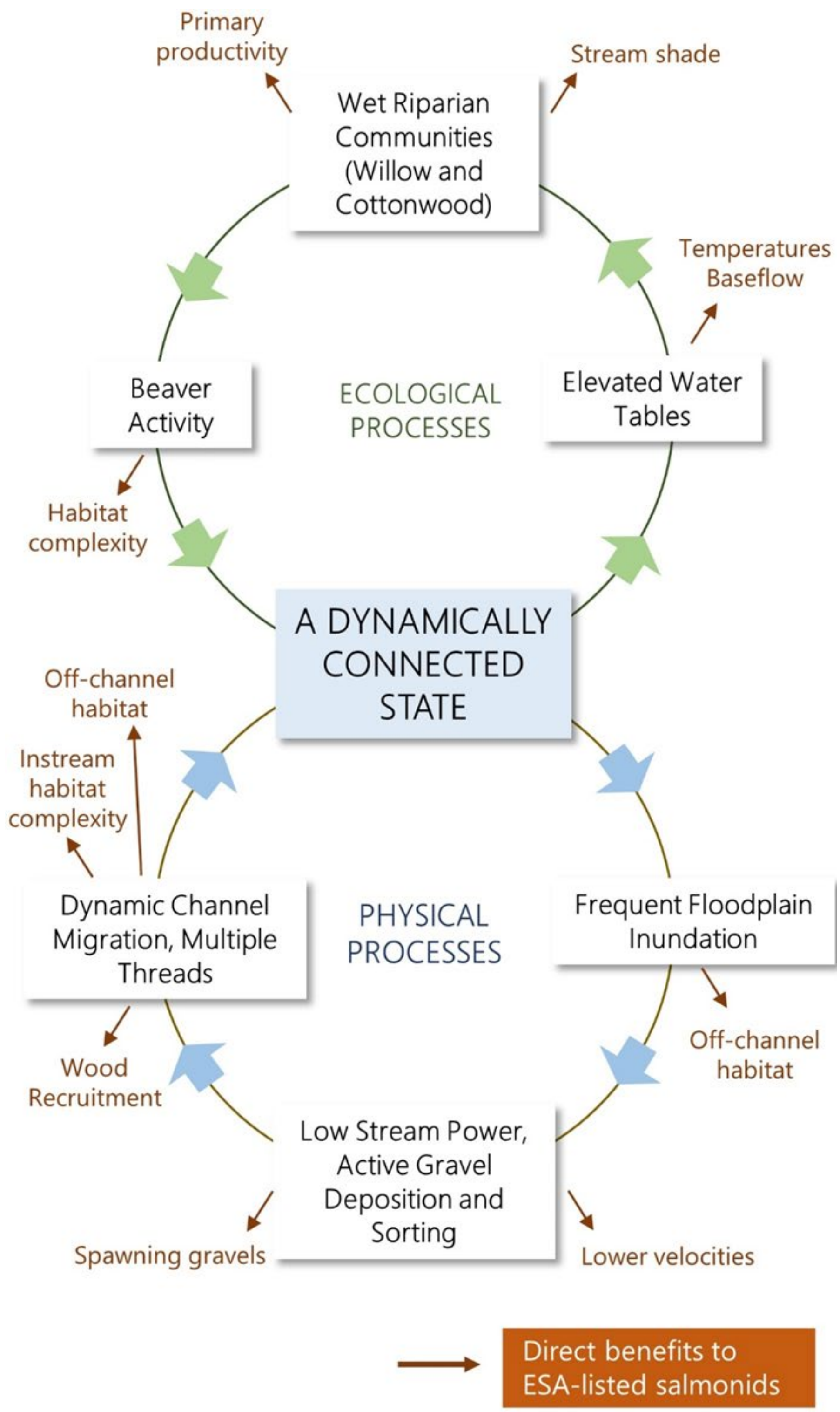


Figure 8 Flow Diagram demonstrating the bio-physical benefits of restoring floodplain connectivity. Direct benefits to salmonids are also displayed.

Table 1 Alternative evaluation matrix.

Element	Current condition	Specific Objective	LTPBR Strategy	LWD Strategy	Floodplain Grading and Channel Fill
Floodplain Connectivity	Floodplain disconnected through historic channel incision, except in middle (multi-threaded) section	Maximize floodplain engagement while avoiding risks to people/infrastructure.	Benefits are likely not substantial in the most incised and single-threaded sections of reach. Local benefits in side channels, though	Benefits likely more substantial than LTPBR, but probably not in line with the additional cost	Achieves greatest benefit to floodplain connectivity.
Instream Complexity	Limited wood, gravel bars formation, and lateral channel activity	A channel-floodplain system with greater complexity, reduced stream power, and active natural processes that promote long-term habitat formation	Provides local complexity and dynamism	Provides more substantial complexity and local dynamism, but reach-scale reductions in stream power are minimal so natural habitat formation is likely to remain low	Reduces overall stream power to the greatest degree, allowing for significant natural habitat formation.
Existing Riparian Vegetation	Existing vegetation is mixed but dominated by dry riparian species (conifer) and mature deciduous species. Existing lack of recruitment from floodplain disconnection, lack of channel dynamism, and a legacy of historic grazing. Prevalent Reed canary grass (RCG) limits recruitment	Preserve existing mature trees to maintain shading and aesthetics	Minimal disturbance to existing vegetation	Modest disturbance to existing vegetation for logjam excavations and access roads	Requires most disturbance, although can be localized in high portions of the site where existing vegetation is degraded/minimal
Riparian Vegetation Recruitment		Reestablish processes (connectivity and dynamism) that support the recruitment and growth of young willow and cottonwood. Increased inundation to combat RCG.	May form localized bars that support vegetation recruitment. Minimal changes to floodplain hydrology limit overall improvement	Likely to form localized bars and bank erosion that supports modest increases to vegetation recruitment. Minimal changes to floodplain hydrology limits broad benefits	Gains in floodplain connectivity and dynamism allow for the most significant potential recruitment
Wetlands	Existing emergent wetlands (sedge dominant) are present in swales onsite, but lack significant connectivity with the river	Increase activation with river to expand wetlands and promote healthy vegetation communities	Unlikely to disturb or improve wetlands to a great degree	May result in modest improvements to local wetland hydrology/connectivity with river	Greatest potential for expansion of existing wetlands, although modest disturbance of existing wetlands may be required.
Groundwater Connectivity and Hyporheic	A generally simplified and static channel (both vertically and in planform) limits opportunities for hyporheic exchange	Increased instream complexity, dynamism, and floodplain engagement to promote these processes	Creates very local hyporheic flow paths around LTPBR structures and associated bars	Creates local hyporheic flow paths around constructed logjams and associated bars	Generates greatest improvement in groundwater dynamics based on raised bed level, enhanced floodplain inundation, and accelerated geomorphic processes
Risk to infrastructure and people	Existing infrastructure includes upstream property owner, onsite RV residence, and downstream feedlot	Avoid increased flood risk to infrastructure. Meet County flood (no-rise) requirements	Limited additional risk	Limited to modest additional risk managed relatively easy through design process	Highest risk of three strategies, although can be addressed through specific design elements.
Longevity of treatments and benefit	NA	Benefits that last multiple decades or ideally generate self-sustaining habitat in perpetuity	Longevity of benefits likely the least of three alternatives, especially given the size of the river relative to the LTPBR structures	Given expected minimal supply of wood from upstream, longevity of benefits likely dictated by the lifespan of individual logjams (~20-30 years)	This approach gives the river the opportunity to find its own dynamic equilibrium relative to watershed conditions (wood and sediment delivery). Therefore, it has the highest potential to create lasting habitat. Although relatively limited wood and sediment delivery suggest the reach may ultimately settle on less dynamic state than would be experienced in the years immediately after construction.
Selected Mix of Treatment Strategies in Preferred Alternative			*LTPBR structures proposed in existing and reconnected side channels. Limited application on mainstem channel margins*	*LWD treatments throughout mainstem and floodplain, but especially paired with graded floodplain connection points*	*Grading strategy creates targeted connection points (paired with targeted gravel augmentation) to engage floodplain, reduce stream power, and promote reach-scale dynamism. Connection points are proposed as broad low points as opposed to side channel inlets.*

3.0.3 DESIGN (80%)

Aside from project goals and objectives outlined in Sections 1.0 and 1.5, the design has the following feasibility and constructability objectives:

- Relative balance in cut and fill to avoid the need for material off-haul.
- Minimal disturbance to existing floodplain wetlands.
- Use of salvaged vegetation and trees to minimize import of materials.

Additional design analysis and input from project stakeholders during the 80% design phase resulted in refinements to the restoration elements proposed in the 30% design. Specific restoration elements of the 80% design discussed below include (1) floodplain and channel grading, (2) large woody material (LWM) elements, (3) habitat structures/features, and (4) site restoration and planting.

3.0.3.1 FLOODPLAIN AND CHANNEL GRADING

The proposed grading at this site utilizes a floodplain grading and channel fill approach, meaning lowering high and disconnected floodplain areas, and filling incised portions of the channel. The lowering of the floodplain in concert with channel fill "resets" areas of the valley to maximize connectivity and to allow the channel to find its natural dynamism. The design approach also minimizes stream power per unit width, and raises groundwater tables to promote riparian and wetland vegetation success. Specific elements in this design include:

- Floodplain grading that targets removal of perched/high areas. More specifically, high areas that are a key link between the channel and existing low ground or disconnected side channels to maximize cost/benefit ratios, reduce project footprint, and minimize impacts to sensitive floodplain habitat.
- Designs err on the side of more rather than less connectivity to allow the stream to find its natural multi-threaded dynamic equilibrium. Excavation of narrow side channels are avoided while broader floodplain grading is preferred.
- Floodplain excavation (lowering) provides a convenient source for needed gravels/cobbles required for channel fill activities avoiding need for material import. Visual observation during field reconnaissance identified sites that indicated presence of gravels and cobbles, ideal for channel fill activities (Figure 9).

Figure 9 Observable cobbles in floodplain soils.

Floodplain grading is proposed in various locations throughout the reach. Rather than excavation of narrow, deep side channels through the floodplain, shallow broad floodplain swales or flow paths were graded. Locations for floodplain grading activities were chosen for their location relative to existing low-lying floodplain areas or disconnected side channels. The extents of gradings were chosen to provide connectivity to these off-channel areas, rather than grade through them (Figure 10). By doing this, we are providing a pathway for overbanking flows to reach these disconnected areas and then allowing the river and floodplain to evolve over time. Effort was also made to limit grading extents to avoid existing floodplain wetlands.

As design progressed to 80%, a handful of locations were identified to incorporate some fine grading elements in the form of small floodplain channels, plug removals and pond/alcove excavation to further increase floodplain connectivity and habitat uplift.

In specific locations, small high-flow channels have been incorporated into the grading to remove “plugs” which otherwise would prevent connectivity to additional floodplain habitat. By doing so, the design incorporates targeted grading efforts which provide large habitat and hydrologic uplift from minimal levels of effort and disturbance. These high flow channels increase inundation extents as well as increase inundation duration.

Additionally, a number of ponds and alcoves have been Incorporated into the proposed floodplain grading. Ponds have largely been sited near proposed floodplain grading areas, where hydraulic connectivity and ground water levels are anticipated to increase post construction, providing greater likelihood these will stay connected and wet throughout the year. These will provide additional perennial pond habitat throughout the reach. Not only will this habitat benefit salmonids, but other aquatic and terrestrial species such as beaver.

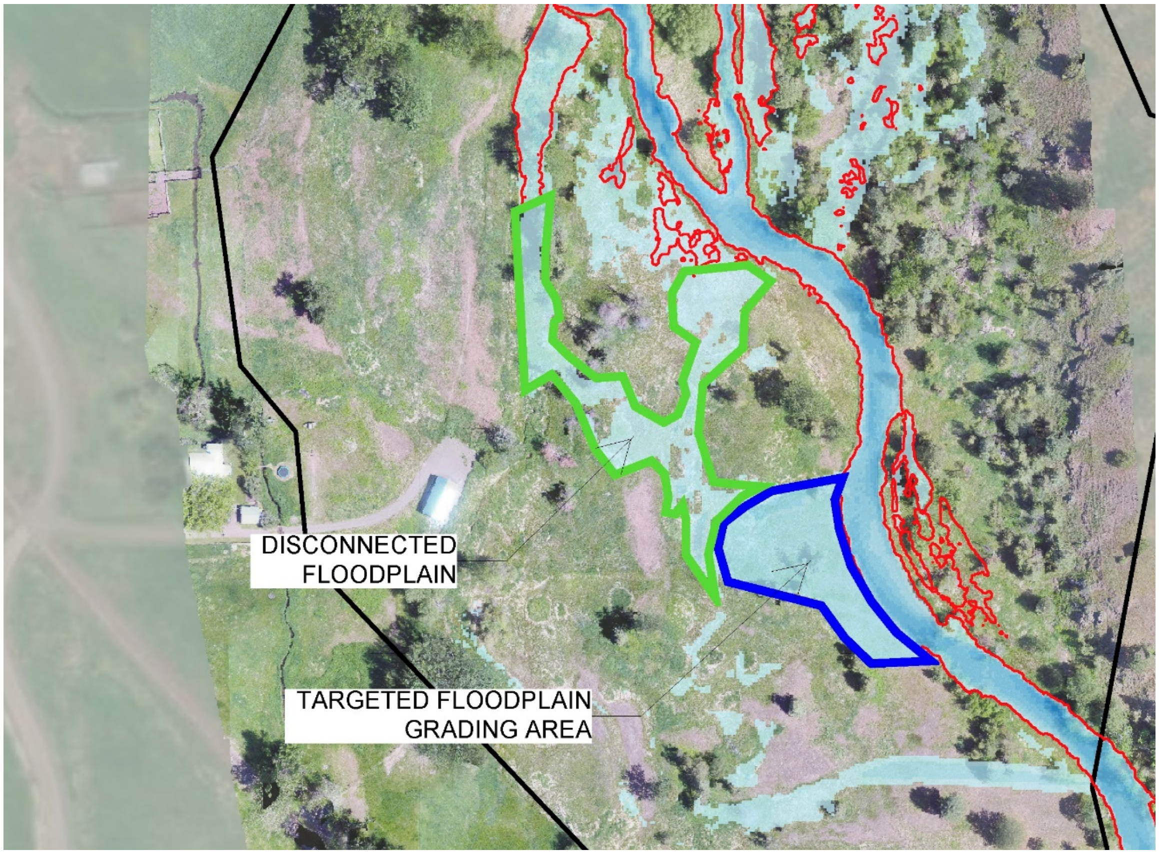


Figure 10 Hydraulic model output showing proposed conditions inundation (blue hatching) overlain with existing conditions inundation (red line) for the 1.5-year flow. Thick blue outline shows approximate extent of proposed floodplain grading/lowering, with a relatively small footprint compared to the expanded area of floodplain connectivity (green outline).

