



Contact Information

2025 Upper Columbia Regional Project Pre-Application

* Pre-applications (SRFB & Monitoring) due March 12, 2025 (COB)

*Complete SRFB applications due in PRISM April 18, 2025 (COB)

*Complete Monitoring applications due in PRISM May 1, 2025 (COB)

*Revised SRFB proposals due in PRISM May 27, 2025 (COB)

*Final revised SRFB & Monitoring applications due in PRISM June 23, 2025 (noon)

Project Title	Entiat 1D Habitat Enhancement Final Design
Sponsor	Chelan County Natural Resources Department
Primary Contact	Mike Kane
E-Mail Address	mike.kane@co.chelan.wa.us

Project Summary

Please provide a description or summary of the proposed project, including project goals. The goal of the project should be to solve identified problems by addressing the root causes. Then clearly state the desired future condition.

This is a final design phase project and includes design development, preparation of a basis of design report, hydraulic modeling and other elements as per Manual 18 Requirements. Additionally included is a CLOMR, wetland delineation and cultural resource surveys. Preliminary Designs were completed in December of 2024 in a SRFB funded effort.

Human impacts within the lower Entiat River have had a large and detrimental effect on instream habitat (re-routing, channelization, levee building, etc.). Due to existing conditions the river lacks the ability to readily create new habitat through natural processes alone. As a result of the confined river channel and limited floodplain habitats, the majority of habitat that historically existed on the lower Entiat River was instream habitat; therefore, re-establishing instream habitat is vitally important to salmon and steelhead (Reclamation 2012).

Goals: Improve side channel hydraulic connectivity and habitat quality for juvenile salmonids. Improve instream habitat for juvenile salmonids. Increase riparian buffer structure and function related to stream shading and large wood recruitment potential. Reduce instream water temperatures.

The desired future condition for this site is to enhance the existing functional attributes like large wood structures and perennial and seasonal side channels.

What are the project objectives? Objectives support and refine biological goals, breaking them down into small steps. Objectives are specific, quantifiable actions the project will complete to achieve the stated goal. Each objective should be SMART (Specific, Measurable, Achievable, Relevant, and Time-bound).

Note: This exact question is included in the PRISM application. Example format: The project seeks to address [specify limiting factor(s)] for [limiting life stage(s)] by [specific actions proposed] to create an estimated [include specific target metrics, as described below] upon implementation in [estimated year].

Side channel connectivity-Objectives: Improve existing 920' of seasonal and perennial side channel features through the strategic construction of 9 ELJs to increase flow interaction and provide cover. Instream habitat-Objective: Install 9 ELJs to provide cover, pool formation, and sediment sorting. Enhance hydraulic variability and provide instream cover along 1600' of the mainstem river. Increase riparian buffer-Objective: Restore riparian mature riparian forested vegetation located within the 2-year floodplain or within 25 feet of the existing banks. Reduce instream water temperatures-Objective: Increase main channel shade through riparian revegetation fill planting and long-term shading along 730' of the south bank. Increase hyporheic and floodplain flow storage and discharge through strategically constructing engineered log jams (ELJs) to deflect and increase flows into adjacent floodplain and gravel bar features along 1600' of mainstem and 920' of side channel habitat.

Budget Request

Values MAY be duplicative and do not have to equal TOTAL anticipated budget in pre-application.

Anticipated Request - SRFB (standard round) 260,345

Anticipated TOTAL Budget 260345

Project Location

Briefly describe the location of the project This project is focused on Reach 1D between River Miles (RM) 4.3 – 4.8 of the Entiat River, bounded upstream by the Hanan-Detwiler diversion structure and downstream by Dinkelman Canyon Road bridge.

Latitude (decimal degrees) 47°40'24.08"N

Longitude (decimal degrees) 120°18'35.57"W

Project subbasin Entiat

Entiat Assessment Unit(s) Entiat River-Mills Creek

Does the proposed project span multiple assessment units? No

Reach(es) Name Entiat River Mills 05

Identify the reach(es) priority/ reach ranking. Note: If the project involves work in multiple reaches, select "Multiple" and include details in the text box that will appear below. Please reference the Prioritization Web Map: <https://prioritization.ucsrb.org/>. Rank 2

Project Information

1. What species will the project benefit?

Spring Chinook

Steelhead

Bull Trout

Summer Chinook

2. Select the project's objectives and the associated tracking metrics

Design, Monitoring or Assessment

4. Does this project already exist in Salmon Recovery Portal or PRISM?

Yes

5. Has this project been submitted previously for funding through the SRFB and/or other process(es)?

Yes

Please explain which process(es) and how this proposal differs from the previous submission (e.g., different phase, modified scope, etc.)

It was previously submitted and funded through Preliminary Designs.

6. What category is the project?

Design

If applicable, what is the secondary project category?

N/A

Is the project eligible for Riparian Funding?

No

Design and Restoration Proposals

7. What project phase(s) are proposed for completion?

Final Design

8. Is your project within a completed (or soon-to-be completed) Reach Assessment or other type of assessment (e.g., Rapid Site Assessment, other)?

Lower Entiat Reach Assessment (BOR 2012)

9. Which limiting factors does the project propose to address?

Cover - Wood

Off-Channel - Floodplain

Off-Channel - Side-Channels

Pool Quantity & Quality

Riparian

Riparian - Canopy Cover

Riparian - Disturbance

10. Which life stages will the proposed project address?

Fry

Spawning and Incubation

Summer Rearing

11. Freshwater Benefits - Describe how your project will improve survival, capacity and/or distribution for target species at the reach scale?

The project will add 9 ELJ structures and associated pools thus increasing overall habitat capacity and distribution within the lower Entiat River. Polivka and Claeson (2020) found that restoration increased the habitat capacity of the reach at the scale of pools created by ELJ's.

Additionally, the strategic location of the ELJ's will enhance flows into side channel habitats, adding capacity by increasing the amount of wetted area. Some of the ELJ's are located within side channels, providing cover and improving survival. Over the long-term, fill-planting of forested clumps along the south shore will increase shading and provide relief to late summer in stream heating.

The Reach-based Ecosystem Indicators (REI) analysis (Reclamation 2012) found that within Lower Entiat River, water quality (temperature); habitat quality (large woody debris, pools, off-channel habitat), floodplain connectivity, and riparian vegetation were in an "at risk" condition due to historic anthropomorphic impacts, including floodplain development, bed armoring (embeddedness), and a lack of large wood recruitment potential.

12. Temporal Effect - Briefly describe how and to what extent the project would promote natural stream/watershed process consistent with the geomorphology of the stream?

In 2012, Reclamation concluded that habitat restoration in the lower Entiat River "should be aimed at improving and enhancing those forms and processes that currently exist, rather than attempting to create wholly new conditions that may not be appropriate or sustainable" (Reclamation 2012). Human impacts within the lower Entiat River have had a large and detrimental effect on instream habitat. Due to existing conditions the river lacks the ability to readily create new habitat through natural processes alone. As a result of the confined river channel and limited floodplain habitats, the majority of habitat that historically existed on the lower Entiat River was instream habitat; therefore, re-establishing instream habitat is vitally important to salmon and steelhead (Reclamation 2012).

The project has limited ability to promote any large scale natural stream process, but the localized benefits of large wood structures and associated pools, flow partitioning and sediment sorting provides a significant improvement in habitat conditions on a reach scale.

13. Temporal Effect - How long will it take for the project to achieve its intended response?

1-10 years

14. Temporal Effect - How long will the restoration action and its benefits persist?

50+ years

15. Temporal Effect - What level and/or interval of maintenance is anticipated? What is the plan for any anticipated maintenance?

The project will be designed to minimize maintenance needs, however a monitoring plan will be developed as part of the Final Designs to identify maintenance needs for ELJ's and plantings. Typically, three years of plant maintenance is required to address potential issues and comply with permitting requirements, especially for disturbed areas associated with access, staging and construction. Maintenance can include watering, mulching, fill planting, and weeding in planted areas. ELJ's typically do not require maintenance, but Monitoring includes checking threaded rods and bolts and whether the ELJ is causing an unintended consequence like excessive erosion, full span channel blockage or other changes not anticipated. Annual maintenance would be anticipated for at least the first three years post-construction.

16. Methods - Briefly describe the potential (for design) or proposed restoration methods and how they will achieve project objectives.

Currently, the Preliminary Design consists primarily of the construction of 9 ELJ's. This includes a reduction from earlier Concepts. The goals of the ELJs remain the same from the conceptual design; The deflector groups will provide cover, slow water down and increase pool habitat and be placed in sections

of the river that are deeper and slower, to have the most impact on river hydraulics and the maintain the scour pool that will be constructed. The smaller jams within the side channel will provide hydraulic complexity within the side channels and help form pools for resting areas while slowing down flows. Both types of jams include a scour pool that will be excavated in front of the structure to provide immediate pool habitat.

