DRAFT

DRAFT Conceptual Design Alternatives Analysis Leavenworth Mill Dam

PREPARED FOR: Chelan County Natural Resource Department
411 Washington St. Suite 201, Wenatchee, WA 98801

PREPARED BY:
Randy Goetz
Parr Excellence
302 W. Steuben Street, #7, Bingen, WA 98605

Mason Lacy, PE
Recreation Engineering & Planning Inc.
485 Arapahoe Ave, Boulder, CO 80302

DATE: March 28, 2022

Table of Contents

Introduction

Chelan County Natural Resource Department (CCNRD) contracted Recreation Engineering & Planning (REP) and Parr Excellence to provide feasibility and concept design services for a possible whitewater park on the Wenatchee River. A feasibility study was undertaken in 2021 investigating six potential sites, documented in the "Wenatchee River Whitewater Park Feasibility Study" dated August 3, 2021. Based on the results of the prioritization matrix analysis in the feasibility study, it was recommended to prioritize the Dryden Dam site and the historic mill dam in Leavenworth.

Site Selection

The Dryden Dam site received the highest prioritization scoring in the feasibility study prioritization matrix. However, this site presents multiple challenges based on current use, the required maintenance of the functionality of the features at the site, and dam owner concerns. The safety risk to recreational use is recognized by all interested parties, and at this time the focus is on addressing these safety concerns rather than developing an enhanced recreational use. The landowners and operators of the dam intend to address safety issues internally.

The potential development of a recreational feature is therefore focused on the Leavenworth Mill Dam (the Leavenworth site). Conceptual design alternatives have been developed and are presented in the following sections to allow a relative comparison and logical selection of a preferred conceptual alternative to collaboratively engage with stakeholders and potentially move into the preliminary design phase. Conceptual plan view sheets are included in Appendix A for Alternatives 1-3.

Conceptual Design Criteria

The following criteria have been developed to guide the conceptual design process and to ensure that project objectives are achieved, and project constraints understood and explicitly addressed. Design criteria are provided below within four sections: River Function, Ecologic Function, Recreational Function, and Engineering/Construction Feasibility. These criteria are presented generally for all work included in the development of a recreational and habitat improvement project at the Leavenworth site.

River Function

Design a project that will be geomorphically resilient given the current and future sediment load, land use, and projected large wood regime. The project will be designed to maintain an equilibrium relationship between hydrology and sediment transport as well as stage-discharge relationships to ensure no negative effects on floodplain inundation, or channel aggradation/degradation. Natural geomorphic character and

process regimes should be maintained through any proposed action. The opportunity exists at the Leavenworth site to return the channel to a more natural condition through the removal of remnant mill dam material including riprap, concrete, and metal. Preference will be given to alternatives that include removal of this material. These concepts are held as a model to guide consideration of current and future attributes including:

- Channel Geometry – Specifically maintain a variable longitudinal profile characterized by riffle-pool sequences and scour driven pool depth maintenance.
- Bed Material – Specifically the prevalence and maintenance of spawning gravels in known spawning locations.
- Channel Stability – Specifically, re-grading areas of the active channel and floodplain to facilitate natural channel and floodplain forming processes that maintain desired conditions over time under existing and projected conditions.

Ecologic Function

Design a project that will maintain existing high-quality habitats in main channel and floodplain environments, and potentially increase abundance of high-quality habitat to benefit native fish species. Hydraulic modeling of any proposed project elements will help determine impacts on up-river migration patterns and designs will incorporate measures to prevent migration interference.

- Juvenile Rearing Habitat - Specifically maintain low velocity areas such as pools, and secondary channels with abundant cover.
- Spawning Habitat – Specifically maintain hydraulic conditions that naturally sort and retain spawning appropriate bed material in existing spawning areas.
- High Flow Refugia – Specifically maintain existing high flow refugia and potentially increase abundance of and access to off-channel habitat such as alcove or floodplain channels.
- In-Channel Habitat – Specifically maintain the amount of high-quality pool habitat and riparian vegetation cover, and variation in cross-section that provides diverse habitat at moderate and intermediate flows, and potentially increase the abundance of high-quality in-stream habitat.