Channel fill proposed is generated from material excavated from floodplain grading areas and will be native alluvium. Prioritization will be given to use excavated materials most suitable for channel including a mix of gravels and cobbles (Figure 9). The channel fill raises the channel bed elevation in locations of incision and in a reach located downstream of a reservoir that is sediment limited and is not likely to naturally aggrade without intervention. Added byproducts of the channel fill is raised water surface elevations (WSE), increased floodplain connectivity, reduction of stream power, and an injection of sediment to a starved system.
Fill is proposed in the following locations:

- Three gravel bars in upper segment of the project reach. The fill to enhance the existing gravel bars will enlarge the bars, reduce width to depth ratios and seed the reach with sediment. These bank-fill areas extend from STA 33+00 to STA 41+75.
- STA 24+00 to STA 25+75. This fill area also aims to enhance an existing gravel bar and reduce width to depth ratios.
- STA 10+45 to STA 20+40 of the Wallowa River main channel.

The channel fill area in the lower segment of the project reach is proposed in a portion of the river that is currently incised, straightened, and has a plain-bed planform. The combination of floodplain grading and channel fill in this location aims to raise water surface elevations, engage the floodplain at lower recurrences reducing stream power, reconnect relic floodplain channels, and spread flow across the floodplain improving hydrologic connectivity.

Cut and fill maps and cross sections highlight the proposed grading and are included in Appendix 1 – 80% Engineering Drawings.

3.0.3.2 LARGE WOODY MATERIAL

Proposed large woody material (LWM) structures, or wood habitat structures (WHS), are designed to mimic racking and accumulation of large wood in natural rivers. The project design includes the following LWM structure types with specific habitat and/or hydraulic functions in mind:

- Margin Deflector Jam - Improves local stream bed heterogeneity and habitat diversity by simulating natural jams accumulated against fallen logs from the bank. The current design includes 13 margin structures.
- Apex Jams – Supports mid-channel bar and island growth to accumulate salmon spawning gravels, retain mobilized wood moving through the reach, and increase local floodplain inundation. The current design includes 16 small apex structures and one large apex structure.
- Channel Spanning Jams – Partially block the mainstem channel to encourage floodplain inundation and instream gravel retention and sorting. The current design includes 2 channel-spanning structures. These jams are generally placed just downstream of inlets of swales and existing side channels to maximize floodplain inundation gains.
- Sweeper Log – Encourages gravel retention and sorting by simulating individual large fallen trees into and across the channel from the bank. The current design includes 8 sweeper logs.
- Floodplain Roughness Logs – Provides roughness to distribute flows, retain fine sediment, and support riparian growth on floodplains. The current design includes 43 floodplain log structures.

Additional unballasted logs will be placed throughout the site to provide additional benefit. Some will be added to graded ponds or overhanging into the channel from banks to provide additional complexity and habitat benefit. Additionally, many individual logs will be added to the proposed channel fill in the lower segment to create a cobble-wood matrix, adding roughness, complexity, and helping retain the placed channel fill material.

The LWM structures will not include anchoring or pinning with cables, chains, nuts, or other methods. Installation will involve embedding logs in the banks, channel bed and floodplain, ballasting with native gravels, cobbles, and boulders, and weaving into existing vegetation to provide stability. Construction of LWM structures will involve importing large logs and looking into opportunities to utilize salvaged wood from onsite.

Log jam stability calculations were performed for all jams except for floodplain wood and sweeper logs. Flows across the floodplain areas are anticipated to be shallow and low velocity. Floodplain wood will be embedded and/or pinned, and if they do mobilize, it is anticipated it will be short distance or simply rotation Sweeper logs utilize logs longer than the bankfull width and brace against other jams as well as existing veg or bank pier logs. This reduces the chance of mobility (Kramer and Wohl, 2017). The calculations on log structures determine the ballast (fill and pier logs) required to stabilize the logs/structures against buoyant and hydraulic forces assuming full submersion of the structure. The buoyancy, sliding, rotation, and overturn calculations performed for the various size classes of logs are detailed in Appendix 8.

Reach-scale user and property risk was assessed using Bureau of Reclamation's Risk Assessment methods (2014, discussed in greater detail in Section 3.6), which provide recommendations on safety factors and design floods for logjam stability. This analysis found that user and property risks are low and moderate, respectively, for the reach. Low:Moderate risk ratings have associated recommendations of 25-year design flood and minimum safety factors of 1.5-1.75 for sliding, buoyancy, and rotation. These parameters supported stability calculations.

3.0.3.3 LOW-TECH RESTORATION TECHNIQUES

The design includes the use of low-tech restoration techniques or low-tech process based restoration (LTPBR) that relies on time, stream power, and beaver to maximize the benefits of these structures. These types of structures include beaver dam analogues (BDA) and post assisted log structures (PALS). BDAs mimic the form and function of natural beaver dams. They can either be post assisted or without posts and are made using a combination of locally available woody material, slash, and sediment. PALS are similar in form to BDAs. PALS have posts driven into the substrate and positioned to accumulate wood. There are three types of PALS intended for this project; channel-spanning, bank-attached, and mid-channel. Benefits of BDAs and PALS include promoting beaver activity, improving channel dynamism, retaining sediment in the channel, and improving floodplain activation. See BDA and PALS details included in the 30% design drawings in Appendix 1.

Since PALS and BDAs are relatively small compared to traditional engineered log jams, they are often installed in series to form a “complex”. This improves the impact that these structures have on the reach. For this project, six complexes (Figure 11) have been identified in the project reach to maximize use of side channels and opportunities for improved floodplain connectivity.

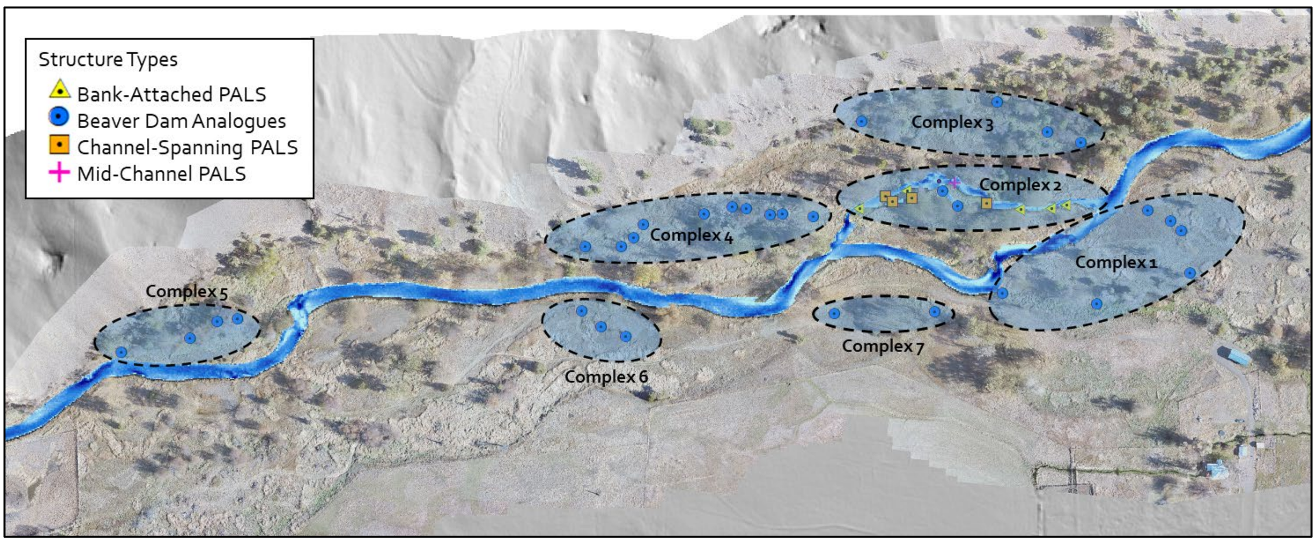


Figure 11. Overview of complex locations within the Wilson-Haun Wallowa River project area (Anabranch, 2021).

LTPBR is an ongoing process that requires some maintenance and adaptive management. Adaptive management plays a major role in 1) evaluating the response to restoration through monitoring and 2) determining how the response to restoration guides future restoration design actions. The health of a complex may change depending on changing channel dynamics, if floods damaged the structures, or any reason that may alter the as-built PALS and BDAs. Figure 12 can be used as a guide to evaluate already installed PALS and BDAs and determine if any additional efforts are needed in the complex.

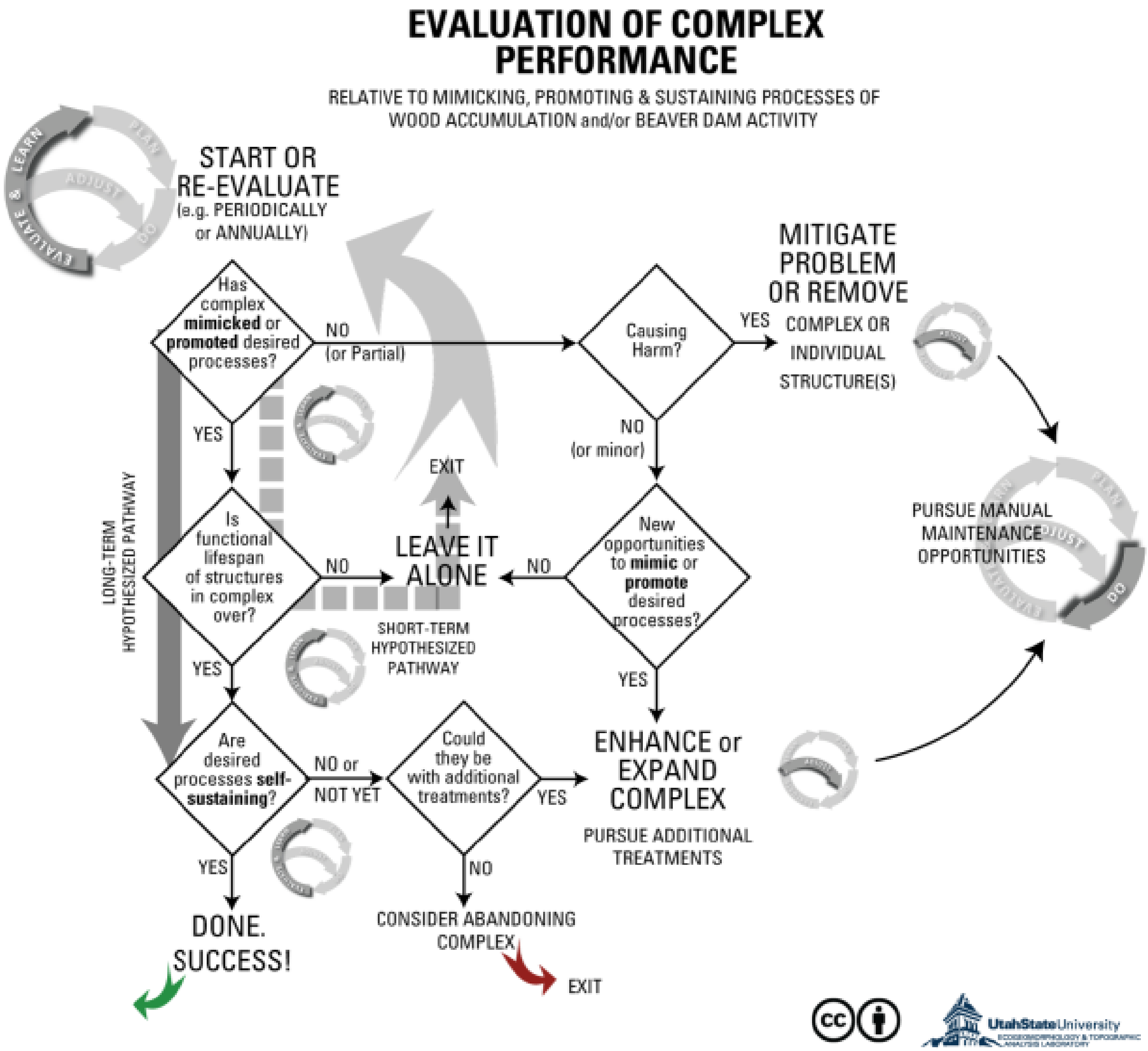


Figure 12. Adaptive management for monitoring and ongoing restoration of LTPBR complexes. Many of the concepts illustrated are also applicable at the scale of an individual structure or the entire project. From Chapter 6 of Wheaton et al. (2019; http://lowtechpbr.restoration.usu.edu).