The ELJs will utilize rootwad posts with some installed at a batter angle. The ELJs will need to be excavated prior to post placement. Post elevations (10 ft below thalweg for the side channel ELJs, and 15 ft below thalweg for the deflector ELJs) were determined based on stability calculations. Rootwad posts are recommended to be used instead of piles due to the large cobbles within the streambed. For both the side channel and deflector ELJs, racking and slash material is placed particularly on the upstream end and flanks of the ELJ to provide complex instream cover. The structures are designed such that scour will not destabilize the structure. If scour occurs, the structure is intended to “self-settle”, essentially lowering the overall elevation of the structure in conjunction with scour; however the racking material at the front of the structure which is countersunk below the bed elevation should serve as a buffer against potential scour. The deflectors will include three bolted connections, at the final (top) layer of the ELJ with the large rootwads pinned to the rootwad posts. This is to prevent the top logs from floating away.

Assessment Proposals

Protection Proposals

Monitoring Proposals

Project Risk and Economic Benefits

1. What is the landownership?

The project is wholly within private lands except for the aquatic portion which is administered by Washington State Department of Natural Resources.

2. Have you secured landowner participation in or acceptance for this project?

Yes

Please explain

We have been working with landowners through the Conceptual Design Process up to completion of the Preliminary Designs. Landowners preferred to wait until Spring to review and comment on the current Preliminary Designs. Their acceptance will be secured during this SRFB process.

3. Describe any land owner requirements (e.g., design elements, right-of-ways, access agreements, liability waivers, etc.) and if/how they could affect the project

The two main landowners on the Left and Right Bank of the river are Agricultural owners and as such use the adjacent uplands for grazing. Riparian buffer widths have been reduced in the Preliminary Designs to reflect their interest in maintaining grazing land. Additionally, at least one of the owners has expressed concern about creating thick forested areas along the shoreline that could promote crown fires and work against fire fuel reduction efforts.

4. Will the project raise potential concerns for interest groups (e.g., recreational users) or the community at large (including upstream/ downstream/ adjacent landowners)?

It is unlikely that the project will create concerns for river floaters which is mostly a small local group of kayakers that run during spring flows and a few local innertuber's that run during summer low flow. Sightlines are good in this area to minimize risk. There have been issues in the past with large wood structures being installed further upstream in the Entiat, but ELJ's in the lower Entiat have not been very controversial in the past.

5. Who will have the responsibility to manage and maintain the project? What is the responsibility of current or future landowners?

Chelan County Natural Resources Department will assume responsibility for managing and maintaining the project. Landowners primary responsibility will be to continue to allow some access for design, monitoring and maintenance. Irrigation of riparian plants may become a landowner responsibility if they are interested, once we have installed and maintained the infrastructure.

6. Are other projects being proposed immediately upstream or downstream of worksite?

Yes

7. Please describe the risk of failure associated with this project.

NSD applied the basic risk evaluation method as outlined in the Bureau of Reclamation (Reclamation) Large Woody Material - Risk Based Design Guidelines (Reclamation 2014) to broadly assess risk to the public and property associated with ELJ elements of the project. The Risk Guidelines make use of two risk matrices which quantify risk associated with ELJ project elements: The Property Damage Risk Matrix, and the Public Safety Risk Matrix. The Matrices quantify general characteristics of the project reach, structure setting, recreational use, and channel characteristics to categorize risk to the public and property as a result of project actions. Ratings for risks associated with public safety concerns and potential property damages result in a low or high and low, moderate, or high risks, respectively (Reclamation 2014). The ratings then result in recommended factors of safety for horizontal and vertical loads which are then applied to ELJ design.

The evaluation resulted in a public safety risk rating of “low”, and a property damage risk rating of “moderate”. Per the RBDG, these risk factors correspond to a 25-year design event with factors of safety of 1.5 and 1.75 for sliding and buoyancy, respectively. Factors of safety for rotation and overturning were determined to be not applicable for all structure types and were not considered.

8. Is there any public outreach planned during and/or after implementation? Does the project build community support for salmon recovery efforts?

Public outreach to date has been limited to project updates during the Entiat Planning Unit Meetings held quarterly. These are well-attended by local Entiat River Corridor residents. Prior to starting work in the 1D Reach, Chelan County was approached by landowners and asked when we were going to do some work in this section of the river.

This project overlaps with prior projects completed by the county and others, including the HD Weir and includes landowners who have historically been very active in Watershed Planning and salmon recovery, the Citizen's Committee and even one contractor.

The project builds on existing support for salmon recovery and the recent opening of fishing seasons where some fishers use the HD Weir to fish on the lower Entiat is especially effective at building support.

9. Does the project represent an opportunity for economic benefit? How much benefit does the project create for the dollars invested?

This proposal is a good investment of public funds because it supports salmon recovery by improving and expanding habitat in a 1/2 mile long reach. Since there are primarily two landowners to work with, it simplifies coordination while maximizing project benefits in the 1D reach.

10. Describe any partnerships, their experience, and types of contributions supporting the project.

The Voluntary Stewardship Program and the Salmon Recovery Funding Board funded the initial phases of the project, including Preliminary Designs. The US Bureau of Reclamation has played an active role in funding reach assessments, project concepts and designs in the Entiat River and is providing funding for Chelan County staff to continue work on this project.

Tom Desgroseillier, with the WDFW Science Program, is very familiar with this reach from years of conducting side channel studies in the lower Entiat. He has graciously contributed his time by reviewing and providing comment on the Preliminary Designs and has agreed to meet with landowners onsite to discuss scientific research conducted in this reach as a way to advance coordination between State and local agencies and landowners.

Optional Section - Preparation for PRISM (SRFB applications only)

The following questions are identical to the questions RCO requires in the PRISM application for SRFB projects. If desired, sponsors can complete associated questions early and copy responses into PRISM during the "Complete Application" phase due on April 18, 2025.

*please note, this section is not applicable for Monitoring proposals

Do you want to review and/or pre-populate PRISM questions?

No

Supporting Documents

[Upper Columbia Process Guide 2025](#)

[SRFB Manual 18 \(2025\)](#)

[RCO Application Resources \(2025\)](#)

PROJECT: 25-1215 PLAN, ENTIAT 1D HABITAT ENHANCEMENT FINAL DESIGN

Sponsor: Chelan Co Natural Resource Program: Salmon State Projects Status: Application Submitted

Parties to the Agreement

PRIMARY SPONSOR

Chelan County Natural Resources Department

Address 411 Washington St Ste 201

City Wenatchee **State** WA **Zip** 98801

Org Type County-Open Space/Nat Resources

Vendor # SWV0001231-12

UBI

Date Org created

Org Notes

[link to Organization profile](#)

Org data updated

SECONDARY SPONSORS

No records to display

MANAGING AGENCY

Recreation and Conservation Office

LEAD ENTITY

Upper Columbia Salmon Rcy Bd L

QUESTIONS

#1: List project partners and their role and contribution to the project.

External Systems

SPONSOR ASSIGNED INFO

Sponsor-Assigned Project Number

Sponsor-Assigned Regions

LINK AN EXISTING SRP PROJECT

Unlink

25-1215, Entiat 1D Habitat Enhancement Final Design, Sa

Project Application Report - 25-1215

Project Contacts

Contact Name Primary Org	Project Role	Work Phone	Work Email
<u>Amee Bahr</u> Rec. and Conserv. Office	Project Manager	(360) 867-8585	Amee.Bahr@rco.wa.gov
<u>Mike Kane</u> Chelan Co Natural Resource	Project Contact	(509) 885-2126	mike.kane@co.chelan.wa.us
<u>Ariel Edwards</u> Upper Columbia Salmon Rcy Bd L	Lead Entity Contact	(208) 540-2691	ariel.edwards@ucsr.org

Worksites & Properties

Worksite Name

#1 Left and Right Bank Entiat River RM 4.3-4.8

Planning	Property Name
✓	Parcel 252010440050
✓	Parcel 252010420050

Project Application Report - 25-1215

Worksite Map & Description

Worksite #1: Left and Right Bank Entiat River RM 4.3-4.8

WORKSITE ADDRESS

Street Address 317 Dinkelman LN

City, State, Zip Entiat WA 98822

Worksite Details

Worksite #1: Left and Right Bank Entiat River RM 4.3-4.8

SITE ACCESS DIRECTIONS

Christensen Property: From State Highway 97A, travel 4 miles up Entiat River Rd. Turn left onto Dinkelman Canyon Rd. Follow Dinkelman Canyon Rd for approximately 0.4 miles. turn Right onto a dirt two-track access road, continue for 0.1 miles.

Wick Property: From State Highway 97A, travel up Entiat River Rd for 4 miles. Wick Property is located on South side of Entiat River Road at Entiat River Road and Dinkelman Canyon Road intersection.

Both Properties are privately held and will required escort by landowner until otherwise noted.

TARGETED ESU SPECIES

Species by ESU	Egg Present	Juvenile Present	Adult Present	Population Trend
Chinook-Upper Columbia River Spring, Entiat River, Endangered		✓	✓	Declining
Steelhead-Upper Columbia River, Entiat River, Threatened	✓	✓	✓	Declining

Reference or source used

Lower Entiat Reach Assessment, January 2012; United States Bureau of Reclamation

TARGETED NON-ESU SPECIES

Species by Non-ESU	Notes
Bull Trout	
Cutthroat	
Lamprey	

Questions

#1: Give street address or road name and mile post for this worksite if available.