Recreational Function

Design for recreationally functional project conditions that:

- Provide intended use over the range of targeted flow conditions.
- Do not create conflicts with existing recreational river and vehicular traffic.
- Fit within City of Leavenworth river recreation management goals and strategies.
- Improve the relationship between river users and river ecology.

- Create a net benefit to recreational enthusiasts, stakeholders, and native species.
- Improve the overall access and user flow within the entire area.

Engineering/Construction Feasibility

Select installation methods that:

- Minimize negative impacts to target species.
- Minimize negative impacts to intact habitat and vegetation.
- Utilize existing access where possible.
- Are acceptable to project property owners.

Conceptual Alternatives

Design concepts encompass a range of approaches to creating a whitewater feature at the Leavenworth site including: a full channel spanning feature with associated upgrades to access such as parking and trails; a partially spanning feature with access upgrades; and a scaled back feature with a minimized footprint and no access upgrades. A no-action alternative is also included in the range. All of the action alternatives include some degree of habitat improvement associated with the removal of archaic dam infrastructure and additions of habitat features, but the degree of priority focus on creation of recreational opportunity varies amongst alternatives. The desired outcome of the project design includes both significant habitat improvements as well as improved recreation opportunity and management.

Alternative 1 – No Action

In the No-Action alternative, the Leavenworth site would be left in its current state without alteration. The remnant structure of the old mill dam would be left in place, with all current hydraulic and ecologic functionality unaltered, and the current pattern of recreational use would continue as well. There are known issues with current patterns of recreational use in this section of the Wenatchee River including trespass on private property, accumulation of garbage and discarded equipment, parking issues, and disturbance of critical habitat for native fish such as spawning redds upstream of the project location. Management of recreational use of the river will need to be addressed in this area even if a recreational feature is not pursued. CCNRD is currently working with the City of Leavenworth on a river recreation management strategy to address these and other issues.

River Function – Hydraulic and geomorphic characteristics of the river would be unchanged in this alternative. Current sediment transport dynamics and the timing and extent of floodplain connectivity will remain as they are currently functioning.

Ecological Function – The current state of ecological processes will remain as they are at this site. Existing relationships between in-stream and off-channel habitat will remain as they are, current issues regarding damage to stream habitat through recreational use will remain as they are. Legacy ecological alterations resulting from the remnants of the old mill dam will remain in place.

Recreational Function – Patterns of recreational use in and around the site will remain as they are. Some aspects of river use in this area concern groups focused on integrity of stream habitat and ecology as well as trespass on river front properties. There is apparent confusion among large numbers of recreational users as to where appropriate put-in and take-out locations can be found, how to practice leave no trace techniques, and in awareness of stream ecology and the importance of staying away from critical habitat.

Engineering and Construction Feasibility - Under the no action alternative there would be no engineering or construction considerations.

Alternative 2 – Dam Structure Rehabilitation

This alternative proposes partially or fully removing the remnants of the old mill dam that currently extends about 1/3 to 1/2 way across the width of the channel from river left. Material includes large rip rap, broken concrete, treated timber, and metal rebar. This material is present above the low water line, below water, and extends across the floodplain and ties into higher ground on river left forming a longitudinal barrier to floodplain hydrology and habitat. The remnants of the dam constrict flow in the channel shunting flow to the right. A combination of riparian vegetation, bioengineering treatments, and boulders would be used to re-grade and stabilize the channel. It is possible to include a small recreational wave feature into this design that would be functional over a limited range of flows but would have a greatly reduced footprint compared to a partially or fully channel spanning recreational feature. This alternative would also consider a variety of habitat improvement and recreation improvements similar to what is included in Alternative 3. Alternative 2 places priority on river and ecological function improvements, with a secondary focus on adding and improving recreation opportunity in the form of a possible naturalistic wave feature built into the existing boulder base and on-site and trail/parking improvements for river access.