Further detail on the proposed LTPBR approach for the Wilson Haun Project is included in Appendix 7.

3.0.3.4 FLOODPLAIN PLANTING AND INVASIVE SPECIES MANAGEMENT

The project team is working diligently to plan for the restoration of native floodplain plant communities on the Wilson-Haun Wallowa River Project. Riparian plant communities on the project site are departed from their historic state. This occurred due to land management practices both local to the site and throughout the watershed. Stands of remanent plant communities do exist on site, which provides the project team with a solid foundation to understand the historic species dynamics, and to plan, restore, and enhance these communities.

The landowners recently initiated a robust multi-year effort to recover these native communities. To date, this included discontinuing domestic livestock grazing in the floodplain, removing encroaching junipers from the floodplain, spraying invasive weeds, and conducting several light planting efforts. Landowner efforts are showing dividends across various sites on the landscape. For instance, cottonwood and aspen saplings are developing in areas where older stable homogenous stands previously developed due to historic land management. Young stems of alder (*Alnus incana*) species are emerging through thick reed canary grass (RCG) (*Phalaris arundinacea*) ground cover. The landowner-initiated practices present an excellent springboard for the project team to build from and set the floodplain plant communities up to regain their long-term ecological form and function.

The project team discussed extensively the plant recovery challenges presented by hydrologically disconnected floodplains (groundwater and surface water exchange), nonnative and invasive RCG, and intense ungulate browse/rubbing. The team would like to address each of these challenges in various ways by executing our riparian recovery plan. The effort will use both tried and true mechanisms to recover communities and limited actions will be on an experimental basis. The team is using best available science, technical resources, and expert opinion to develop our plan. Below are several of the broad themes the team will fine-tune as we transition from the 30% to 100% design phase.

Biomic Approach[1](Castro and Thorne, 2019)*:* The project's overall holistic approach centers around treating the core drivers of ecosystem degradation by addressing key elements of the floodplain and riverine environment's geomorphology, hydrology and biology. Plant communities fall into the latter category from a planning perspective but are intertwined closely with hydrology and geomorphology. By treating each of these key elements and understanding their interrelationships, the plan will lead to the successful recovery of native floodplain plant communities.

Design Hydraulics and Post-Construction Elevations: The project team will use the restoration treatment types, final projected elevations, and hydraulics data to design the placement and densities of plant species and nursery stock products (e.g., wetland sod mats, whips, brush trench, willow clumps, deep rooted, seeding, etc.).

Core Area Approach: The project will use conservation biology and restoration strategies such as core areas and connectivity to assess where to actively plant and in what densities, and where to promote passive approaches to recovery. The team started to make observation and will continue to map ground-based observations to target core plant community types for restoration. For example, one clear observation is that much of the river right floodplain and valley flank contains remanent native plant communities likely robust enough to warrant a more passive plant recovery approach. Limited actions such as the planting of more willow species, pruning to mimic natural stand heterogeneity, fencing, and installing small amounts of wetland sod mats near fresh channel notching areas will be most appropriate for this side of the valley bottom. Alternatively, the river left floodplain is likely to need a more active and even aggressive approach in certain areas. The left floodplain was likely more heavily used historically by humans and domestic livestock. On this valley flank there are several small pockets of native sedge and rush communities, an aspen stand, and some cottonwoods, but overall this side of the stream is lacking desirable vegetation and community heterogeneity (Figure 13).

Figure 13. ***On the right side of this photo is the river left valley flank. Notice the lack of stand heterogeneity and riparian hardwood communities in this section of floodplain.***

Existing native plant communities: Preserving and enhancing existing native communities is a key strategy. To date, the project team has started a plant list to document native and non-native species on the project site. Research into local vegetative community guides is ongoing. Through this research the team identified several communities of note that likely existed at the project site historically. Examples include:

Black Cottonwood/Common Snowberry Community Type, Black Cottonwood/Mountain Alder-Red Osier-Dogwood Plant Association, Willow/Aquatic Sedge Plant Association, Coyote Willow Plant Association, Willow/Aquatic Sedge Plant Association, Ponderosa Pine/Common Snowberry Plant Association, Quaking/Aspen Aquatic Sedge Plant Community Type, and others (Crowe and Clausnitzer, 1997).

Reeds Canary Grass (RCG): RCG is abundant on the project site. The project team conducted several conversations concerning this invasive, rhizomatous grass. The team consulted technical resources and experts on how to address the challenges this ground cover presents for a restoration project, and the recovery of native riparian plant communities. It is clear to the project team that eradicating this grass is not an option. The team would like to use a diverse planting approach to try to diversify our native plant communities and further marginalize RCG. There are strategies to reduce the stronghold this species presents that range from very aggressive to more passive approaches. The project will include passive approaches like shading out RCG and developing areas where more perennial flow exists to the point where RCG is no longer tolerant of inundated conditions. More aggressive/costly approaches will include placing down thick wetland sod mats post-earthwork to compete against RCG invasion, spray-scrape-replant methods, willow clump/large tree planting, and others (Figure 14).

Figure 14. From left to right various planting techniques– willow clump planting (Hoag, 2003), wetland sod mats (2021), cluster planting (Hoag, 2009).

3.1 INCORPORATION OF HIP SPECIFIC ACTIVITY CONSERVATION MEASURES FOR ALL INCLUDED PROJECT ELEMENTS.

The Wilson-Haun Wallowa River Project will be designed using HIP activity specific conservation measures. Design and construction drawings and specifications developed during future next design phases will follow and include all HIP Conservation Measures Specific to the project's proposed activities as well as the general conservation and construction measures.

The following activity categories, as defined under the BPA Habitat Improvement Program (HIP) programmatic, were identified during the 15% review by the Restoration Review Team (RRT):

- 1c – Headcut and grade stabilization
- 2a – Improve Secondary and Floodplain Connectivity
- 2d – Install Habitat-Forming instream Structures
- 2e – Riparian and Wetland Vegetation Planting
- 2f – Channel Reconstruction

3.2 SUMMARY OF SITE INFORMATION AND MEASUREMENTS (SURVEY, BED MATERIAL, ETC.) USED TO SUPPORT ASSESSMENT AND DESIGN

3.2.1 TOPOGRAPHIC CONDITIONS AND SURVEY

Elevation data used for design and modeling purposes is a composite surface of two LiDAR datasets, reviewed and/or integrated into an existing conditions terrain for this project. The two LiDAR sets include a 2009 LiDAR for the floodplain and 2020 blue-green topobathymetric LiDAR for the active channel area. The 2009 LiDAR was used in lieu of the 2019 LiDAR in the floodplain because the 2009 LiDAR more closely matches elevations of surveyed points (collected utilizing Real Time Kinematic (RTK) GPS collected in the floodplain in January 2021, and additional points collected in June 2021. The mean difference between the surveyed points and 2009 LiDAR surface was -0.476 feet, while the mean residual for the 2020 LiDAR was -0.953 feet. This discrepancy is thought to be due to the dense reed canary grass present at the site. The 2020 LiDAR is used within the channel and active floodplain area to capture the topobathymetric conditions within the reach, and the channel alignment adjustments that have occurred since the 2009 LiDAR . The composite surface best represents the true elevation of the floodplain and the current conditions in the active channel area.

Topographic data collected in proposed grading areas was utilized for multiple design purposes. Alignments and profiles of existing floodplain flow paths was utilized in order to ground truth proposed grading areas. Collecting accurate vertical profiles enabled the design team to better estimate the extent of grading needed to connect to low-lying floodplain areas.

Getting multiple topographic points in proposed grading areas enabled the design team to estimate vertical discrepancies in proposed excavation and fill areas. This enabled the design team to determine correction factors for earthwork quantities to better balance cut and fill for the project site.

The following survey datums are associated with this project.
Horizontal Datum - NAD83/2011 - Oregon North, International Survey Feet
Vertical Datum - NAVD 88 - Geoid Model 2012b

3.2.2 WETLANDS

In lieu of a formal wetland delineation, wetlands along the project reach were mapped using a hybrid approach which relied primarily on hydrology and vegetation as indication of wetland area. This approach consisted of a site assessment which generally observed vegetation and hydrology patterns, and surveyed an approximate wetland boundary using an RTK GPS. The field component did not collect field data using the standard wetland data form and did not evaluate soils. Ordinary high water (OHW) was determined in the field with network RTK GPS survey equipment within 1-meter horizontal accuracy. These data points were associated with LiDAR elevation values and used to interpolate the lateral extent of OHW along the project reach (See Approximate Wetland Areas and OHW map in Appendix 4).

The second component of this hybrid approach included a desktop analysis. This analysis took into account National Wetland Inventory (NWI) mapped wetlands (See NWI map in Appendix 4), field survey data, and LiDAR derivatives. Desktop data included recent high-resolution drone imagery (GRMW, 2019), height above water surface (HAWS) relative elevation layer (TU, 2019), and general topographic information. These inputs supplemented the field surveyed points by refining indicator patterns like vegetation (drone imagery), geomorphic position (HAWS and elevation data), drainage patterns (all datasets), visible surface water ponding (drone imagery), and others. Field data points were specifically associated with HAWS relative elevations. These elevations were used to extrapolate the approximate wetland boundaries shown on the Approximate Wetland Areas and OHW map in Appendix 4.

The above-described hybrid approach was chosen, due to the restorative nature of this project. The project's intent is to engage the floodplain and reactivate hydrology of under functioning wetlands and expand the overall distribution of wetlands on site. By conservatively mapping wetlands, this approach provided the detail necessary for initial design.

Within the project area, approximately 3.9 acres of wetland was identified, and 4.5 acres of within the bounds of the OHW were mapped.

On similar projects in eastern Oregon, regulatory agencies have found this level of detail sufficient for permitting. However, negotiations with permitting agencies are outstanding and should be started promptly. If a formal delineation is required, fieldwork should be scheduled as soon as possible to capitalize on springtime hydrology. The Department of State Lands (DSL) review period for wetland delineation reports is 120-days. It would also be prudent to discuss the need for functional assessments (ORWAP and SFAM) with permitting agencies.

3.3 SUMMARY OF HYDROLOGIC ANALYSES CONDUCTED, INCLUDING DATA SOURCES AND PERIOD OF RECORD INCLUDING A LIST OF DESIGN DISCHARGE (Q) AND RETURN INTERVAL (RI) FOR EACH DESIGN ELEMENT (30%).

The Wallowa River drains the northern Wallowa Mountains in northeast Oregon. In the broader context of the watershed, the project reach is located downstream of Hurricane Creek and just upstream of the Lostine River confluence. The watershed contributing to the project reach is 276 square miles (mi^2), with a mean annual precipitation of 27.7 inches (over the watershed area) and a mean and maximum elevations of 5,300 and 9,800 feet (USGS Streamstats). From 1995-2009, the USGS operated a gage just upstream of the site named Wallowa River upstream of Cross Country Canal (13329770). A subset of the mean daily flow record at that station is shown in Figure 15. The Oregon Water Resources Department has since operated a gage (13329765) at a similar location (https://apps.wrd.state.or.us/apps/sw/hydro_report/gage_data_request.aspx?station_nbr=13329765).

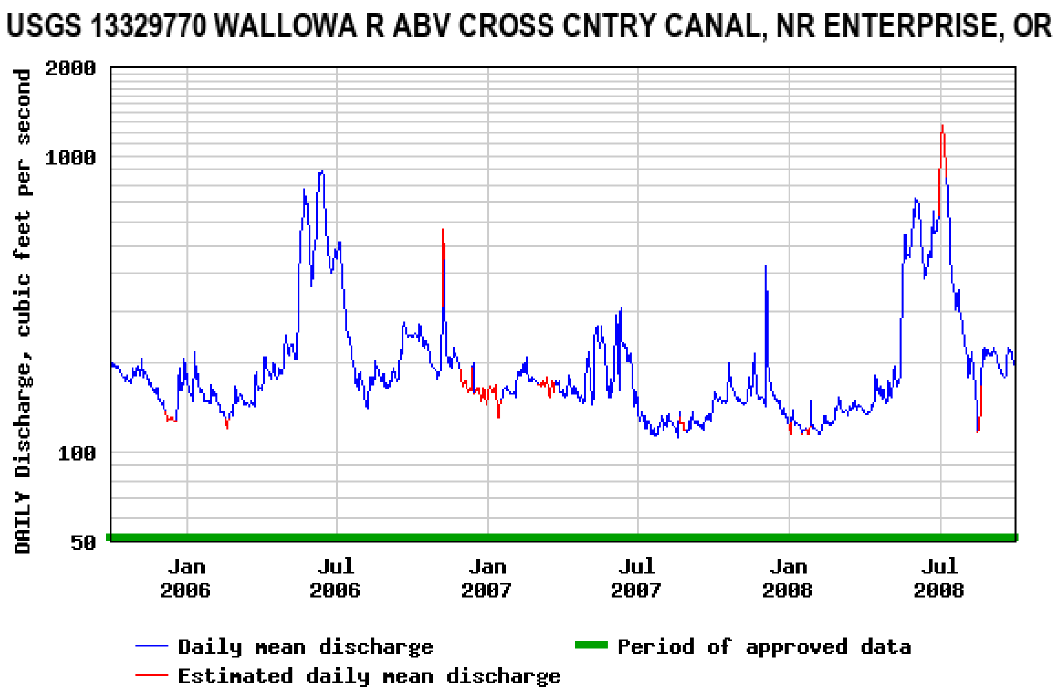


Figure 15 Mean daily flow record a USGS gage just upstream of the site.