5618 Dinkelman Canyon Road, Entiat WA 98822

Project Application Report - 25-1215

Project Location

RELATED PROJECTS

Projects in PRISM

PRISM Number	Project Name	Program Name	Current Status	Relationship Type	Notes
22-1502 P	Entiat 4.6 (1D Reach) Prel. Design	Salmon Federal Projects	Closed Completed	Earlier Phase	Preliminary Design Completed

Related Project Notes

Questions

#1: Project location. Describe the geographic location, water bodies or habitat types, and the location of the project in the watershed, i.e. nearshore, tributary, main-stem, off-channel, etc.

This design project will look at both left and right banks of the Entiat River between river miles 4.3 and 48. This project will mainly focus on the main stem of the Entiat River but will also include investigation into reactivation of two smaller side channel along the right bank and one small side channel on the left bank. This project is located within the lower portion of the 1D reach of the Entiat River.

#2: How does this project fit within your regional recovery plan and/or local lead entity's strategy to restore or protect salmonid habitat? Cite section and page number.

This project is in accordance with proposed restoration efforts outlined in the Entiat Watershed Plan. Appendix A page A-3 outlines proposed system wide and specific location projects to be implemented in the Entiat Watershed. This effort aligns with proposed projects "1) Entiat River - Instream Habitat Diversification through investigation of optimal placement of Engineered Log Jams to assist in pool development and large woody debris recruitment. Proposed Project 2) Entiat River Corridor - Riparian Planting; this design effort will have a large riparian enhancement task. Riparian vegetation on the left bank is sparse and in need of improvement. Also project 3) Entiat River Bridge-to-Bridge Fish Habitat Restoration is immediately adjacent to this project area. Future implementation of this design will provide for an expansion of this previously conducted project.

#3: Is this project part of a larger overall project?

No

#4: Is the project on State Owned Aquatic Lands? Please contact the Washington State Department of Natural Resources to make a determination. [Aquatic Districts and Managers](#)

No

Property Details

Property: Parcel 252010440050 (Worksite #1: Left and Right Bank Entiat River RM 4.3-4.8)

✓ Planning

LANDOWNER

Name Bruce Wick
 Address 20 Entiat Cemetary Road
 City Entiat
 State WA Zip 98822
 Type Private

CONTROL & TENURE

Instrument Type Landowner Agreement
 Timing Proposed
 Term Length Fixed # of years
 # Yrs
 Expiration Date
 Note

Project Application Report - 25-1215

Property: Parcel 252010420050 (Worksite #1: Left and Right Bank Entiat River RM 4.3-4.8)

✓ Planning

LANDOWNER

Name Garn Christensen
Address 317 Dinkelman LN
City Entiat
State WA Zip 98822
Type Private

CONTROL & TENURE

Instrument Type Landowner Agreement
Timing Proposed
Term Length Fixed # of years
Yrs
Expiration Date
Note

Project Proposal

Project Description

This is a final design phase project and includes design development, preparation of a basis of design report, hydraulic modeling and other elements as per Manual 18 Requirements. Additionally included is a CLOMR, wetland delineation and cultural resource surveys. Preliminary Designs were completed in December of 2024 in a SRFB funded effort (22-1502). Project is located on the lower Entiat River.

Human impacts within the lower Entiat River have had a large and detrimental effect on instream habitat (re-routing, channelization, levee building, etc.). Due to existing conditions the river lacks the ability to readily create new habitat through natural processes alone. As a result of the confined river channel and limited floodplain habitats, the majority of habitat that historically existed on the lower Entiat River was instream habitat; therefore, re-establishing instream habitat is vitally important to salmon and steelhead (Reclamation 2012).

Goals: Improve side channel hydraulic connectivity and habitat quality for juvenile salmonids. Improve instream complexity habitat for juvenile salmonids. Increase riparian buffer structure and function related to stream shading and large wood recruitment potential. Reduce instream water temperatures.

The desired future condition for this site is to enhance the existing functional attributes like large wood structures and perennial and seasonal side channels.

Project Questions

Project Application Report - 25-1215

#1: Problem statement. What are the problems your project seeks to address? Include the source and scale of each problem. Describe the site, reach, and watershed conditions. Describe how those conditions impact salmon populations. Include current and historic factors important to understand the problems.

The Lower Entiat Reach Assessment (BOR 2012) compared historical conditions to existing conditions and found large pools had declined from ~3.5-4.0 per mile to 0.5 per mile. This was attributed to a lack of large instream structures and LWD recruitment potential. This also corresponds to a high degree of impairment associated with LWD which historically had less than 10 logjams per mile to an existing condition of 2.3 logjams per mile or 132 individual pieces per mile. This has been attributed to logging and clearing of riparian corridors reducing the available wood for recruitment and lack of structure to retain wood. Floodplain connection has been reduced by 20% due to levees limiting the active 2-year floodplain, providing a medium degree of impairment compared to historical. Riparian condition falls into a medium to High degree of impairment based on reduction from an average width of 100' to one of about 25' as a result of clearing for development.

Within this section of the 1D reach, there are some log jams present as well as some side channel features. Upstream and downstream sections of 1D have less wood and off-channel features and less opportunities for those characteristics. Channel straightening has occurred in the 1C reach downstream. The legacy of logging, splash dams, LWD removal, agricultural development, and flood control activities (deepening and straightening) have affected pools, large wood and other habitat features at the site, reach and watershed scale.

#2: Describe the limiting factors, and/or ecological concerns, and limiting life stages (by fish species) that your project expects to address.

The project is within a Tier 1 AU for Steelhead Restoration and a Tier 2 for Spring Chinook and Bull Trout Restoration. Winter rearing is a high priority life stage for Spring Chinook and Steelhead, summer rearing is a high priority for Steelhead, and Steelhead spawning, fry colonization, and smolt emigration are medium priorities.

At risk limiting factors include: cover wood, floodplain connectivity, off-channel-side channels, pool quantity and quality. All of these limiting factors would be addressed by the project. Riparian canopy cover is an unacceptable limiting factor and the project will partially address this one due to the site constraints related to existing agricultural uses.

#3: What are the project goals? The goal of the project should be to solve identified problems by addressing the root causes. Then clearly state the desired future condition. Include which species and life stages will benefit from the outcome, and the time of year the benefits will be realized. **Example Goals and Objectives**

Goal: Improve side channel hydraulic connectivity and habitat quality for juvenile salmonids for summer and winter flows.
Goal: Improve instream habitat for juvenile salmonids.
Goal: Increase riparian buffer structure and function related to stream shading and large wood recruitment potential which could benefit multiple salmonid life stages year-round.
Goal: Reduce instream water temperatures during summer juvenile rearing.

Project Application Report - 25-1215

#4: What are the project objectives? Objectives support and refine biological goals, breaking them down into smaller steps. Objectives are specific, quantifiable actions the project will complete to achieve the stated goal. Each objective should be SMART (Specific, Measurable, Achievable, Relevant, and Time-bound). [Example Goals and Objectives](#)

Objective: Improve existing seasonal and perennial side channel features through the strategic construction of 7 ELJs to increase flow interaction and provide cover.

Objective: Install 9 ELJs to provide cover, pool formation, and sediment sorting.

Objective: Enhance hydraulic variability and provide instream cover over 1,320'.

Objective: Restore riparian mature riparian forested vegetation located within the 2-year floodplain or within 50 feet of the existing banks (some areas will not be a full 50' wide but fill planting with conifers and cottonwood will enhance shading over long term).

Objective: Increase main channel shade through riparian revegetation planting and long-term shading. (some areas will not be a full 50' wide but fill planting with conifers and cottonwood will enhance shading over long term).

Objective: Increase hyporheic and floodplain flow storage and discharge through strategically constructing engineered log jams (ELJs) to deflect and increase flows into adjacent floodplain and gravel bar features over 1,320'.

Project Application Report - 25-1215

#5: Scope of work and deliverables. Provide a detailed description of each project task/element. With each task/element, identify who will be responsible for each, what the deliverables will be, and the schedule for completion.

Task 1. Cultural Resource surveys and report

The Consultant will work with the CCNRD and lead agencies to initiate the Sec. 106 process based on APE, conduct a survey and write a report.

- Field survey
- Report

Task 2. Wetland Delineation

The Consultant will complete field work and a report on wetland and OHWM locations and characteristics in the Spring/Summer of 2026.

-Wetland Report.

Task 3. 90% Designs

Building on Phase 1 efforts, NSD will update the 60% design and develop a 90% design package to support CCNRD's regulatory review process. Revisions will incorporate wetland delineation data, feedback from landowners and permitting agencies, changes in field conditions, and updates to the hydraulic model based on proposed design features. Design modifications are expected to include updates to engineered log jam (ELJ) elevations and architecture, as well as refined access and staging locations based on stakeholder input and wetland features.

-90% design plans, a basis of design report, special provisions, and a construction cost estimate.

Task 4. Hydraulic Assessment

A Hydraulic Model will be modified to represent 90% design conditions within the study reach and used to evaluate hydraulic and floodplain processes, existing flood risks to private property, and aid in the development of restoration concepts.

To evaluate conditions a steady state simulation of the following flow events will be run:

- 100 year flood discharge.
- 10 year flood discharge.
- 1.01 year flood discharge.
- Typical winter flow discharge.
- Low summer flow discharge.