River Function - In terms of the continuum of river function, this alternative would be on a trajectory toward natural functionality and a return to pre-dam conditions at the project site. Channel and floodplain connectivity and floodplain habitat and processes have the potential to benefit from the removal of floodplain riprap and treated timber currently bisecting the river left floodplain.

Ecological Function – This alternative has the potential to benefit ecological processes through the reconnection of processes and habitat both laterally between the channel

and floodplain and longitudinally on the floodplain itself. Off-channel habitat has been identified as a critical limiting factor in the Lower Wenatchee River in past assessments, and the removal of remnant dam material directly addresses the function of off-channel habitat at this location. Considerations would take place during the design to ensure that changes to channel hydraulics would not adversely affect upstream habitat or fish passage through the project area.

Recreational Function – The functionality of the project area in terms of recreational use will be enhanced through removal of potentially dangerous debris from the channel, thereby increasing safety to river users. The potential for a small recreational feature to be incorporated into the design further enhances recreational function.

Engineering and Construction Feasibility – With active construction activity and associated engineering and planning, this alternative adds complexity relative to Alternative 1. In this alternative, there is work in the active channel and the need for access by heavy equipment, staging and stockpiling of materials, disposal of removed material, and associated temporary impacts. However, in-water work would be limited to the dam infrastructure itself and potential habitat additions such as backwater features, etc.

Alternative 3 – Partially Channel Spanning Recreational Feature

This alternative includes partial or full removal of the remnants of the old mill dam and the construction of two recreational features that will be designed to resemble natural boulder drops that will create hydraulic conditions providing a “play wave” in the river that is preferred by kayakers and can also be enjoyed by surfers, stand-up paddle boarders, and tubers. The upper feature would occupy the general footprint of the remnant dam, and the lower feature would be built into the riffle downstream of barn beach with a large pool separating the two features. The existing riffle on river right would remain essentially the same as its current condition but would be re-graded as necessary to function properly with the altered channel geometry and hydraulics of the recreational features while maintaining fish passage. Habitat is considered in the design as well by incorporating both in-channel habitat and off-channel habitat features. Clusters of natural boulders would be placed for stability and hydraulic variability in the channel which is important for fish refugia and can enhance gravel sorting and retention conducive to salmonid spawning. Root wads could be placed along the riverbank on river left to provide cover habitat and to drive localized pool scour. The connectivity of off-channel habitat found in the river left floodplain upstream of the dam remnant material and wood could be added for enhanced habitat quality. The design will consider and plan for improved traffic of river users and could include improved access points, trails, and clear signage to mitigate known issues with river use in this area.

River Function – Alternative 3 would create similar effects to those in Alternative 2 with a full removal of the old mill dam remnants. Artificial flow constriction and floodplain

disconnection could be alleviated. Placed recreational features would control grade and retain the essential hydraulic character of the channel in the project area. High flow effects currently created by the mill dam remnants would most likely be altered, such as the upstream extent of the backwater currently created by the dam remnants. These effects would be similar under Alternative 2.

Ecological Function – Ecological functioning of the project area through the placement of partially spanning recreational features is expected to be similar to Alternative 2. The primary ecologic effects would result from removing floodplain rip-rap, including off-channel habitat enhancement, and addressing impacts from current patterns of recreational use. Additional habitat features would include boulders and root wads placed to provide enhanced habitat while minimizing risks to humans. The placement of the recreational feature itself would be expected to have minimal ecological impact. The design process would investigate potential effects to sediment transport, fish passage, and floodplain connectivity to ensure no negative effects.

Recreational Function – Installing a recreational feature allows for recreation managers to directly address current issues with recreational use of the river in and around the project area. The amount and pattern of traffic, points of entry and exit from the river, river access routes, and impacts to sensitive habitat areas could be more effectively managed through intentional recreational planning in this area of the river. The installation of the feature is expected to increase recreational use to some degree, though this increase will be localized around the feature itself and is likely to represent a small percentage of users at peak times of use that typically includes tubers and paddle boarders. The feature has the potential to attract and guide larger numbers of typical users through a planned route and through managed access points.