Major influences on flow regime at the site include Wallowa Lake management, snowmelt, and irrigation. Comparison with the Lostine River helps to inform some of the influences from irrigation and lake/reservoir management (see Figure 16). In general, this comparison shows the elevated late summer flows from irrigation and the relatively small peak flows in the Wallowa River (especially when considering the drainage area of the Lostine River gage has about 25% the drainage area of the Wallowa River gage shown).

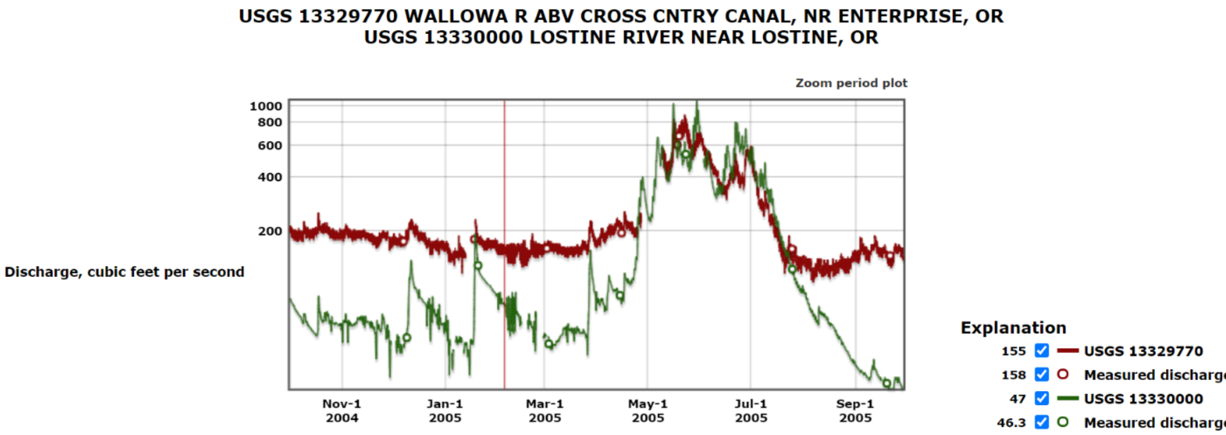


Figure 16 Comparison of mean daily flows recorded on the Wallowa and Lostine Rivers in 2005. The respective drainage areas at these two gages are 272 and 71 mi^2.

Daily flow data was collected from USGS site 13329770 Wallowa River above Cross Country Canal near Enterprise, Oregon from 1995 to 2009 to calculate flow exceedance (Table 2). Peak flows were taken from the Wallowa River McDaniel Habitat Enhancement Project Peak FQ Bulletin 17C analysis that used the same USGS site (Table 3) (TetraTech).

Table 2 Flow exceedance calculations from USGS Site 13329770; date range from 1995 to 2009.

	Month												
% of Time Exceeded	10	11	12	1	2	3	4	5	6	7	8	9	Annual
1%	322	374	443	300	436	393	491	926	1041	1140	437	535	912
5%	301	299	349	248	274	287	356	776	930	924	350	338	605
25%	223	212	194	192	200	218	230	462	661	411	250	258	262
50%	197	188	170	171	165	175	192	286	464	268	193	217	197
75%	183	170	155	150	146	155	172	221	349	177	145	173	165
95%	149	150	130	124	126	139	145	159	178	129	117	108	131
99%	121	144	120	116	116	136	135	120	142	115	109	103	115

Table 3 Peak flows from the McDaniel Habitat Enhancement Project developed from the 13329770 gage.

Annual Chance Exceedance, yr	Recurrence Interval, yr	Discharge, cfs
95%	1.05	470
66%	1.5	780
50%	2	930
20%	5	1,280
10%	10	1,510
4%	25	1,790
2%	50	2,000
1%	100	2,200

3.4 SUMMARY OF SEDIMENT SUPPLY AND TRANSPORT ANALYSES CONDUCTED, INCLUDING DATA SOURCES INCLUDING SEDIMENT SIZE GRADATION USED IN STREAMBED DESIGN.

Refer to Section 2.1 for discussion on sediment supply and transport.

3.5 SUMMARY OF HYDRAULIC MODELING OR ANALYSES CONDUCTED AND OUTCOMES – IMPLICATIONS RELATIVE TO PROPOSED DESIGN.

A two-dimensional (2D) hydraulic model was developed using HEC-RAS version 5.0.7 (USACE, 2019). The model was used to estimate existing hydraulic conditions important for understanding the behavior of the site. The existing conditions model also provides a baseline for proposed conditions modeling documented in subsequent sections. All model runs are quasi-steady flow run for six hours with one hour of ramp up.

3.5.1 MODEL GEOMETRY AND BOUNDARY CONDITIONS

The model geometry for Wilson-Haun includes the following:

- A single 2D mesh area:
    - Nominal floodplain grid size set to 50 feet,
    - Three in-channel refinement regions with grid sizes between 4 and 8 feet,
- An upstream flow hydrograph boundary condition spanning the bankfull channel along the mesh interface immediately downstream of School Flat Road bridge (flows modeled shown in Table 4),
- A downstream normal depth boundary condition spanning the floodplain along the mesh interface,
- Roughness values summarized in Table 5,
- A composite surface including:
    - 2020 topobathymetric LiDAR (GRMW 2020), and
    - 2009 LiDAR (BOR 2009).

Table 4 Summary of modeled flows used for upstream flow hydrograph.

Flow	CFS	Notes
95% exceedance	131	--
25% exceedance	262	Low-flow activation target
5% exceedance	605	High-flow activation target
2-year	929	--
5-year	1279	--
10-year	1507	--
25-year	1789	--
100-year	2200	Modeled for no-rise

Table 5 Summary of Manning's n roughness coefficients used for HEC RAS model.

Regions	Manning's Roughness Coefficient
Channel	0.03
Channel Fill	0.06
Floodplain – Sparse Herbaceous	0.05
Floodplain – Dense Wetland Vegetation	0.06
Floodplain – Dense Woodland	0.08
Wood Habitat Structure and Low-Tech Structures	0.10

Floodplain hydraulic roughness is set to 0.05 based on published guidelines (NRCS, 2016) and professional judgement. Roughness increases relative to base floodplain roughness (Sparse Herbaceous) of 0.01 and 0.03 are used for areas of denser vegetation. In comparison to the 30% design model more floodplain area is considered as dense vegetation after a June site visit, especially the right bank side channels. In-channel hydraulic roughness was set to 0.03 based on calibration using surveyed high-water marks. For estimating roughness increases we used the Cowan equation (shown below), where n_b is the base roughness, and n_1, n_2, n_3 , and n_4 are corrections for surface irregularity, changes in cross section geometry, obstructions such as LWD, and vegetation, respectively (USGS 1989). For the channel fill area, we assume the manning's n value would be equal to the existing conditions value plus an adjustment to the n_3 correction factor to account for the LWD in this segment.

$$n = (n_b + n_1 + n_2 + n_3 + n_4)m$$

The elevation data is a composite surface using 2009 LiDAR for the floodplain and 2020 blue-green topobathymetric LiDAR for the active channel area. The 2009 LiDAR was used in lieu of the more recent LiDAR in the floodplain because the 2009 LiDAR more closely matched the elevations of surveyed points within the floodplain. The mean residual between the surveyed points and 2009 LiDAR surface was -0.476 feet (-0.65 feet following additional data collection in June 2001), while the mean residual for the 2020 LiDAR was -0.953 feet. This discrepancy is thought to be due to the dense reed canary grass present at the site. The composite surface best represents the true elevation of the floodplain and the current conditions in the active channel area.

The model was calibrated to a set of surveyed high water marks that were collected using an RTK-enabled GPS unit. In-channel hydraulic roughness was initially set to 0.043 to match the listed Manning's n value for the nearby, and hydraulically similar, Upper Grand Ronde River. Using a calibration run of 696 cfs, based on the peak instantaneous flow prior to the site visit, modeled water surface elevations were compared to the surveyed high-water marks. Adjusting the in-channel Manning's n value down to 0.03 kept the hydraulic roughness within a reasonable range and brought the mean residual of surveyed high water marks and modeled water surface elevations down to -0.60 feet. The remaining residual is possibly due to (1) the level of accuracy of the GPS unit and (2) the topobathymetric LiDAR not capturing the true conveyance of the channel. The higher modeled water surface elevations indicate that the model is making conservative estimates of water surface elevations for flood flows.

Compared to the 30% design model, the 80% design model has overall higher roughness in the floodplain, a finer in-channel mesh (8-foot cells instead of 10-foot cells), and double the run time (6 hours instead of 3 hours). The in-channel mesh was refined to better capture wood-related roughness increases incorporated into the proposed conditions geometry, which are relatively small areas. The only channel fill area in the proposed conditions to have increased roughness is the largest, downstream-most channel fill area that spans the entire channel and will have a large quantity of incorporated wood. All other channel fill areas are represented by terrain edits only without changing the roughness. The limit to how fine the cells in the in-channel mesh could be made was set by model run time, as anything below 8-feet led to run times greater than 15-20 minutes.

The proposed conditions elevation data is a composite of the existing conditions geometry file with terrain modifications related to proposed floodplain and channel grading activities generated in Autodesk Civil 3D. Wood structures are incorporated into the proposed conditions geometry as increased roughness regions. Equivalent Manning's roughness values for channel and floodplain were used in existing conditions and proposed conditions models.

3.5.2 MODEL RESULTS

In addition to the water surface profiles and results maps shown in this section, modeling results maps are provided in Appendix 3. Figure 17 shows the extent of the model and difference between 100-year existing and proposed conditions inundation extents.

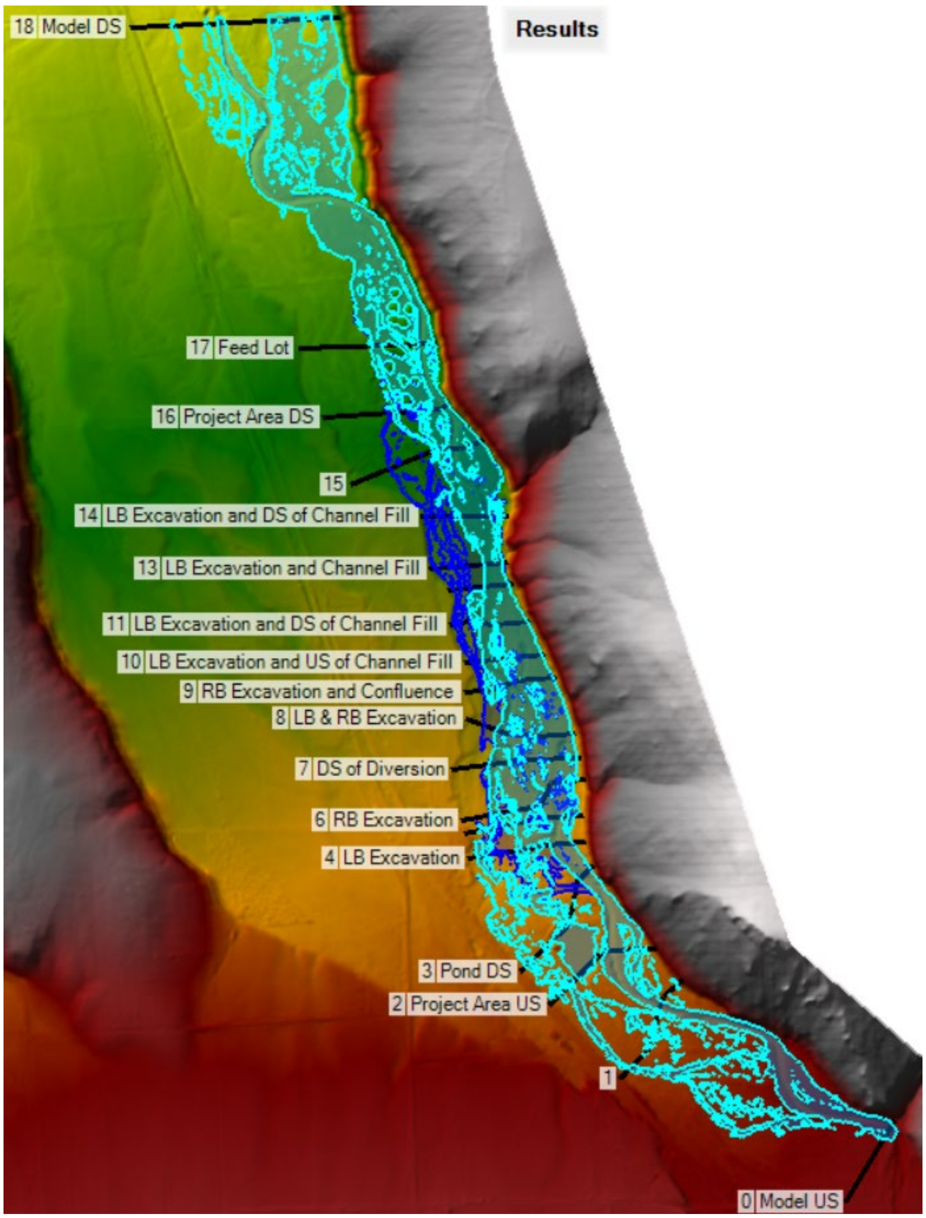


Figure 17: Overview of the model extents that shows the 100-year flow extents under existing conditions (light blue) and proposed conditions (dark blue). Cross-sections used for analysis are included.