Task 5. CLOMR

The project reach is within a FEMA-designated Zone A2 Special Flood Hazard Area (SFHA) with a delineated floodway and defined base flood elevations (BFEs), subject to "zero rise" standards per Chelan County Flood Code and National Flood Insurance Program (NFIP) regulations. The 60% design hydraulic analysis suggests the project will be unlikely to meet "zero rise", requiring a Conditional Letter of Map Revision (CLOMR) and subsequent Letter of Map Revision (LOMR). Consultant will perform final hydraulic analyses and prepare a complete CLOMR application package, including required FEMA forms, model files, maps, and supporting documentation.

Submittals for this task will include an MT-2 application consisting of:

- Riverine Hydrology & Hydraulics Form 2
- Digital data (e.g., hydraulic model, terrain, etc.)
- Certified topographic map
- Annotated FIRM and FBFM maps
- Narrative describing the project, methods, and analysis results

Task 6. 100% Design

Consultant will finalize a bid-ready design package incorporating feedback from CCNRD, stakeholders, and agencies on the 90% design to support the CCNRD construction bid process.

Submittals will include 100% design plans, a basis of design report, special provisions, and a construction cost estimate.

Task 7. Permitting Support

Agency field visits and meetings and permit preparation by sponsor and consultant.

Task 8. Project Management/Coordination

Project Application Report - 25-1215

- #6: What are the assumptions and physical constraints that could impact whether you achieve your objectives? Assumptions and constraints are external conditions that are not under the direct control of the project, but directly impact the outcome of the project. These may include ecological and geomorphic factors, land use constraints, public acceptance of the project, delays, or other factors. How will you address these issues if they arise?

We have worked with left and right bank landowners to date, so they are familiar with the Preliminary Designs at this stage and we have had to make modifications already to accommodate landowner concerns including a reduction in Riparian Planting Area.

Based on our current designs and existing site conditions, we do not anticipate any issues with permit agencies at this time.

Geomorphic constraints in this reach include the large cobble substrate on banks and channels and challenges associated with these conditions related to restoration of natural processes and the creation and maintenance of pools. Our designs take this into account to create pools in locations that are best suited to sustain pools through a variety of flow conditions.

We do not anticipate any issues with public acceptance of the project but will work with the community to resolve issues if they do arise. The county has completed a number of projects in the lower and middle Entiat and have had to address a variety of issues during planning and implementation of these projects.

- #7: How have lessons learned from completed projects or monitoring studies informed this project?

Historically the 1D reach has been a monitoring reach to assess success of projects implemented in other parts of the watershed as part of the Intensively Managed Watershed (IMW). USFWS completed a multi-year study of side channels in the lower Entiat to compare use in the PUD, Wilson and "San Ray" side channels. The sponsor has incorporated feedback from those studies and other large wood focused studies by Polivka and others into the designs. Review by the principal investigator in the side channel studies has been incorporated into the Preliminary Designs and he has even volunteered to meet onsite to discuss the scientific basis for habitat restoration in this reach with the landowner and sponsor.

Other lessons in methods for LWD construction in the lower Entiat have been learned from previous projects and Bureau of Reclamation project review completed in 2012.

For example, pile driving in large cobble dominated substrates is not effective, so excavated post methods for ELJ construction are preferred. Heavily vegetated side channels might utilize a rock collar type ballast to avoid excavation and vegetation disturbance.

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#8: Describe the alternatives considered and why the preferred was chosen.

The conceptual design included 17 ELJs, divided into seven design groups. See p. 18 of Lower Entiat ID Reach Habitat Enhancement Project Preliminary Basis of Design Report (BDR) in attachments.

The preliminary design included the following analyses and updates:

- Updated hydraulic analysis and refinement of ELJ placement to further optimize desired hydraulic effects. This included building the ELJs into the surface to better understand expected effects.
- Refinement of ELJ structure design to improve structure stability and increase habitat benefits.

The hydraulic updates made during the preliminary design process show an increase in water surface elevation on the floodplain, with some rise to surrounding homeowners. Due to the confined area with private landowners on both sides of the river, water surface elevation rise is sensitive. To reduce rise, the ELJ count went from seventeen ELJs in conceptual to thirteen ELJs at the start of the preliminary process. After discussions with the County, these updates resulted in a final ELJ count of nine.

In summary, the following changes and updates were made for the final preliminary design:

- Keep the upstream cross vane in place to limit permitting hurdles and difficult construction access.
- Eliminate the boulder clusters that were proposed as they were planned to be sourced from the cross vane removal.
- The removal of the Group 1 right bank deflector ELJ, due to keeping the cross vane.
- The removal of the Group 3 deflectors because of increased water surface elevation rise at the Firoved property.
- The removal of the Group 4 apex ELJ due to increased left bank floodplain water surface elevation rise.
- The removal of the most downstream Group 5 right bank deflector ELJ to encourage more flow to the downstream right bank side channel.
- The removal of the Group 6 deflector because of increased left bank floodplain water surface elevation rise.
- The removal of the Group 7 deflector due to a culturally sensitive area.

#9: How were stakeholders consulted in the development of this project? Identify the stakeholders, their concerns or feedback, and how those concerns were addressed.

The main landowner on the right bank, the San Ray Orchard property, changed during the Preliminary Design phase of the project. All orchards had been torn out and the land was fallow, when we started the design process. The new landowner is continuing to use the property for agriculture, so some of the project elements, like expanded riparian buffer widths had to be modified to accommodate the owner. The new owner also wants to ensure that the project design is driven by science, so the sponsor has provided him with local studies to show how the habitat is used and why enhancing pools and LWD is important. The main left bank landowner also has an agricultural property with horses and mules occupying a large area adjacent to the river. His main concern is similar in that he does not want to lose grazing land, so the proposed riparian buffers on the left bank have been reduced.

Landowners and fisherman use the HD Wier at the upper extent of the project and feedback preferred no modifications to that structure, so that was removed after Conceptual Designs. (Modifying it was initially proposed along with LWD structures to enhance flow into the Right Bank seasonal side channel).

#10: Does your project address or accommodate the anticipated effects of climate change?

Yes

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#10a: How will your project be climate resilient given future conditions?

Restoration and enhancement of the riparian corridor will combat the effects of increased drought occurrences and higher annual average temperatures by providing a greater amount of shading to the Entiat River over the long term. The potential to reactivate side channels within this section of reach 1D will also provide for greater flood plain connectivity and alluvial water transport to accommodate a possible increase in rain on snow type events.

#10b: How will your project increase habitat and species adaptability?

The project primarily focuses on increasing pools and associated complexity in the mainstem and side channel habitats. Along with fill planting and an increase in the riparian corridor width to enhance shading, this can provide thermal refuge habitat for salmonids and other aquatic species, improving adaptability.

#11: Describe the sponsor's experience managing this type of project. Describe other projects where the sponsor has successfully used a similar approach.

CCNRD has implemented over 60 salmon habitat restoration projects in the Wenatchee and Entiat sub-basins. These projects range in complexity from small riparian planting projects on private land to fish barrier removals on both public and private land to large floodplain reconnection projects requiring multiple years of planning and design with multiple entity coordination and negotiated agreements. CCNRD has successfully completed projects with BNSF Railways, WA Department of Transportation, US Forest Service, large organized private landowner groups, individual private landowners, irrigation districts and other local and state government landowners. The sponsor has connected side channel habitats and added complexity in the lower Wenatchee and Entiat Rivers, including CMZ 11,12/13, and Monitor Side Channel, and the Harrison Side Channel where similar conditions existed. Monitoring of those projects has shown extensive juvenile fish use and pool development.

#12: Will veterans (including the veterans conservation corps) be involved in the project? If yes, please describe.

No

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Planning Supplemental

#1: Is the project an assessment / inventory?
No

#2: Is your project a Barrier / Screening Diversion Inventory Project?
No

#3: Is this a fish passage design / screening design project?
No

#4: Will the project develop a design?
Yes

#4a: Will a licensed professional engineer design of the project?
Yes

#4b: Will you apply for permits as part of the project scope?

Cultural resource surveys and wetland delineations will be completed and permitting meetings and field visits will be held during the final design process. Permits will be drafted but the sponsor will not apply for permits until construction funding has been secured, so it could be after completion of the project.