Engineering and Construction Feasibility – This alternative presents similar opportunities and constraints to Alternative 2 with additional considerations in enhancing off-channel habitat. Similar access, staging, BMP's, and timing would be employed for in-channel work. Additional stockpile areas would be needed for material placed to create the feature, or habitat enhancement materials such as large wood. Additionally, depending on the extent of recreational planning such as trails and access points, a significant amount of construction work could take place outside of the river.

Alternative 4 – Fully Channel Spanning Recreational Feature

Alternative 4 includes previously described elements of Alternatives 2 and 3 including removal of the remnant mill dam and enhancement of off-channel habitat features, and additionally includes the installation of completely channel spanning recreational features. The approach to hydraulic design, materials, and construction would be similar to Alternative 3 with a more laterally extensive in-channel treatment. In this conceptual design scenario, the river right riffle that was maintained in Alternative 3 would be altered to extend the drop structures across the width of the channel. The result would

be more powerful recreational features that could be utilized over a greater range of flows, with more water directed over the recreational features. The design process would be sensitive to maintenance of fish passage through the project area. Habitat enhancement features included in Alternative 3 would be included in Alternative 4 as well.

River Function – This alternative poses the greatest alteration to existing river function in terms of hydraulic characteristics at the project site and channel morphology within the footprint of the feature. The existing remnant of the mill dam creates an upstream backwater and pushes the channel thalweg to the right with a relatively narrow slot of high velocity. A fully channel-spanning recreational feature would likely create a more uniform cross-section that would function more as a channel spanning riffle crest resulting in more uniform distribution of velocity across the channel. Changes to hydraulics will affect patterns of sediment transport through the section as well as upstream. Changes to the cross-section will also affect flow dynamics as stage increases at high flow. The final design will ultimately determine changes in river function, and consideration will be taken to maintain continuity of sediment transport and hydrologic processes.

Ecological Function – Alternative 4 is expected to have similar ecological effects as Alternative 3 including enhancement of in-channel and off-channel habitat. Frequency and extent of floodplain inundation will be maintained through design of this feature. Care will need to be taken in design to ensure that gravel deposition in upstream spawning areas is not adversely affected, as well as ensuring fish passage through the features.

Recreational Function – Alternative 4 presents recreational enhancement with similar anticipated effects as Alternative 3, but with greater scope. The channel spanning feature presents to opportunity to further guide flow of traffic of river users and patterns of use. There would be more space available on the feature for multiple people to use the feature simultaneously.

Engineering and Construction Feasibility – Engineering and construction considerations in this alternative expand significantly from Alternatives 2 and 3 based on the increase in the footprint of the feature, increase in necessary construction materials and associated staging and stockpiling of materials and equipment, and need to do work across the entire width of the river. The increased river access necessary could involve access from both sides of the river, more complex dewatering scenarios, and a compressed timeline to get the additional construction finished during the in-water work window.

Based on the greater project footprint of Alternative 4, and the desire to maintain a more naturalized rock riffle along river right, channel spanning recreational features are not something CCNRD is interested in investigating further at this site. Rather than invest in developing a concept design for Alternative 4, example photos of channel spanning recreational features constructed at other locations are shown below.

Figure 1. Two channel spanning recreational features constructed at the whitewater park in Salida, CO on the Arkansas River.

Figure 2. Channel spanning recreational features constructed at the whitewater park in Siloam Springs, AR on the Illinois River.

Selection of Preferred Alternative

Conceptual design alternatives were presented to community members, stakeholder groups, and permitting agencies to gather feedback and guidance on design solutions that would best serve the greatest portion of river users while maintaining habitat and river function. Following these meetings, a preferred alternative was developed which combined aspects of multiple options and resulted in a concept design that is more focused on habitat rehabilitation while also providing recreational enhancements.

Leavenworth Mill Dam Rehabilitation and Recreation Improvement Project (RRIP)

The preferred alternative is a hybrid concept centered on removing relic material remnants of the mill dam near Barn Beach in Leavenworth, WA., rehabilitating in-channel habitat around the dam removal, providing options for habitat enhancements up and downstream, and creating a recreational riverine wave feature within the rehabilitated dam alignment. This approach is essentially Alternative 3 with a greater focus on habitat rehabilitation and a design that includes only one riverine wave feature installation.