Results indicate a significant increase in floodplain inundation at all modeled flows (Figure 18). Under existing conditions, until higher flows are reached (~10-year flow), floodplain inundation was predominantly limited to the right floodplain except for some small areas on the left. Under proposed conditions, modeling indicates significant increases to floodplain connectivity at all modeled flows compared to existing conditions. Under proposed conditions, overbank flow is observed at the 25% annual exceedance flow (262 cfs), significant inundation to the right and left bank floodplains by the 5% (605 cfs) annual exceedance flow, and near complete coverage within and beyond the proposed floodplain grading areas by the 10-year flow (1,510 cfs). The model shows leakage in the floodplain for overbank flows, but mostly through side channels in the floodplain. Because of the dense vegetation at the site the LiDAR terrain may not be capturing the full conveyance capacity of these flow paths, so the leakage is retained in the model rather than refining the grid resolution or adding breaklines.

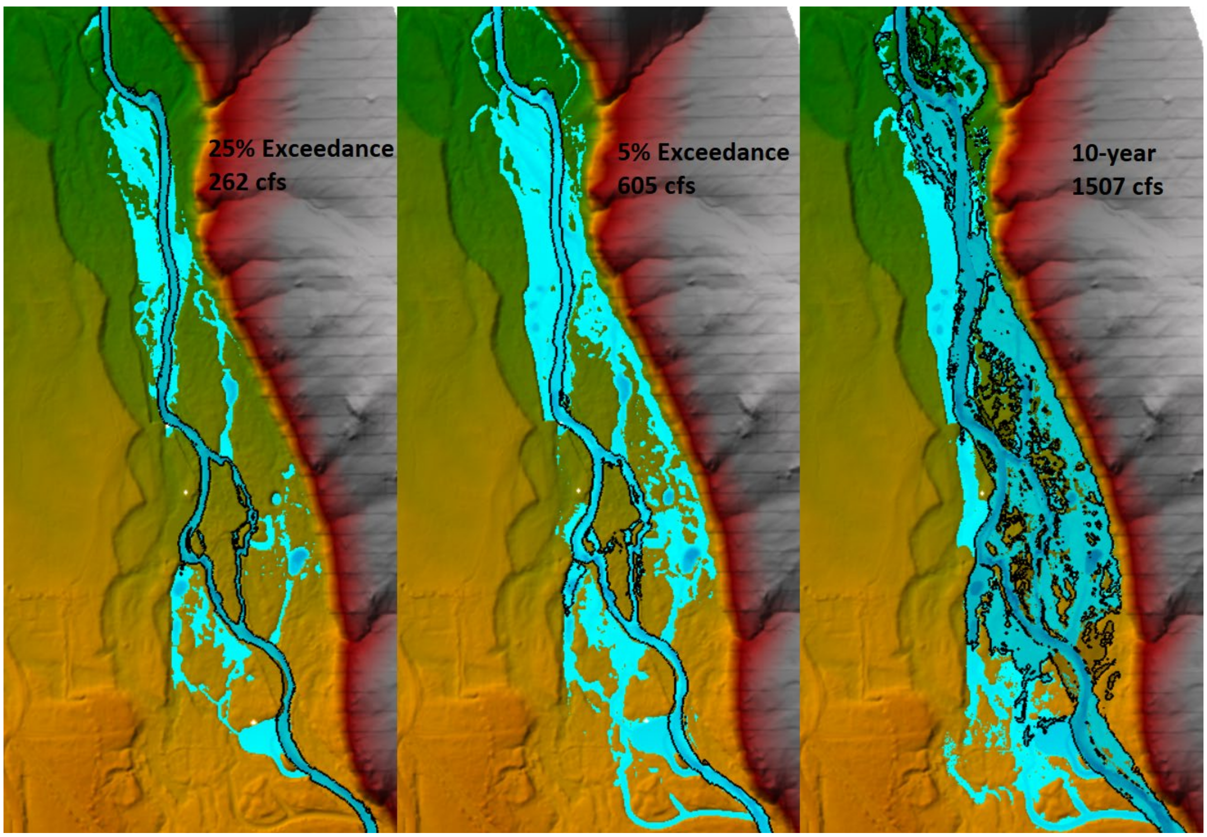


Figure 18: Comparison of existing and proposed conditions for various modeled flows. Existing conditions extents are outlined in black and proposed conditions extent is shown in light blue.

Compared to the 30% design, 80% model results indicate floodplain inundation is greater overall, likely due to the more aggressive grading and channel fill in the downstream reach. While the effects of the downstream-most channel fill area are compounded by both increasing in-channel roughness and raising the terrain (channel fill), there is a large amount of in-channel wood placed within this reach to warrant increasing the roughness along with the terrain edits.

The map results (inundation and velocity) of the proposed conditions modeling are available in Appendix 3. Appendix 3 also contains the water surface elevations (WSE) for various flood flows at multiple cross-sections used for the flood analysis. Under the proposed conditions there is no change in the 100-year WSE at the upstream and downstream extents of the model (Figure 18). At the downstream project boundary, the proposed conditions 100-year WSE is 0.04 feet below the existing conditions WSE in-channel (Figure 19). At the upstream project boundary, there is no rise in the 100-year WSE, and the proposed conditions 100-year WSE is 0-0.02 feet below the existing conditions 100-year WSE.

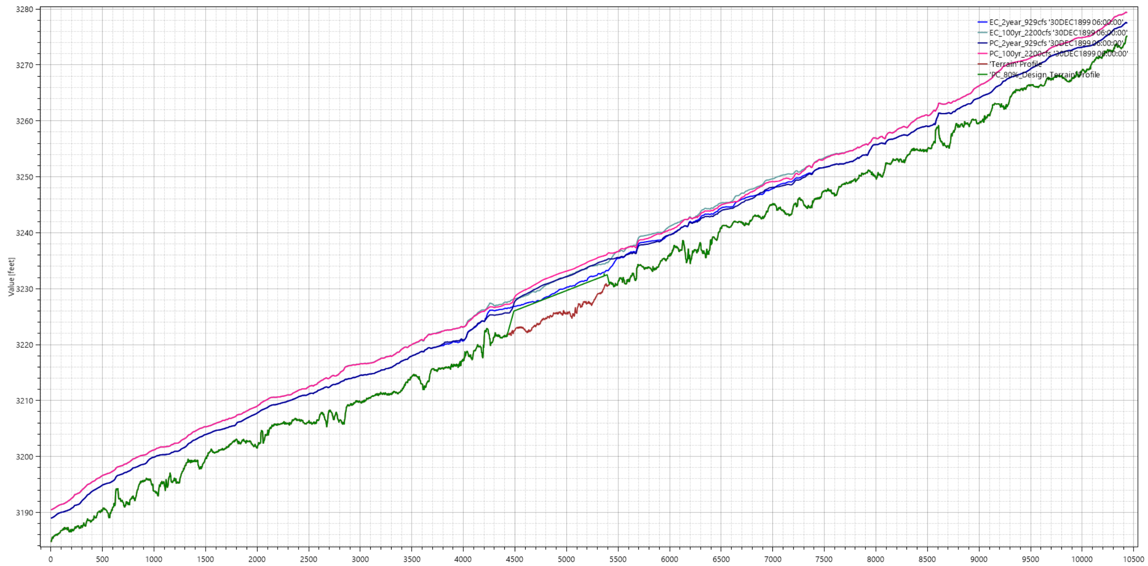


Figure 19: Modeled water surface profiles of the 2- and 100-year flows. Project boundary extends from Station 3575 to 7450.

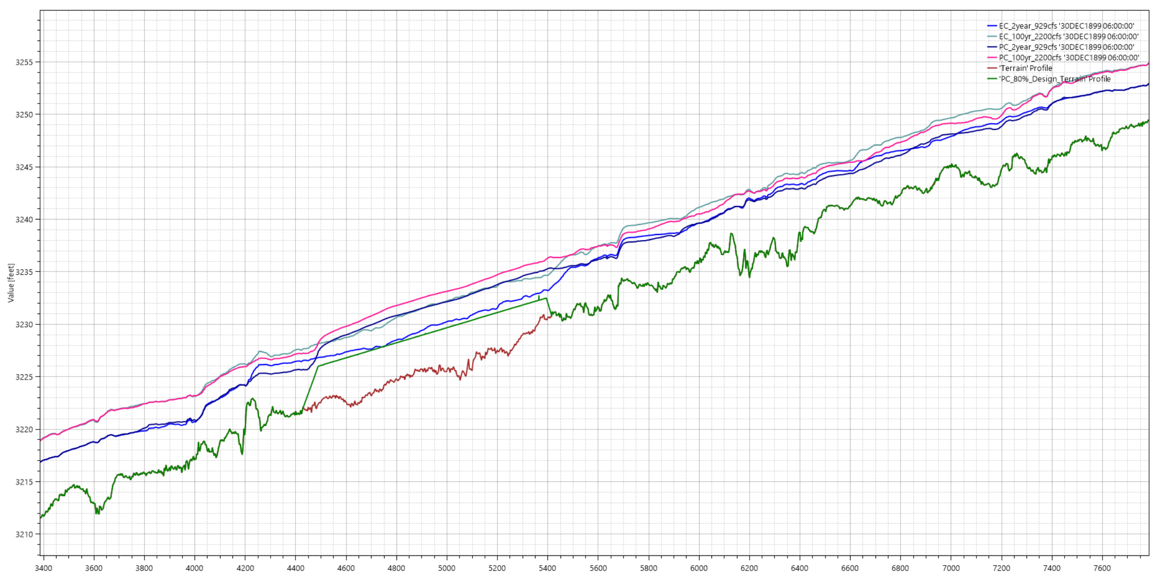


Figure 20. Modeled water surface profiles of the 2- and 100-year flows through the project reach.

Modeled water surface elevations within the project area are typically higher in floodplain areas under proposed conditions as compared to existing conditions. Conversely, modeled water surface elevations are typically lower in the channel under proposed conditions as compared to existing conditions. The low-lying wetlands near the on-site shed experience a 1-foot increase in the 100-year WSE between existing and proposed conditions. Under proposed conditions the inundation extent on the shed's graded pad increases and the maximum depth increases from 0.28 feet to 0.48 feet. At the downstream end of the property, although the in-channel 100-year WSE shows no rise there is a 0.1 foot rise in the left-bank floodplain (Figure 20) currently utilized as a feed lot. Subsequent analysis including running the model with the channel fill terrain edits but without increased roughness and running the model with an additional cut channel to capture the left bank flow before it can enter the feed lot will be completed before the final design to address this downstream rise in WSE.

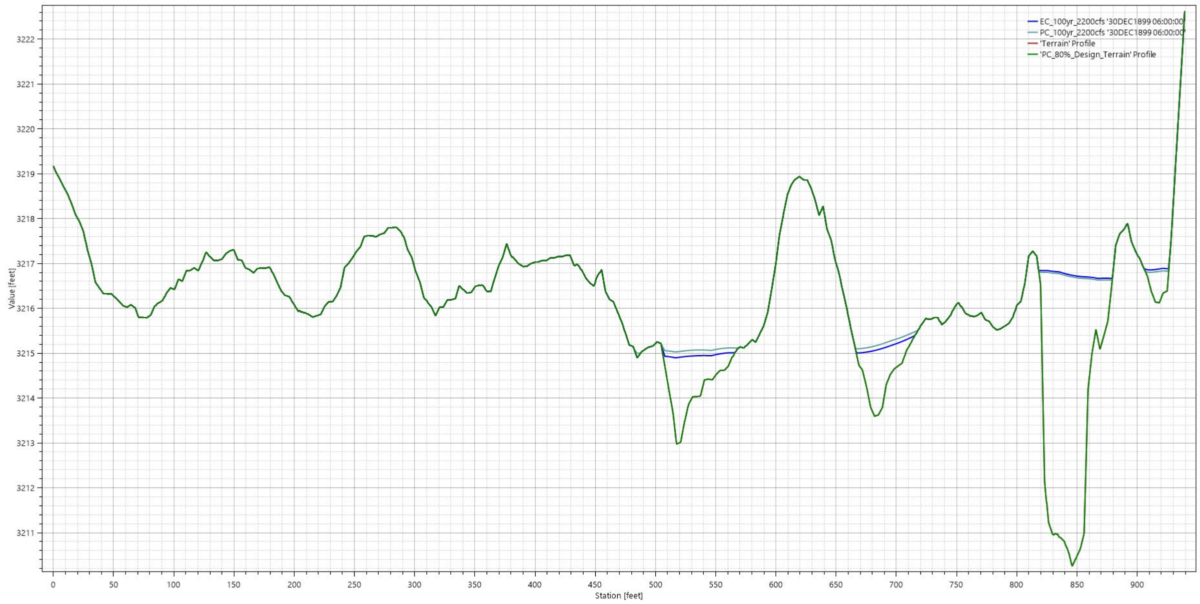


Figure 21: Model cross-section #17 immediately downstream of the project. See Figure 18 for location of cross-section #17.

3.6 STABILITY ANALYSES AND COMPUTATIONS FOR PROJECT ELEMENTS, AND COMPREHENSIVE PROJECT PLAN.

3.6.1 PRELIMINARY RISK ASSESSMENT [30%]

The project team assessed reach scale user and property risk using Bureau of Reclamation's Risk Assessment methods (2014), which provides recommendations on safety factors and design floods for stability.