Planning Metrics

Worksite: Left and Right Bank Entiat River RM 4.3-4.8 (#1)

Area Encompassed (acres) (B.0.b.1)	13.4
Miles of Stream and/or Shoreline Affected (B.0.b.2)	0.50

DESIGN FOR SALMON RESTORATION

Final design and permitting (B.1.b.11.a RCO)

Total cost for Final design and permitting	\$239,345
Project Identified in a Plan or Watershed Assessment. (1221) (B.1.b.11.a)	Chelan County Conservation District, 2004, Entiat Water Resource Inventory Area (WRIA) 46 Management Plan.
Priority in Recovery Plan (1223) (B.1.b.11.b)	Chelan County Conservation District, 2004, Entiat Water Resource Inventory Area (WRIA) 46 Appendix A, pA-3 Priority 1: Instream Habitat Diversification. Priority 2: Riparian Planting

EQUIPMENT

Purchase miscellaneous equipment

Total cost for Purchase miscellaneous equipment	\$1,000
Number of miscellaneous equipment items	1
Describe the miscellaneous equipment being purchased	Anzu Robotics Raptor T drone

Note: This amount is only a portion of the total

CULTURAL RESOURCES

Cultural resources

Total cost for Cultural resources	\$20,000
Acres surveyed for cultural resources	10.00

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Overall Project Metrics

COMPLETION DATE

Projected date of completion

09/30/2027

Planning Cost Estimates

Worksite #1: Left and Right Bank Entiat River RM 4.3-4.8

Category	Work Type	Estimated Cost	Note
Cultural Resources	Cultural resources	\$20,000	
Design for Salmon restoration	Final design and permitting (B.1.b.11.a RCO)	\$239,345	
Equipment	Purchase miscellaneous equipment	\$1,000	
	Subtotal:	\$260,345	
	Total Estimate For Worksite:	\$260,345	

Summary

Total Estimated Costs:	\$260,345
Total Estimated Planning Costs:	\$260,345

Project Application Report - 25-1215

Cost Summary

	Estimated Cost	Project %	Admin/AA&E %
<u>Planning Costs</u>			
Planning	\$260,345		
SUBTOTAL	\$260,345	100.00 %	
Total Cost Estimate	\$260,345	100.00 %	

Funding Request and Match

FUNDING PROGRAM

Salmon State Projects	\$260,345	100.000000
-----------------------	-----------	------------

SPONSOR MATCH

Questions

#1: Explain how you determined the cost estimates

This cost estimate is based off quotes developed by qualified design consultants experienced in these types of planning and design projects. The remainder of the estimate is based of the departments known staff and survey requirements to successfully conduct projects of this nature. Currently this cost estimate does not include indirect since it is listed as State funding. If it changes to Federal funding, indirect costs will be added at that time.

Other Funding

OTHER FUNDING DETAILS

Cultural Resources

Cultural Resource Areas

Worksite #1: Left and Right Bank Entiat River RM 4.3-4.8

Area: Love Left Bank Area

#1: Describe any planned ground disturbing pre-construction/restoration work. This includes geo-technical investigation, fencing, demolition, decommissioning roads, etc.

No ground disturbing activity at this phase of the project. A detailed APE will be developed at this phase.

#2: Describe the existing project area conditions. The description should include existing conditions, current and historic land uses and previous excavation/fill (if depths and extent is known, please describe).

The existing project area has a recent history of agricultural use and this is mostly the current use as well. Portions of the lower Entiat had bulldozers driven down the stream bed, but no definitive record has been found to show that has occurred in this location. The banks appear armored, but no levees are not evident. Instream work was completed at the downstream boundary, Dinkelman Weir, and the upstream boundary, HD Weir, of the project area.

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#3: Will a federal permit be required to complete the scope of work on the project areas located within this worksite?

No

#4: Are you utilizing Federal Funding to complete the scope of work? This includes funds that are being shown as match or not.

Unknown

#5: Do you have knowledge of any previous cultural resource review within the project boundaries during the past 10 years?

No

#6: Are there any structures over 45 years of age within this worksite? This includes structures such as buildings, tidegates, dikes, residential structures, bridges, rail grades, park infrastructure, etc.

Unknown

Area: Right Bank access and staging

#1: Describe any planned ground disturbing pre-construction/restoration work. This includes geo-technical investigation, fencing, demolition, decommissioning roads, etc.

No ground disturbing activities planned in this phase.

#2: Describe the existing project area conditions. The description should include existing conditions, current and historic land uses and previous excavation/fill (if depths and extent is known, please describe).

The existing project area has a recent history of agricultural use and this is mostly the current use as well. Portions of the lower Entiat had bulldozers driven down the stream bed, but no definitive record has been found to show that has occurred in this location. The banks appear armored, but no levees are not evident. Instream work was completed at the downstream boundary, Dinkelman Weir, and the upstream boundary, HD Weir, of the project area.

#3: Will a federal permit be required to complete the scope of work on the project areas located within this worksite?

No

#4: Are you utilizing Federal Funding to complete the scope of work? This includes funds that are being shown as match or not.

Unknown

#5: Do you have knowledge of any previous cultural resource review within the project boundaries during the past 10 years?

No

#6: Are there any structures over 45 years of age within this worksite? This includes structures such as buildings, tidegates, dikes, residential structures, bridges, rail grades, park infrastructure, etc.

Unknown

Area: Wick Left Bank

#1: Describe any planned ground disturbing pre-construction/restoration work. This includes geo-technical investigation, fencing, demolition, decommissioning roads, etc.

No ground disturbing activities planned in this phase.

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#2: Describe the existing project area conditions. The description should include existing conditions, current and historic land uses and previous excavation/fill (if depths and extent is known, please describe).

The existing project area has a recent history of agricultural use and this is mostly the current use as well. Portions of the lower Entiat had bulldozers driven down the stream bed, but no definitive record has been found to show that has occurred in this location. The banks appear armored, but no levees are not evident. Instream work was completed at the downstream boundary, Dinkelman Weir, and the upstream boundary, HD Weir, of the project area.

#3: Will a federal permit be required to complete the scope of work on the project areas located within this worksite?
No

#4: Are you utilizing Federal Funding to complete the scope of work? This includes funds that are being shown as match or not.
Unknown

#5: Do you have knowledge of any previous cultural resource review within the project boundaries during the past 10 years?
No

#6: Are there any structures over 45 years of age within this worksite? This includes structures such as buildings, tidegates, dikes, residential structures, bridges, rail grades, park infrastructure, etc.
Unknown

Project Permits

Permits and Reviews	Issuing Organization	Applied Date	Received Date	Expiration Date	Permit #
None - No permits Required					

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Attachments

Required Attachments

7 out of 7 done

Applicant Resolution/Authorizations	✓
CCA Tribal Notification	✓
Cost Estimate	✓
Landowner acknowledgement form	✓
Map: Planning Area	✓
Photo	✓
RCO Fiscal Data Collection Sheet	✓

PHOTOS (JPG, GIF)

Photos (JPG, GIF)



666671 # 666672

PROJECT DOCUMENTS AND PHOTOS

Project Documents and Photos

File Type	Attach Date	Attachment Type	Title	Person	File Name, Number Associations	Shared
	04/18/2025	Application Document	Entiat-River-Mills-05-Entiat-1D-Habitat-Enhancement-Final-De	MikeK	Entiat-River-Mills-05-Entiat-1D-Habitat-Enhancement-Final-Design (002).pdf, 666705	✓
	04/18/2025	Design document	Lower Ent Prelim BOD_small.pdf	MikeK	Lower Ent Prelim BOD_small.pdf, 666683	✓
	04/18/2025	Map: Planning Area	Location Map.pdf	MikeK	Location Map.pdf, 666681	✓
	04/18/2025	Design document	Entiat1D_Preliminary Plans.pdf	MikeK	Entiat1D_Preliminary Plans.pdf, 666680	✓
	04/18/2025	Visuals	Visuals of Reach Ent 4.6.pdf	MikeK	Visuals of Reach Ent 4.6.pdf, 666678	✓
	04/18/2025	Photo	LWD structure pano.jpg (1).JPG	MikeK	LWD structure pano.jpg (1).jpg, 666672	✓
	04/18/2025	Photo	Harrison LWD pool.jpg	MikeK	Harrison LWD pool.jpg, 666671	✓
	04/18/2025	RCO Fiscal Data Collection Sheet	SRFB 2025_FiscalDataCollectionSheet_final.pdf	MikeK	SRFB 2025_FiscalDataCollectionSheet_final... 666661	
	04/18/2025	Landowner acknowledgement form	Garn Christensen_LandownerAcknowledgement	MikeK	Garn Christensen_LandownerAcknowledge... 666660	
	04/18/2025	Landowner acknowledgement form	BRUCE_WICK_LandownerAcknowledgem	MikeK	BRUCE_WICK_LandownerAcknowled... 666659	
	04/18/2025	Cost Estimate	Ent 1D-CostEstimate (2).xlsx	MikeK	Ent 1D-CostEstimate (2).xlsx, 666655	✓
	04/18/2025	CCA Tribal Notification	CCA-TribalNotices_CCNRD_2025.pdf	MikeK	CCA-TribalNotices_CCNRD_2025.pdf, 666654	✓
	04/18/2025	Applicant Resolution/Authorizations	SRFB2025_CCNRD_ApplicantAuthorizatic	MikeK	SRFB2025_CCNRD_ApplicantAuthori... 666653	✓

Application Status

Application Due Date: 06/23/2025

Status Name	Status Date	Submitted By	Submission Notes
Application Submitted	04/18/2025	Mike Kane	Thanks Amee and Ariel!
Preapplication	04/02/2025		

Project Application Report - 25-1215

I certify that to the best of my knowledge, the information in this application is true and correct. Further, all application requirements due on the application due date have been fully completed to the best of my ability. I understand that if this application is found to be incomplete, it will be rejected by RCO. I understand that I may be required to submit additional documents before evaluation or approval of this project and I agree to provide them. (Mike Kane, 04/18/2025)

Date of last change: 04/18/2025

CUMULATIVE TOTALS

This sheet contains automatic calculations

Project Name	Entiat 1D Habitat Enhancement Final Design
SRFB #	25-1215
Sponsor	Chelan Co Natural Resource