In this design, all the unnatural remnant dam material such as riprap, rebar, concrete, and treated timber is removed, and the channel is regraded and stabilized using natural river material. Grading in the river right portion of the former dam alignment includes a graded riffle and boulder clusters. These materials will be sized for hydraulic stability and to provide passable conditions for all critical fish passage flows. The river left portion of the former dam alignment is the location of the riverine wave feature. This would be a standing hydraulic wave created by placing large smooth interlocking boulders to form the wave, as well as a mid-channel rock island to constrict flow and promote the wave feature. Remnant dam material (riprap) that over time has been transported to a riffle immediately downstream will also be removed, and the stream bed re-graded with natural bed material, enlarging the existing pool. Outside of the channel in the river left floodplain, removed dam material will be replaced with native riparian vegetation, with bio-engineered treatments providing stability until riparian plantings reach maturity.

In tandem with remnant relic dam removal, habitat enhancement options include placement of large wood structures along stream banks upstream on river left, and boulder clusters in the riffle past the recreational wave. Enhancing off-channel habitat in an existing low spot in the river left floodplain is also included as an option. This feature would be designed to provide rearing habitat for juvenile salmonids and would include large wood and riparian vegetation planted along the perimeter. A pedestrian footpath would be established between the existing tuber takeout upstream of Barn Beach leading to the existing parking lot. This path would help to manage foot traffic to protect sensitive riparian areas.

In the design process, attention will be paid to minimizing adverse impacts of planned actions on existing habitat and hydraulic conditions. For instance, fish passage conditions through the riffle at Barn Beach will be analyzed to ensure they are maintained or improved through proposed activities.

River Function – The focus on river function in the preferred alternative is maintenance of current hydraulic conditions, and functional enhancement where possible. In other words, no action will be taken that would decrease fish passage ability, or adversely affect surrounding habitat availability and quality. This includes maintaining existing depths, velocities, gradients, and grade controls. Through re-grading and placement of boulder clusters, it is possible to decrease channel velocities and increase passable conditions through the river right riffle.

Ecological Function – The preferred alternative has the potential to increase ecological function in the project area by removing channel and floodplain riprap and re-grading the channel with natural material. Rehabilitated areas will be planted with native riparian vegetation. Options include construction of fully connected off-channel habitat providing juvenile salmonid rearing habitat. Additional habitat features would include boulders and root wads placed to provide enhanced habitat while minimizing risks to humans. The placement of the recreational feature itself would be expected to have minimal ecological impact, and would not utilize grout, metal, or any mechanized component. The design process would investigate potential effects to sediment transport, fish passage, and floodplain connectivity to ensure no negative effects. In addition, the design can address impacts from current patterns of recreational use which currently impact in-channel and riparian habitat.

Recreational Function – Incorporating recreation improvement into the concept design allows for recreation managers to directly address current issues with recreational use of the river in and around the project area. The amount and pattern of traffic, points of entry and exit from the river, river access routes, and impacts to sensitive habitat areas could be more effectively managed through intentional recreational planning in this area of the river. The installation of the recreational feature is expected to increase recreational use to some degree, though this increase will be localized around the feature itself and is likely to represent a small percentage of users at peak times of use that typically includes tubers and paddle boarders. The timing of increased use will also occur during higher spring and fall flows, not during summer base flows when peak tubing and paddleboarding occurs. The recreation improvement component has the potential to attract and guide larger numbers of typical users through a planned route and through managed access points.

Engineering and Construction Feasibility – The preferred alternative includes work in the active channel and the need for access by heavy equipment, staging and stockpiling of materials, disposal of removed material, and associated temporary impacts. However, in-water work would be limited to the dam infrastructure itself and potential habitat additions such as backwater features, etc. Additionally, depending on the extent of recreational planning such as trails and access points, a significant amount of construction work could take place outside of the river.