The project team performed a preliminary reach-scale risk assessment following the guidance outlined in the Large Woody Material (LWM) Risk-Based Design Guidelines (Reclamation 2014). This evaluation includes assessing Public Safety Risks and Property Damage Risks associated with the placement of LWM in the project reach. Direct outcomes of this risk assessment approach include recommendations on log-jam design, safety factors for stability, and design floods. The risk assessment made use of general information, professional judgement, and information about reach user characteristics provided by the landowner, the Wilson Family.

3.6.1.1 PUBLIC SAFETY RISK MATRIX

The Public Safety Risk matrix plots two major categories: the structure characteristics of each LWM structure versus the user characteristics for the project area (Reclamation 2014). Each category has several factors that are associated with the risk of that characteristic summarized below. The project design team assigned each factor a rating from 0 to 10, which represent low to high levels of public safety risk. For each category, the rating assigned to each factor is summed and then averaged. The average for each category is plotted on the matrix to determine the overall risk to the public of the LWM structure (Figure 21).

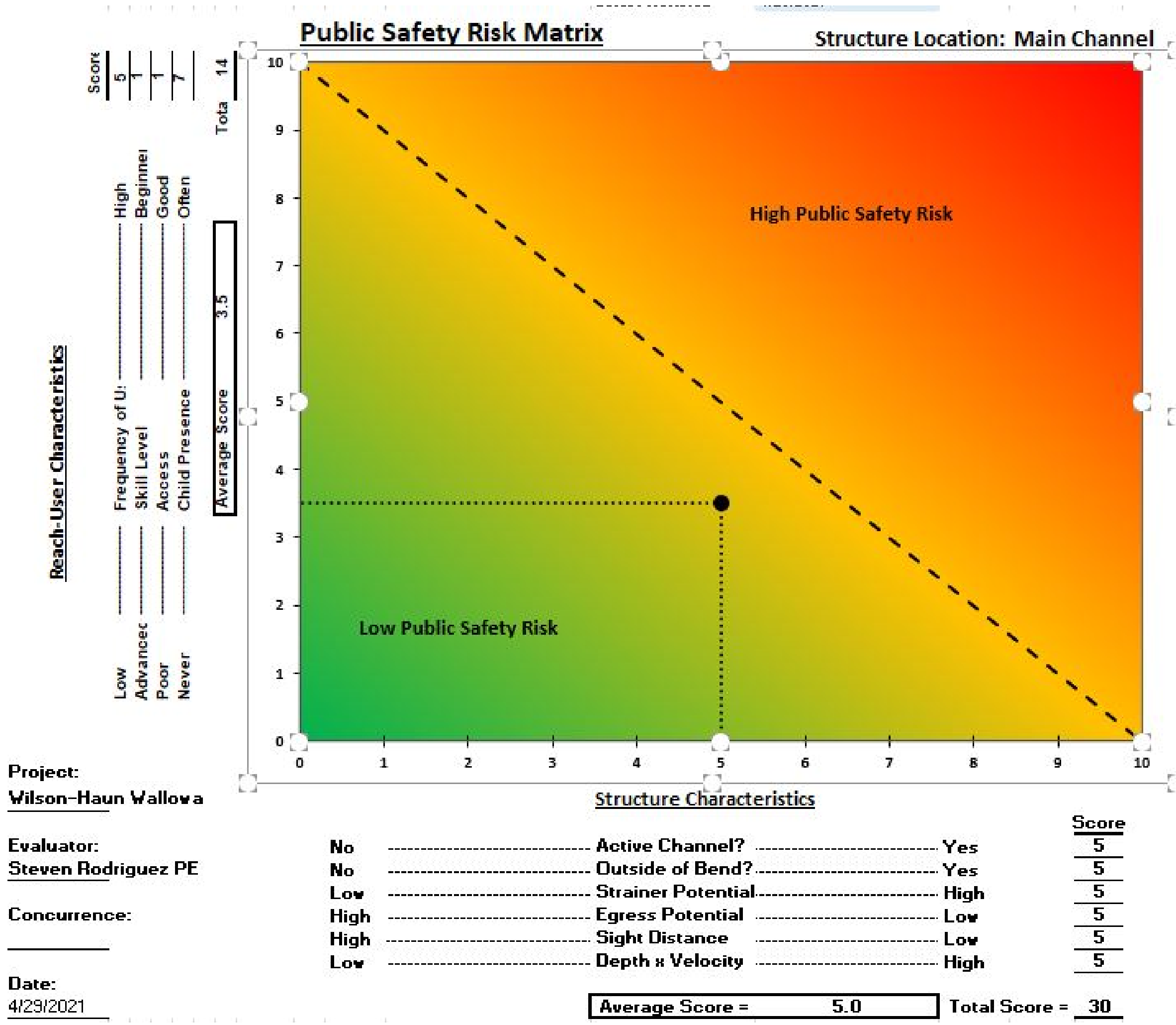


Figure 22 Public Safety Risk Matrix (Reclamation 2014).

Reach User-Characteristics

The reach user-characteristics are plotted on the Y-axis of Figure 21 and include the following four factors for developing an average categorical risk:

- Frequency of use – This factor rates the level of use that can be expected in the project area by floating, swimming, or other in-river activities. A reach of river that is frequently used by the public would have a higher rating.
- Skill Level – This factor rates the level of skill and knowledge of the river reach that is anticipated by the recreationists using the system. A reach that is frequently used by individuals with proper safety equipment and training would receive a lower risk rating than one that is frequented by low-skilled inner-tube recreationists.
- Access – This factor rates the risk of public safety related to accessibility to the project reach—specifically, LWM structures. The easier the access, the higher the risk.
- Child Presence – This factor rates the risk of the project reach for the presence of children, who are prone to investigating or climbing on LWM structures. A reach that that has easy access for children, or is near children camps or parks, has a higher risk.

The rating evaluation for the reach-user characteristics are summarized in Table 5.

Table 6 Reach-User Characteristic Ratings.

Reach-User Characteristics	Rating	Notes
Frequency of Use	5	The river is used regularly for recreation by the landowners for such activities as fishing, and in some locations floating. The project reach is only accessible through private property, which limits the use by individuals other than family members.
Skill Level	1	Use of the river along this reach is by property owners who have indicated a high level of skill in their recreation activities.
Access	1	The reach is on private property, significantly limiting access.
Child Presence	7	The property owner has a child and has indicated other children visit the site. The site being located on private property limits the potential presence for children others than those associated with the family.
Average	**3.5**	**Low overall use and suitability as a floatable river make public safety risk low.**

Structure Characteristics

The structure characteristics include the following six factors for developing an average categorical risk:

- Active Channel – This factor rates the uncertainty of physical channel migration. The magnitude of risk is higher in anticipation of dynamic channel movement.
- Outside of bend – This factor rates the location of the LWM structure design inside or outside of a bend. A person is more likely to be forced into a structure on the outside of a bend; therefore, a higher risk rating is associated with a structure located on the outside of a bend.
- Strainer potential – This factor rates the potential for a structure to pin or entrap a person. The more voids or protrusions a structure has, the higher the risk of entrapping an individual.
- Egress potential – This factor rates the ease of avoiding the LWM structure by floating or swimming around the structure. Structures that protrude into the channel or cause the recreationist to be pushed into deep, quick stream currents have higher ratings.
- Sight distance – This factor rates the ability for recreationist to see the structure from upstream and have enough time to divert away from the structure. Length of approach, slope, width, and stream velocity should all be considered when analyzing risk for this factor. An LWM structure located downstream of a bend in a narrow channel would have a higher risk rating.
- Depth x velocity – This factor rates channel approach velocity and depth to assess the safety of standing and moving, or walking away and around, the structure. A lower rating is applied to stream systems with lower depths and velocities where recreationists can easily avoid a structure.

At this design stage, LWM structure-specific risks were not assessed and all scores were assumed to be 5.

Based on the above, the overall public safety risk category is ranked as low (Figure 21). Structure-specific scoring in future design phases may reveal specific structures with differing risk categories.

3.6.1.2 PROPERTY DAMAGE RISK MATRIX

The Property Damage Risk matrix evaluates property damage risk potential for all structures within a project reach by weighing the property/project characteristics and stream potential against each other factors (Reclamation 2014). A rating of 0 to 10 is assigned to each of the factors associated with the two property damage risk categories. The average for each category is then plotted on the property damage matrix to determine the overall risk of the LWM structure (Figure 22).

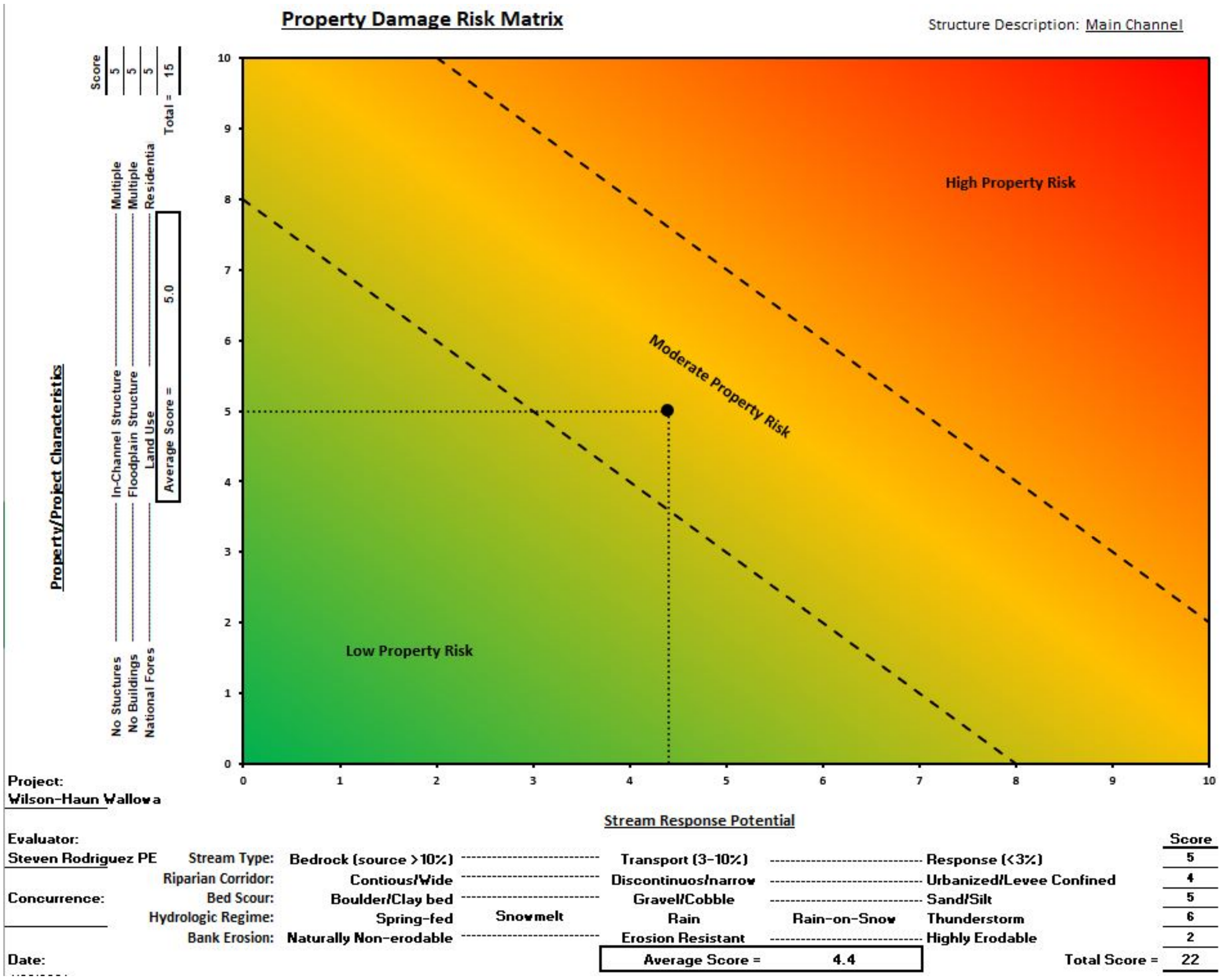


Figure 23 Property Damage Risk Matrix (Reclamation 2014).

Stream Response Potential

The property/project characteristics are plotted on the X-axis of Figure 22, and include the following five factors for developing an average categorical risk:

- Stream type – This factor rates the stream's sensitivity to change based on the stream type and slope within a project reach. A project located in a response reach within an alluvial channel may have high sensitivity and receive a high stream type rating.
- Riparian corridor – This factor rates the project reach's ability to absorb disturbances through natural riparian resiliency without causing harm to habitat or property. A project located in a reach with a wide riparian corridor would be rated low compared to a stream with a relatively narrow riparian corridor.
- Bed scour potential – This factor rates the project reach's physical susceptibility to bed changes based on channel material composition. Streams with highly erodible material such as sand or loose gravel may be susceptible to great disturbance and therefore have a higher rating.
- Bank erosion potential – This factor rates the project reach's physical susceptibility to bank erosion based on bank material composition. Channels with banks composed of highly erodible material such as sand or loose gravel are associated with a higher risk rating.

- Dominant Hydrologic Regime – This factor rates the stream's temporal hydrologic variability. Stream systems with evidence of high variability in their hydrograph have a much greater potential for system response and hence a relatively lower channel stability. Higher hydrograph variability equates to higher risk potential.

The evaluation of the five stream response factors for the project reach is provided in Table 6 with notes describing the rational for each rating.