	OVERALL PROJECT Cost	GRANT REQUEST Amount	PRISM MATCH Amount	MATCH NOT IN PRISM Amount	Budget Check
<u>Sheet #1 Acquisition</u>					
Property Costs	\$ -	\$ -	\$ -	\$ -	0
Incidental Costs	\$ -	\$ -	\$ -	\$ -	0
Administrative Costs	\$ -	\$ -	\$ -	\$ -	0
Indirect Costs	\$ -	\$ -	\$ -	\$ -	
STotal	\$ -	\$ -	\$ -	\$ -	0
<u>Sheet #2 Design</u>					
Design Costs	\$ 260,345	\$ 260,345	\$ -	\$ -	
Indirect Costs	\$ -	\$ -	\$ -	\$ -	
STotal	\$ 260,345	\$ 260,345	\$ -	\$ -	0
<u>Sheet #3 Restoration</u>					
Construction Costs	\$ -	\$ -	\$ -	\$ -	0
AA&E	\$ -	\$ -	\$ -	\$ -	0
Indirect Costs	\$ -	\$ -	\$ -	\$ -	
STotal	\$ -	\$ -	\$ -	\$ -	0
Totals	\$ 260,345	\$ 260,345	\$ -	\$ -	0

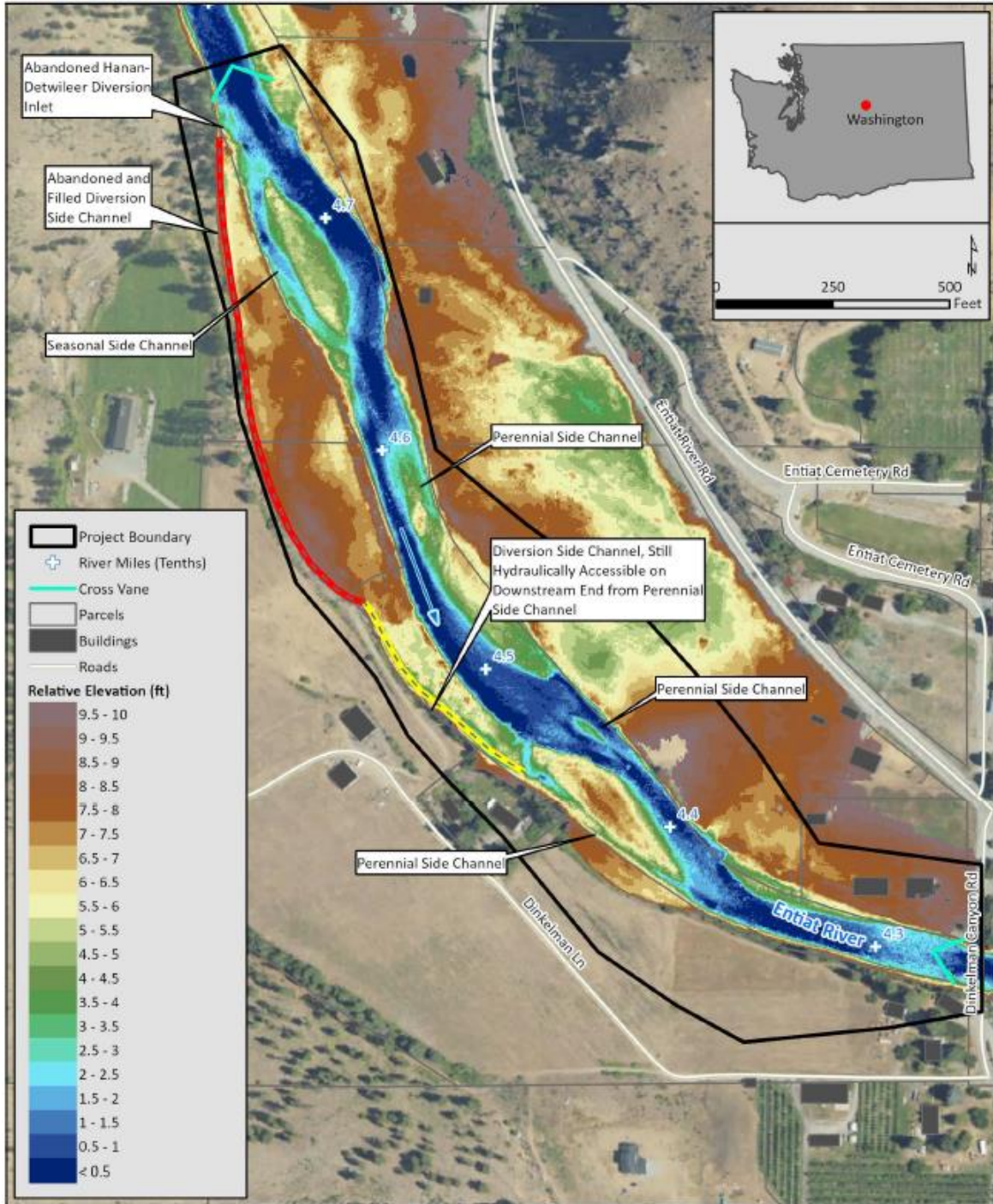


Figure 1: Project Area Existing Conditions



**Lower Entiat 1D Reach (RM 4.3 – 4.8)
Habitat Enhancement Project
Preliminary Basis of Design Report**



Chelan County Natural Resource Department
411 Washington St #201
Wenatchee, WA 98801



1900 N. Northlake Way, Suite 211
Seattle, WA 98103

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INTRODUCTION

The Chelan County Natural Resource Department (CCNRD) is leading restoration efforts to support the recovery of Endangered Species Act (ESA) listed salmonids within the Entiat River. This project is focused on Reach 1D between River Miles (RM) 4.3 – 4.8 of the Entiat River, bounded upstream by the Hanan-Detwiler diversion structure and downstream by Dinkelman Canyon Road bridge. The project’s designs focus on habitat enhancement of ESA-listed species using engineered logjams to increase adult holding and juvenile rearing habitats, and riparian enhancement to improve stream shade and long-term wood recruitment potential. See Figure 1 for project area map.

This report presents the basis of design for restoration associated with the Lower Entiat 1D project. The draft preliminary designs are presented in Appendix A.

PROJECT BACKGROUND

The Lower Entiat River 1D project reach (RM 4.3 – 4.8) is located within the Entiat River-Mills Creek Assessment Unit (AU) which extends from the Entiat River confluence with the Columbia River up to the confluence with the Mad River tributary at RM 10.7. Within this AU, the project reach is located within reach 5 which extends from RM 4.0 – 5.8 (UCSRB 2020). In 2020, the Upper Columbia Salmon Recovery Board (UCSRB) provided prioritization of salmon restoration and protection actions within the Upper Columbia basin (UCRTT 2020). This work included the prioritization of habitat action types at a reach scale within the Lower Entiat reach 5. Overall, the Entiat River-Mills Creek AU is a Tier 1 restoration reach for steelhead, a Tier 2 reach for both Spring Chinook and bull trout (UCSRB 2020a).

In the fall of 2020, in collaboration with the CCNRD, Natural Systems Design (NSD) initiated development of a reach-scale assessment of restoration opportunities within the Lower Entiat River within reach 5. The primary purpose of the effort was to describe a suite of potential salmon habitat enhancement and restoration actions that contribute to the recovery of ESA-listed species by directly addressing “at risk” reach-scale ecosystem indicators (REI) (NSD 2021).

To support this evaluation, NSD conducted an assessment of existing conditions and potential restoration opportunities through collecting field data and combining it with existing available information the Entiat River-Mills Creek AU and specifically Reach 5. Existing available information utilized in the assessment includes, but was not limited to, the Bureau of Reclamation (Reclamation) Lower Entiat Reach Assessment (Reclamation 2012), the Habitat Action Prioritization Strategy and supporting data sources (UCRTT 2020, UCSRB 2020a, UCSRB 2020b, UCSRB 2021), the Upper Columbia Biological Strategy (UCRTT 2021), and available digital LiDAR data (WDNR 2015). The conclusions presented in the 2021 document provide an overview of project opportunities within the lower Entiat River 1D reach. Those project opportunities were used to provide the framework for developing the preliminary plans as presented in this report.

Salmonid Use in the Project Reach

The lower Entiat River is utilized by multiple life history stages of Upper Columbia River spring Chinook salmon (*Oncorhynchus tshawytscha*) (ESA Endangered), Upper-Columbia Summer Steelhead (*Oncorhynchus mykiss*) (ESA Endangered), and Columbia River bull trout (*Salvelinus confluentus*) (ESA Threatened) (Andonaegui, C. 2001, UCRTT 2017). In the study area the highest use is associated with juvenile salmonids, primarily steelhead, during summer and winter rearing months. Spring Chinook juveniles also are present and use winter rearing habitats. The Lower Entiat River 1D Reach (RM 4.3 – 6.3) characterization is based on the US Bureau of Reclamation report that analyzed the lower 26 miles of the Entiat River (USBR 2009). The USBR reported Reach 1D as having

a “lack of spawning habitat, juvenile rearing habitat, and adult holding habitat” for Upper Columbia steelhead, and a “lack of juvenile rearing habitat and adult holding habitat” as well as a habitat limiting factor of summer and winter water temperatures for Upper Columbia spring Chinook salmon. Table 1 outlines the use for each critical life history stage within the study area.

Table 1: ESA-listed salmonid status and life history stage use in the Lower Entiat River, Entiat River-Mills Creek AU, Reach 5 (UCSRB 2021)

SPECIES/LIFE HISTORY	ESA STATUS	ADULT MIGRATION	ADULT HOLDING	SPAWNING	FRY	SUMMER REARING	WINTER REARING	SMOLT
SPRING CHINOOK	Endangered	Low	Not Supported	Not Supported	Not Supported	Low*	High*	Low
STEELHEAD	Threatened	Low	Low*	Medium	Medium	High*	High*	Medium
BULL TROUT	Threatened	Low	Not Supported	Not Supported	NA	NA	NA	NA

****Salmonid life history targeted to improve with this project***

Existing Conditions

The project reach (RM 4.3 – 4.8) is bounded by the abandoned Hanan-Detwiler diversion structure at the upstream end of this project, and the Dinkelman Canyon Road bridge at the downstream. The project reach includes private landowners on both sides of the river. See Figure 1: Project Area Existing Conditions below for an overview of the project reach.

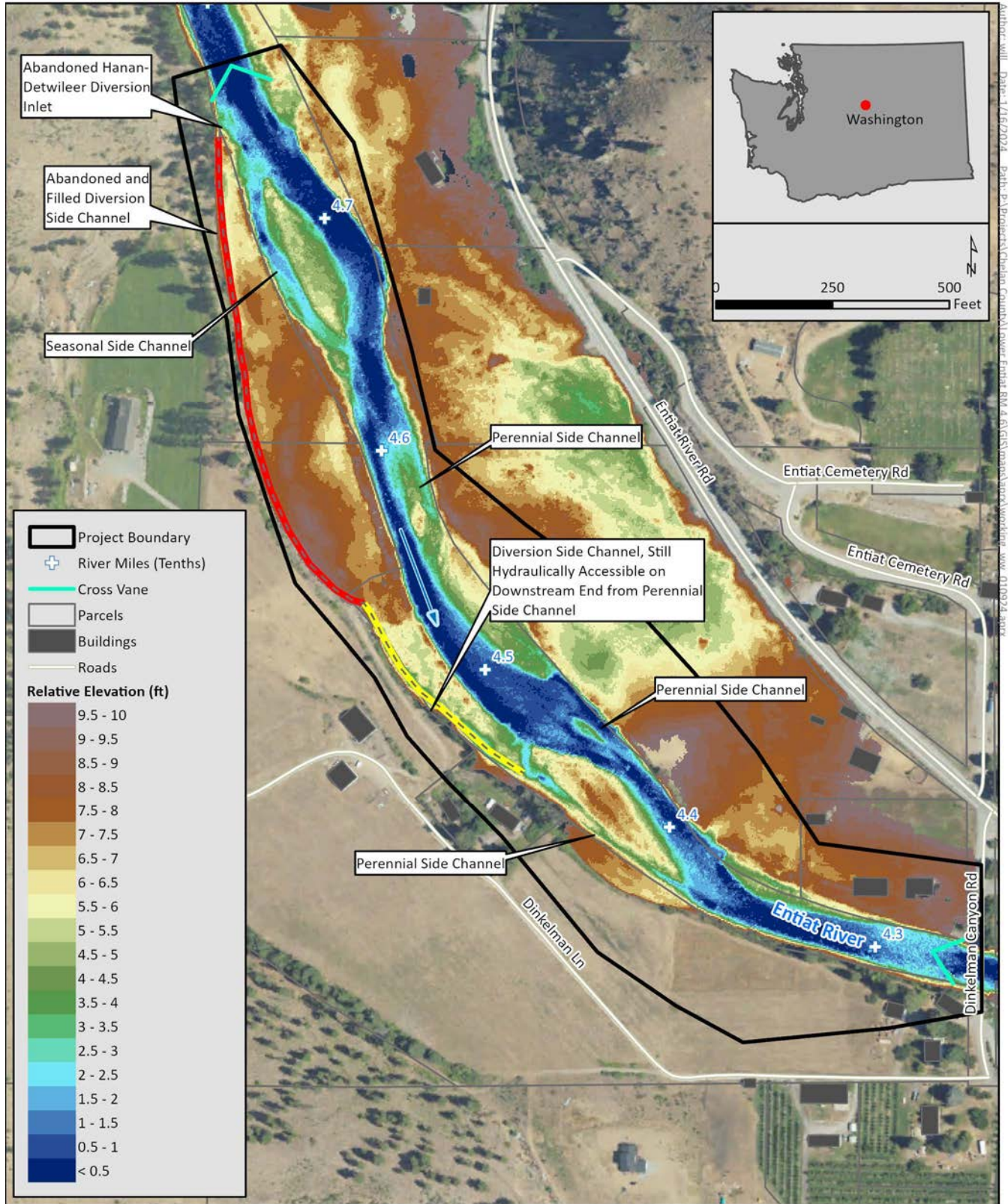


Figure 1: Project Area Existing Conditions

Within the project reach the river channel morphology is plane bed, and is relatively straight (sinuosity 1.1), and moderately steep (slope 1.1%). The channel substrate consists of armored/embedded coarse glacial outwash, with cemented banks. The channel features rifles, runs, an existing cross vane, and seasonal and perennial side channels (Figure 2). The channel maintains a largely single-threaded planform with occasional split flows around islands and has maintained a very narrow channel migration corridor due to confinement by terraces composed of erosion-resistant glacial outwash (Reclamation 2012). Steep bedrock slopes form the channel margin in several places and provide angular boulders to the reach. Side channels are generally located along the inside of channel bends and are predominantly activated at higher spring flows; however, two perennially flowing side channels do persist at RM 4.7 and 4.5. Accumulations of LWD are typically located at the head of island features, with additional LWD racked in existing vegetation or on gravel/boulder bars. Aside from these few channel islands and side channel inlets, few other locations have significant accumulations of LWD. Scour and pool formation is limited, with the few deep pools within the reach associated with thalweg scour along the bedrock margins of the valley wall. The existing riparian buffer consists of willow and red-osier dogwood shrub communities with a narrow band of mature cottonwood. The LWD recruitment potential is limited due to the naturally armored banks, lack of LWD forcing agents, and lack of large trees along the corridor (Reclamation 2012).

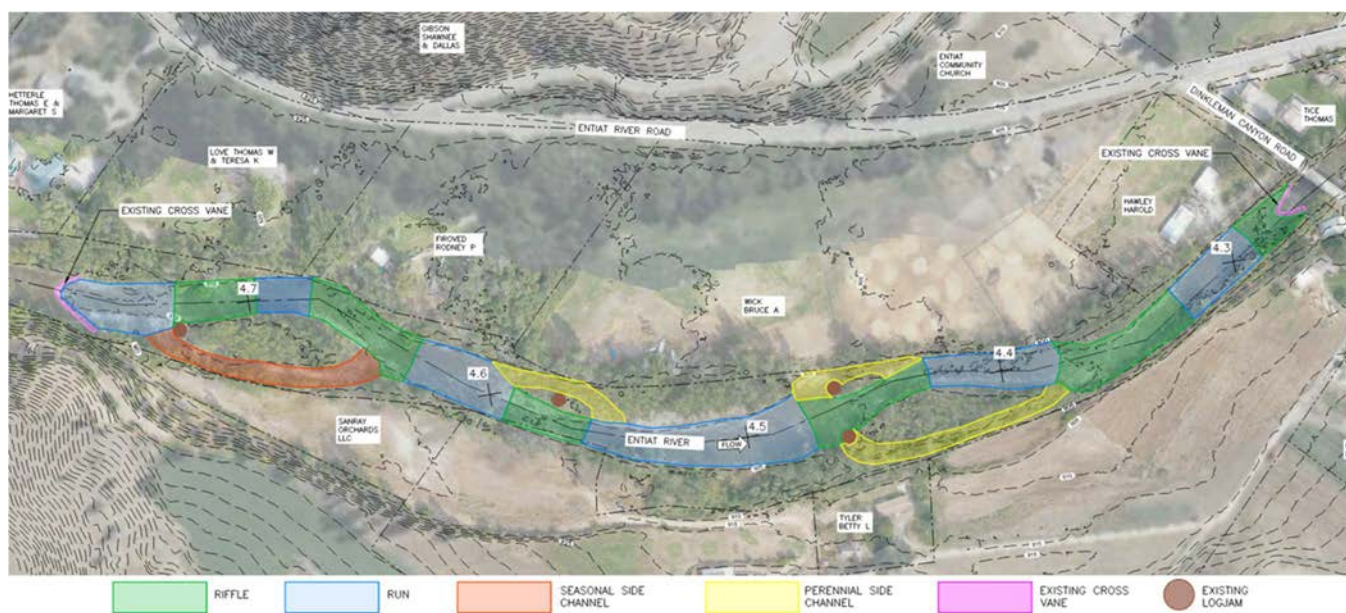


Figure 2: Project Area Existing Stream Features

The lower Entiat River has a recent history of anthropogenic impacts to instream habitat, floodplain connectivity, and riparian communities have degraded the habitat forming and maintaining processes that support aquatic and terrestrial species. Impacts associated with logging, log drives, dams (the former Mill dam at RM 3.6 is downstream from the study reach), flood control dredging, agriculture and irrigation, road construction, fire, the removal of beaver, and the removal of riparian vegetation have all contributed to degraded habitat.