Table 7 Stream response potential ratings

Stream Response Potential	Rating	Notes
Stream Type	5	The reach is an alluvial channel with a relatively low gradient (0.27%). Although the reach is considered a response reach, it has many characteristics of a transport reach and so it has a moderate sensitivity to change, in large part due to the moderated flow and sediment regime caused by Wallowa Lake upstream
Riparian Corridor	4	Existing riparian corridor is somewhat discontinuous, but wide through the project reach. Post-project conditions should have increased width and density of riparian corridor, which should increase overall resilience. Additionally, reed canary grass appears to have a stabilizing effect on fluvial processes
Bed Scour Potential	5	The reach is dominated by cobble-sized sediment (although bars are finer) and exhibits significant armoring. While historic incision has occurred, it is less active now, with widening being a more dominant process. Thus, the stream appears more likely to be in a recovery phase of stream evolution cycles.
Bank Erosion Potential	6	Bank erosion processes are active but slow. Historical aerials indicate relatively slow rates of channel migration and bank erosion. This appears to be a function, again, of limited sediment supply from upstream and a regulated flow regime. The bank erosion that does occur appears to happen in relatively large floods. Because the design intends to induce bank erosion, the rating is elevated slightly over existing conditions
Dominant Hydrologic Regime	2	The hydrologic regime is influenced by the regulated Wallowa Lake. The watershed also has a natural snow-melt regime. Together these characteristics lead to a flow regime with low flashiness and relatively small peak flows for the watershed area.
Average	**4.4**	**The average stream response potential risk is low to moderate.**

Property/Project Characteristics

The property/project characteristics are plotted on the Y-axis of Figure 22, and include the following three factors for developing an average categorical risk:

- In-channel structures – This factor rates the risk of LWM based on the proximity and vulnerability of in channel structures such as bridges, piers, docks, pumps, fish screens, and other features in the channel.
- Floodplain structures – This factor weighs the vulnerability and type of structures within the 100-year floodplain. Projects that have multiple structures within the 100-year floodplain may be rated high.
- Land use – This factor is used to determine the damage potential based on land use. Natural land uses may receive a lower rating than farmland or rural residence based on the judgement of the design team.

The evaluation of the three property/project characteristic factors is provided in Table 7 with notes describing the rational for each rating.

Plotting of average scores on Figure 22 reveals a moderate property risk category.

Table 8 Property/Project Characteristics

Property/Project Characteristics	Rating	Notes
In-Channel Structures	5	Near the lower end of the project reach, there is a segment of the left bank reinforced with riprap. Downstream of the project reach are both private and public bridges.
Floodplain Structures	5	The properties in the project area and neighboring are large (ranches), resulting in low density of residences/structures in the floodplain. Within the project reach, there is auxiliary residence on the margin of the active floodplain. Downstream of the project, the neighboring property has a residence and a feed lot with non-living structures in the floodplain.
Land Use	5	The project and neighboring properties are private ranches with residences and land used for farming/agriculture.
Average	**5**	**The average property risk is low.**

3.6.1.3 RISK-BASED LWM DESIGN RECOMMENDATIONS

The identified low categories of public safety and property risks have associated recommendations of design flood and factor of safety (FOS) listed in Table 8.

Table 9 LWM risk-based design recommendations (Reclamation, 2014). Yellow highlighting calls-out the project reach.

Public Safety Risk	Property Damage Risk	Stability Design Flow Criteria	FOS Sliding	FOS Buoyancy	FOS Rotation & Overturning
High	High	100-year	1.75	2.0	1.75
High	Moderate	50-year	1.5	1.75	1.5
High	Low	25-year	1.5	1.75	1.5
Low	High	100-year	1.75	2.0	1.75
Low	Moderate	25-year	1.5	1.75	1.5
Low	Low	10-year	1.25	1.5	1.25

3.6.2 LWD STABILITY CALCULATIONS [80%]

Large Woody Material (LWM) (Log Jams) stability calculations were performed for all LWM and are included in Appendix 8. A risk assessment for the project reach was performed at the previous design phase, where design factors of safety (FOS) were determined for the different stability criteria. The stability design criteria are based on low public safety risk and moderate property damage risk, which corresponds to the 25-year flow event. All jams meet or exceed the target FOS of 1.5-1.75 for sliding, buoyancy, and rotation & overturning according to BOR LWD Risk Guidelines (see Table 8). There is one large apex jam proposed in the design. That jam poses a high property damage risk rating because of its size and proximity to the downstream end. A 100-year flow event was used to determine the factors of safety, which is 2 for buoyancy and 1.75 for all other categories. The small wood and single log floodplain placements are intended to have localized mobility on the floodplain and in the reach but are expected to move relatively short distances and be retained within the project area.

Furthermore, more complex LWM Jams gain additional stability from factors that are not typically considered in log stability calculations. In mid-size streams it has been documented that the length of logs as well as their arrangement (perpendicular vs. parallel to flow) are stronger predictors of stability than diameter. By using key logs longer than the bankfull width and bracing against the existing vegetation, the chance of mobility is significantly reduced (Kramer and Wohl, 2017). Therefore, in the event logs are floated, they are likely to remain stable and continue to collect additional debris.

As mentioned previously, there is a large apex jam proposed at the downstream end of the property. This jam poses the most property damage risk and is about ¼ mile upstream of a shallow bridge. Although the jam is designed to withstand the 100-year event, there are always uncertainties in these risk assessment calculations and the impact of structures becoming mobile must be understood. Additional risk to the downstream property is indicated by the HEC-RAS 2D model. The proposed conditions model showed that there is little to no increased inundation downstream of the project site for the 25-year event. However, the 100-year event shows a slight increase in inundation extents with proposed grading and LWD.

Safety Factors		**Minimum Recommended Safety Factor**	**Calculated Safety Factor**			
			Large Apex	**Small Apex**	**Margin Deflector**	**Channel Spanner**
Buoyancy	FOS_b	1.75 (2, Large Apex)	2.91	2.33	2.23	3.2
Sliding	$FOS_{sliding}$	1.5 (1.75, Large Apex)	3.9	2.43	6.75	5.08
Rotation	$FOS_{rotation}$	1.5 (1.75, Large Apex)	1.82	3.49	2.65	2.1
Overturn	FOS_{OT}	1.5 (1.75, Large Apex)	2.16	1.63	10.43	3.17

3.6.3 SCOUR ANALYSIS [80%]

Scour calculations were performed on the Margin Deflector, Small and Large Apex and Channel Spanner Jams and are included in Appendix 8. For margin jams, the Karaki and Richardson equation was used to estimate local scour. For mid-channel structures (Apex and Channel Spanner), the HEC-18 pier scour equation was utilized. Utilizing hydraulic output data with these equations, worst case scenario potential scour depths were 6.3 feet for the margin deflector structures, and the worst-case scenario for mid-channel structures was 5.7 feet. With the exception of the large apex structure at the downstream end of the project, the proposed LWM structure pose a low to moderate risk to structures and property. The potentially increased aquatic habitat associated with scour (a 3-4 foot excavated scour pool is incorporated in the structure designs) is a reasonable offset to risk of failure associated with scour. The stability analyses consider the depth of scour when specifying pier log depths, and log burial depths and embedment lengths incorporate the assumption of erosion of material. Furthermore, more complex LWM Jams such as the proposed channel spanner jam gain additional stability from factors that are not typically considered in log stability calculations. The stability of key members (which are full length trees salvaged in proposed grading areas onsite or imported from nearby source) will rely on their length to brace against existing vegetation on one bank and be embedded in the opposite bank where feasible. In mid-size streams it has been documented that the length of logs as well as their arrangement (perpendicular vs. parallel to flow) are stronger predictors of stability than diameter. By using key logs longer than the bankfull width and bracing against the existing vegetation, the chance of mobility is significantly reduced (Kramer and Wohl, 2017). Therefore, in the event logs are floated, they are likely to remain stable and continue to collect additional debris.

In the case of the large apex at the downstream end of the reach, the potential scour depth is incorporated into the design. Stability calculations take into account potential scour depths, and ballast on keyed logs in the channel is only accounted for below existing grade, assuming any built up ballast behind the rootwads may potentially erode away.

3.7 DESCRIPTION OF HOW PRECEDING TECHNICAL ANALYSIS HAS BEEN INCORPORATED INTO AND INTEGRATED WITH THE CONSTRUCTION – CONTRACT DOCUMENTATION.

Sections in Chapter 3 include technical analyses associated with the project reach. Data collection of in situ site information included: topographical survey, hydrology analysis and hydraulic modeling.

The collection of survey data combined with LiDAR provides the base map information for the existing terrain utilized for the proposed design and hydraulic modeling.

Hydrologic analysis provides the design team with expected flow regimes for Wallowa River. Expected annual and bank full discharge flows as well as flood events aid design of channel and floodplain design as well as LWM stability analysis.

Hydraulic modeling informs channel and floodplain design with velocities, shears and water surface elevations, critical to optimize flow spreading and floodplain connectivity while minimizing flood impacts to surrounding properties. Additionally, hydraulic model output informs elevations and extents of grading activities, placement and design of LWM structures, and stability analysis.

3.8 FOR PROJECTS THAT ADDRESS PROFILE DISCONTINUITIES (GRADE STABILIZATION, SMALL DAM AND STRUCTURE REMOVALS): A LONGITUDINAL PROFILE OF THE STREAM CHANNEL THALWEG FOR 20 CHANNEL WIDTHS UPSTREAM AND DOWNSTREAM OF THE STRUCTURE SHALL BE USED TO DETERMINE THE POTENTIAL FOR CHANNEL DEGRADATION.

This project does not include any actions that address profile discontinuities.

3.9 FOR PROJECTS THAT ADDRESS PROFILE DISCONTINUITIES (GRADE STABILIZATION, SMALL DAM AND STRUCTURE REMOVALS): A MINIMUM OF THREE CROSS-SECTIONS – ONE DOWNSTREAM OF THE STRUCTURE, ONE THROUGH THE RESERVOIR AREA UPSTREAM OF THE STRUCTURE, AND ONE UPSTREAM OF THE RESERVOIR AREA OUTSIDE OF THE INFLUENCE OF THE STRUCTURE) TO CHARACTERIZE THE CHANNEL MORPHOLOGY AND QUANTIFY THE STORED SEDIMENT.

This project does not include any actions that address profile discontinuities.

4.0 CONSTRUCTION – CONTRACT DOCUMENTATION

4.1 INCORPORATION OF HIP GENERAL AND CONSTRUCTION CONSERVATION MEASURES

HIP Construction Conservation Measures are included in the design drawings in Appendix 1.

4.2 DESIGN – CONSTRUCTION PLAN SET INCLUDING BUT NOT LIMITED TO PLAN, PROFILE, SECTION AND DETAIL SHEETS THAT IDENTIFY ALL PROJECT ELEMENTS AND CONSTRUCTION ACTIVITIES OF SUFFICIENT DETAIL TO GOVERN COMPETENT EXECUTION OF PROJECT BIDDING AND IMPLEMENTATION.

The Preliminary Design materials are located in Appendix 1 – 80% Engineering Drawings.

4.3 LIST OF ALL PROPOSED PROJECT MATERIALS AND QUANTITIES.

Material quantities for excavation are estimated in units of bank cubic yards (calculated in place prior to removal). This quantity does not include increases in volume due to “swell” and “loose” factors that are important to contractors when estimating haul and other costs. It is often preferred by contractors for excavation quantities to be specified on a bank cubic yard basis to eliminate discrepancies between the engineer’s and contractor’s estimates of the swell and loose factors.

Table 9, and Appendix 5, includes the 80% estimate and provides an approximation of quantities and total project costs. This table does not include estimated project costs for permitting, design, monitoring, and/or ongoing maintenance. Estimated costs are presented in 2021 dollars and would need to be adjusted to account for price escalation for implementation in future years.

Note that the actual cost of construction may be impacted by the availability of construction equipment and crews and fluctuation of supply prices at the time the work is bid. W2r makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bids or actual costs.

Primary assumptions of the cost estimate include:

- Unit costs – include contractor markup, profit, and overhead;
- Mobilization/demobilization – Assumed to be 10% of all other fixed costs;
- Temporary stream diversion/water management – Assumed to be 10% of all other fixed costs;
- Temporary erosion control – Assumed to be 3% of all other fixed cost;
- Floodplain excavation – excavation costs assume common excavator, bulldozer, scraper and high capacity dump truck equipment;
- Onsite Disposal – the cost estimate assumes that natural material excavated from the floodplain will be used to fill areas in the channel or floodplain;
- Contingencies – 20% construction contingency is included in the total bid estimate to account for future design changes and unforeseen conditions.

Table 10 Estimate of Probable Construction Cost

PROJECT: Wilson-Haun Wallowa River					
80% DESIGN COST ESTIMATE					
DATE: 9/17/2021					
	Costs				
Item	**Qty**	**Unit**	**Unit Cost**	**Total**	**Notes**
MOBILIZATION	1	LS	$ 73,000	$ 73,000	ENGRS ESTIM - 10% OF FIXED COSTS
WATER MGMT, TEMP STREAM DIVERSION & PLAN	1	LS	$ 73,000	$ 73,000	ENGRS ESTIM - 10% OF FIXED COSTS
EROSION & WATER POLLUTION CONTROL	1	LS	$ 22,000	$ 22,000	ENGRS ESTIM - 3% OF FIXED COSTS
CLEARING AND GRUBBING	6	AC	$ 3,500	$ 21,000	INCL GRADING AREAS, LOG SALVAGE, STOCKPILE, PLACEMENT
FLOODPLAIN EXCAVATION	15,700	CY	$ 12	$ 188,400	INCL ONSITE HAUL, PLACEMENT, AND GRADING
WHS TYPE 1 - MARGIN DEFLECTOR JAM	13	EA	$ 5,300	$ 68,900	INCL. LOG PROCURMENT, DELIVERY, PLACEMENT, BALLAST, AND EXCAVATION
WHS TYPE 2 - APEX JAM	16	EA	$ 4,500	$ 72,000	INCL. LOG PROCURMENT, DELIVERY, PLACEMENT, BALLAST, AND EXCAVATION
WHS TYPE 3 - SWEEPER LOG	8	EA	$ 2,000	$ 16,000	INCL. LOG PROCURMENT, DELIVERY, PLACEMENT, BALLAST, AND EXCAVATION
WHS TYPE 4 - FLOODPLAIN WOOD (1 LOG)	18	EA	$ 700	$ 12,600	INCL. LOG PROCURMENT, DELIVERY, PLACEMENT, BALLAST, AND EXCAVATION
WHS TYPE 5 - FLOODPLAIN WOOD (2 LOG)	25	EA	$ 1,300	$ 32,500	INCL. LOG PROCURMENT, DELIVERY, PLACEMENT, BALLAST, AND EXCAVATION
WHS TYPE 6 - CHANNEL SPANNING JAM	2	EA	$ 15,200	$ 30,400	INCL. LOG PROCURMENT, DELIVERY, PLACEMENT, BALLAST, AND EXCAVATION
WHS TYPE 7 - LARGE APEX JAM	1	EA	$ 11,400	$ 11,400	INCL. LOG PROCURMENT, DELIVERY, PLACEMENT, BALLAST, AND EXCAVATION
LOOSE FLOODPLAIN WOOD	85	EA	$ 400	$ 34,000	INCL. LOG PROCURMENT, DELIVERY, AND PLACEMENT
BRUSH TRENCH (10' LENGTH)	30	EA	$ 250	$ 7,500	INCL. WILLOW HARVEST, MATERIALS, EQUIP AND LABOR
BEAVER DAM ANALOGUES	34	EA	$ 1,800	$ 61,200	INCL. MATERIALS, EQUIP AND LABOR
POST ASSISTED LOG STRUCTURES	6	EA	$ 2,400	$ 14,400	INCL. MATERIALS, EQUIP AND LABOR
SEEDING	9.1	AC	$ 3,500	$ 31,850	INCL. MATERIALS, EQUIP AND LABOR
RIPARIAN PLANTING AND FLOODPLAIN RESTORATION	6.8	AC	$ 15,000	$ 102,000	INCL. MATERIALS, EQUIP AND LABOR
UPLAND PLANTING AND FLOODPLAIN RESTORATION	2.3	AC	$ 10,000	$ 23,000	INCL. MATERIALS, EQUIP AND LABOR
ENGINEERING SUPPORT DURING CONSTRUCTION	1	LS	$ 25,000	$ 25,000	ASSUMING CONST STAKING AND 2 WEEKS EQUIVALENT ONSITE SUPPORT
SECTION TOTAL				**$ 920,150**	
Design Contingency			20%	$ 184,030	UNCERTAINTIES
TOTAL CONSTRUCTION COST				**$ 1,105,000**	(ROUNDED UP)

4.4 DESCRIPTION OF BEST MANAGEMENT PRACTICES THAT WILL BE IMPLEMENTED AND IMPLEMENTATION RESOURCE PLANS INCLUDING:

This section will be further developed in the next design phase. The current design includes HIP General Aquatic Conservation measures to follow during and post construction, which includes temporary erosion and sediment control (TESC) measures as well as best management practices (BMP's). Use of erosion control measures such as fiber rolls and silt fencing is anticipated and will aid in addressing the stockpiling and final grading of spoil material and associated storm water runoff from leaving the site. Temporary access routes will assist with runoff and roadway rutting, while erosion control around stockpiles and staging areas assists with runoff and run-on associated with precipitation events. Stabilized construction entrances are anticipated to prevent erosion associated with heavy equipment entering the site and provide an area for washout prior to construction equipment leaving the site.

1. SITE ACCESS STAGING AND SEQUENCING PLAN.

Preliminary access and staging locations are shown in the design drawings provided in Appendix 1. Access routes follow existing roads and avoid sensitive areas such as wetlands to the highest extents possible. Key entrance points to the project site from the roadway are shown based on discussions with the landowner. All staging areas are currently shown outside the ordinary high-water delineation.

Detailed construction sequencing that minimizes potential impacts to wildlife, water quality and habitat is included in the design drawings provided in Appendix 1.

2. WORK AREA ISOLATION AND DEWATERING PLAN.

Removal of water details for temporary bypass of the river or individual wood structure installations are shown in the design drawings in Appendix 1. Details include a step-by-step process and configurations for dewatering and rewatering the river before, during and after bypass. Additional details include bulk bag coffer dam installations and area isolation for large wood structure installations. More information regarding the detailed location for coffer dam locations and dewatering activities are incorporated into the Access, Staging, Water Management & TESC plan Sheet C3.1 in Appendix 1.

3. EROSION AND POLLUTION CONTROL PLAN.

The design drawings in Appendix 1 include HIP General Aquatic Conservation Measures applicable to erosion control, stockpiling, dust abatement, spills, and invasive species control measures. Subsequent design submittals will include the location of specific BMP measures to be incorporated during construction. Specific measures proposed for the project likely include use of erosion control measures such as fiber rolls/wattles and silt fencing to address the stockpiling of spoil material and associated storm water runoff from leaving the site. Sediment barriers such as fiber rolls on fill slopes will assist in controlling erosion and associated storm water runoff. Temporary access routes will assist with runoff and roadway rutting, while erosion control around stockpiles and staging areas assists with runoff and run-on associated with precipitation events. The stabilized construction entrance helps to prevent erosion associated with heavy equipment entering the site and also provides an area for washout prior to construction equipment leaving the site.

4. SITE RECLAMATION AND RESTORATION PLAN.

Sheet C6.1 of the design drawings in Appendix 1 provides the Site Reclamation and Restoration Plan for this project and depicts the areas to receive treatment and lists of plant and seed species to be applied. A more detailed approach is summarized below.

GENERAL APPROACH

The project team will break out the site using buffers along stretches of stream and new side channels/ponds. There will also be specific sites with prescriptions by the site. For example, a proposed 'cut' area at the upstream end of the site will be called 'Site 1.' In this site there will be a specific planting prescription that uses a variety of planting techniques including cluster planting, sod mats, willow clump planting, seeding, and whole shrub/tree planting. There will be several areas in the project area protected from browse to encourage rapid recovery of native vegetation.

ZONE 1: RIPARIAN AREA - TOE ZONE TO TRANSITION ZONE

Zone 1 will be planted with:

- At a 50% rate across the 1 year-465 cfs model output footprint.
- All 'Cut' areas will be planted at a 70% rate across their total acreage
- All existing mainstem and side channel habitats will be planted along their banks (10-foot bank buffer at a 80% rate across the total acreage
- All new channel, and wetted floodplain areas will be treated with 2 rows (1m wide per row, 16-foot long per sod mat) of wetland sod mat consisting of sedge/rush mix.
- All new pond habitats will receive 2 rows (1m wide, 16ft long/ea) of wetland sod mats. The first will consist of bulrushes and the second will consist of sedge/rush communities.
- All sods mats will be grown out to a minimum 75% root mass.
- Several areas will be protected with browse protection.

ZONE 2: TRANSITION ZONE TO UPLAND ZONE

Zone 2 will be planted with

- At a 50% rate across the project area. Focus areas will be fine-tuned before final design.

SEEDING: WHOLE PROJECT FOOTPRINT

The project area will be seeded at a rate of 30lbs seed per acre across the entire project area the first fall following implementation and again at the same rate in the second-year post-implementation. This will include a riparian seed mix for areas closer to the stream (Zone 1) and an upland seed mix for upland areas (Zone 2).

BROWSE PROTECTION: SELECT AREAS

Whitetail deer herbivory is a challenge to the establishment of native vegetation on the property. The project team will enclose several areas with buck n pole style fencing to encourage pockets of vegetation to recover rapidly in site specific locations.

WEED SPRAYING: WHOLE PROJECT FOOTPRINT WITH A FOCUS ON AREAS DISTURBED BY HEAVY EQUIPMENT

The project team is working on a cost estimate and treatment for weed-spraying - 1 and 2 years post project.

5. LIST PROPOSED EQUIPMENT AND FUELS MANAGEMENT PLAN.

The design drawings in Appendix 1 include HIP General Aquatic Conservation Measures applicable to construction equipment and spill prevention, control and counter measures. Section 5 – Equipment of these notes includes conservation measures addressing the use, staging, maintenance and refueling of equipment. Section 9 – Spill, Prevention, Control and Counter Measures of these notes include procedures and precautions for storing, handling any hazardous materials onsite.

4.5 CALENDAR SCHEDULE FOR CONSTRUCTION/IMPLEMENTATION PROCEDURES.

Construction is anticipated to occur in the summer of 2022, with work occurring before during and after the in-water work window of July 15-August 15. Project elements below ordinary high water (OHW) will be carried out during the in-water work window. Project elements in areas above OHW may be completed prior and after the window.

Revegetation of areas disturbed including seeding, staking and planting will occur after the earthwork and habitat structure installations are completed.

4.6 SITE OR PROJECT SPECIFIC MONITORING TO SUPPORT POLLUTION PREVENTION AND/OR ABATEMENT.

This section to be developed at a later design phase.

5.0 MONITORING AND ADAPTIVE MANAGEMENT PLAN

5.1 INTRODUCTION

This section to be developed prior to final design.

5.2 EXISTING MONITORING PROTOCOLS

5.3 PROJECT EFFECTIVENESS MONITORING PLAN

OBJECTIVE 1

OBJECTIVE 2

5.4 PROJECT REVIEW TEAM TRIGGERS

5.5 MONITORING FREQUENCY, TIMING, AND DURATION

BASELINE SURVEY

AS-BUILT SURVEY

MONITORING SITE LAYOUT

POST-BANKFULL EVENT SURVEY

FUTURE SURVEY (RELATED TO FLOW EVENT)

5.6 MONITORING TECHNIQUE PROTOCOLS

PHOTO DOCUMENTATION AND VISUAL INSPECTION

LONGITUDINAL PROFILE

HABITAT SURVEY

CHANNEL AND FLOODPLAIN CROSS-SECTIONS

5.7 DATA STORAGE AND ANALYSIS

5.8 MONITORING QUALITY ASSURANCE PLAN

6.0 References

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APPENDICES

1 80% ENGINEERING DRAWINGS AND SPECIFICATIONS

2 15% (CONCEPT) DESIGN DRAWING AND ALTERNATIVES ANALYSIS MEMORANDUM, 30% DESIGN DRAWINGS

3 HYDRAULIC MODEL OUTPUT

4 WETLANDS M APS

5 80% QUANTITIES AND CONSTRUCTION COST ESTIMATE

6 15% AND 30% HIP REVIEW COMMENTS AND RESPONSES

7 DRAFT LTPBR DESIGN APPROACH

8 DESIGN CALCULATIONS

4. SITE RECLAMATION AND RESTORATION PLAN.

Sheet C6.1 of the design drawings in Appendix 1 provides the Site Reclamation and Restoration Plan for this project and depicts the areas to receive treatment and lists of plant and seed species to be applied. A more detailed approach is summarized below.

GENERAL APPROACH

The project team will break out the site using buffers along stretches of stream and new side channels/ponds. There will also be specific sites with prescriptions by the site. For example, a proposed 'cut' area at the upstream end of the site will be called 'Site 1.' In this site there will be a specific planting prescription that uses a variety of planting techniques including cluster planting, sod mats, willow clump planting, seeding, and whole shrub/tree planting. There will be several areas in the project area protected from browse to encourage rapid recovery of native vegetation.

ZONE 1: RIPARIAN AREA - TOE ZONE TO TRANSITION ZONE

Zone 1 will be planted with:

- At a 50% rate across the 1 year-465 cfs model output footprint.
- All 'Cut' areas will be planted at a 70% rate across their total acreage
- All existing mainstem and side channel habitats will be planted along their banks (10-foot bank buffer at a 80% rate across the total acreage
- All new channel, and wetted floodplain areas will be treated with 2 rows (1m wide per row, 16-foot long per sod mat) of wetland sod mat consisting of sedge/rush mix.
- All new pond habitats will receive 2 rows (1m wide, 16ft long/ea) of wetland sod mats. The first will consist of bulrushes and the second will consist of sedge/rush communities.
- All sods mats will be grown out to a minimum 75% root mass.
- Several areas will be protected with browse protection.

ZONE 2: TRANSITION ZONE TO UPLAND ZONE

Zone 2 will be planted with

- At a 50% rate across the project area. Focus areas will be fine-tuned before final design.

SEEDING: WHOLE PROJECT FOOTPRINT

The project area will be seeded at a rate of 30lbs seed per acre across the entire project area the first fall following implementation and again at the same rate in the second-year post-implementation. This will include a riparian seed mix for areas closer to the stream (Zone 1) and an upland seed mix for upland areas (Zone 2).

BROWSE PROTECTION: SELECT AREAS

Whitetail deer herbivory is a challenge to the establishment of native vegetation on the property. The project team will enclose several areas with buck n pole style fencing to encourage pockets of vegetation to recover rapidly in site specific locations.

WEED SPRAYING: WHOLE PROJECT FOOTPRINT WITH A FOCUS ON AREAS DISTURBED BY HEAVY EQUIPMENT

The project team is working on a cost estimate and treatment for weed-spraying - 1 and 2 years post project.

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