The Reach-based Ecosystem Indicators (REI) analysis (Reclamation 2012) found that within Lower Entiat River, water quality (temperature); habitat quality (large woody debris, pools, off-channel habitat), floodplain connectivity, and riparian vegetation were in an “at risk” condition due to historic anthropomorphic impacts, including floodplain development, bed armoring (embeddedness), and a lack of large wood recruitment potential. Table 4 below presents the UCSRB (2020b) evaluation of Reach 5 REIs and a crosswalk with those REIs

that ranked “unacceptable” and “at risk” with the target salmonid life history stage, and potential restoration actions.

Table 2: Unacceptable and At-Risk Reach-Based Ecosystem Indicators, Life History Stage Target, and Action Crosswalk for Entiat River-Mills Creek AU, Reach 5 (UCSRB 2020b).

GENERAL CHARACTERISTIC	GENERAL INDICATOR	ATTRIBUTE	LIFE HISTORY STAGE TARGET	ACTION CROSSWALK
Watershed Condition	Water Quantity and Quality	Temperature	Summer Rearing	Increase Riparian Shade and Hyporheic Flows
Habitat Quality				
	Large Woody Debris	Cover	Summer and Winter Rearing	Increase Wood Structure and Sources
	Pools	Pool frequency and quality	Summer Rearing	Create Pools with Instream Structure
	Off-Channel Habitat	Side Channels	Summer and Winter Rearing	Side Channel/Off-Channel Habitat Restoration
	Undercut Banks	Cover	Summer Rearing	Improve Riparian Health and Root Cohesion
Channel Condition	Floodplain Connectivity	Riparian Structure/Canopy Cover	NA	Riparian Planting
	Substrate	Embeddedness	Winter Rearing	Increase Sediment Sorting
	Channel Complexity	Cover, Pools, LWD	Summer and Winter Rearing	Increase LWD and Pool Formation and Maintenance

Past restoration actions near the project reach have been limited to the construction of the John Small Pond and side channel at RM 5.0, led by the Washington Department of Fish and Wildlife (WDFW) in 2004, the abandonment of the Hanan-Detwiler diversion and the construction of channel spanning cross-vanes at RM 4.75 and RM 4.6 in 2007. The upstream cross vane was installed at the Hanan-Detwiler diversion intake to create pool habitat and maintain the fish bypass channel. The downstream cross vane at Dinkelman Canyon Rd bridge was installed to provide pool habitat. In 2014, the project reach was designated as a temporary control reach for monitoring efforts which prevented any additional restoration actions from occurring up to 2020. Currently restoration actions can now be taken to improve current instream and floodplain conditions that directly benefit those key juvenile salmonid life history stages that rely on summer and winter rearing habitats.

In August 2023 NSD and CCNRD staff conducted a reconnaissance of the project reach to evaluate examine geomorphic and habitat conditions, evaluate potential conceptual restoration actions, and evaluate construction feasibility for restoration actions. Figure 3 through Figure 11 provide examples of existing conditions observed by the NSD team.



Figure 3: Left panel: example of coarse bed material at RM 4.6 facing downstream. Right panel: riffle crest above plane bed channel at RM 4.65.

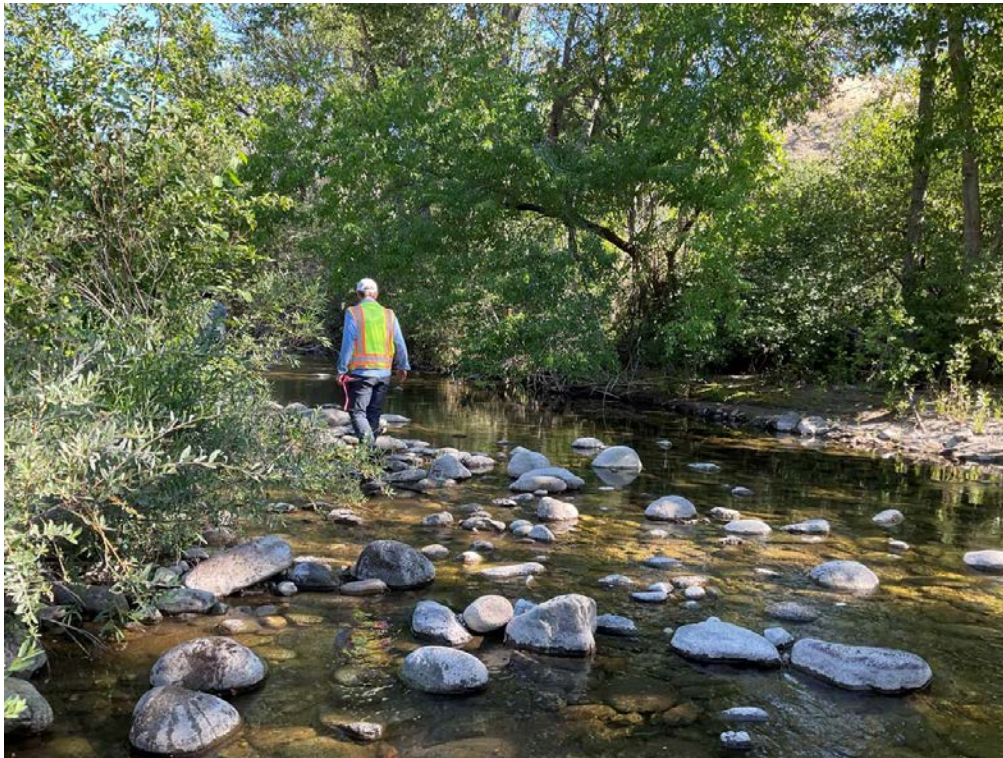


Figure 4: Perennial side channel on left bank facing upstream at RM 4.57



Figure 5: Typical bank armoring with coarse cobble and root cohesion.



Figure 6: Natural wood accumulation at island head near right bank side channel at RM 4.73.



Figure 7: Perennial side channel on river right at RM 4.73. Left panel: Wood jam at right bank side channel inlet at RM 4.47. Right Panel: Side channel conditions during low fall flows.



Figure 8: Seasonal side channel on river right at RM 4.73 below the Hanan-Detwiler cross vane. Left panel is November 2021 with shallow flow, right panel is dry in August 2023.

The Hanan-Detwiler diversion was constructed in 2007 and includes a channel-spanning cross vane weir (Figure 9), two rootwad structures downstream of the cross vane on the banks of the main channel, and a 1,500-foot-long fish return channel. The project was intended to improve fish passage, conserve water, and minimize diversion operation and maintenance on the Entiat River. However, sometime in early 2011 the diversion was plugged with soil and boulders from the cross vane, rendering the diversion ditch dry (USBR 2012). A downstream cross vane (Figure 10), approximately 75 feet upstream of Dinkelman Canyon Road bridge, was constructed in 2001 to provide pool habitat but the excavated pool on the downstream end has since partially filled in.



Figure 9: Upstream cross vane at Hanan-Detwiler diversion at RM 4.78.



Figure 10: Downstream cross vane by Dinkelman Canyon Road bridge at RM 4.28

The existing riparian habitat is limited to narrow bands of primarily deciduous tree and shrub species directly adjacent to the river channel. These bands of native species include black cottonwood, ponderosa pine, willow, alder, poison oak, and snowberry. The majority of the wider floodplain areas have been cleared of woody vegetation for orchard and pasture (Figure 11)



Figure 11: Right bank open pasture near RM 4.7.

PROJECT GOALS AND OBJECTIVES

In 2012, Reclamation concluded that habitat restoration in the lower Entiat River “should be aimed at improving and enhancing those forms and processes that currently exist, rather than attempting to create wholly new conditions that may not be appropriate or sustainable” (Reclamation 2012). Human impacts within the lower Entiat River have had a large and detrimental effect on instream habitat. Due to existing conditions the river lacks the ability to readily create new habitat through natural processes alone. As a result of the confined river channel and limited floodplain habitats, the majority of habitat that historically existed on the lower Entiat River was instream habitat; therefore, re-establishing instream habitat is vitally important to salmon and steelhead (Reclamation 2012).

Overall, restoration measures should focus on recovering, to the extent possible, the impaired processes identified in Table 2. Although the proposed restoration measures are expected to benefit a large suite of native aquatic and terrestrial species, the primary purpose of this project is to propose a suite of potential salmon habitat restoration design elements that contribute to the recovery of ESA-listed species by directly addressing “at risk” reach-scale ecosystem indicators.

The following are the project goals and objectives:

- ▶ Goal: Improve side channel hydraulic connectivity and habitat quality for juvenile salmonids.
 - Objective: Improve existing seasonal and perennial side channel features through the strategic construction of ELJs to increase flow interaction and provide cover.
 - Objective: Remove human-constructed barriers to existing habitat to reconnect flows to side channels and floodplain features.
- ▶ Goal: Improve instream habitat for juvenile salmonids.
 - Objective: Install ELJs to provide cover, pool formation, and sediment sorting.

- Objective: Enhance hydraulic variability and provide instream cover.
- ▶ Goal: Increase riparian buffer structure and function related to stream shading and large wood recruitment potential.
 - Objective: Restore riparian mature riparian forested vegetation located within the 2-year floodplain or within 50 feet of the existing banks.
- ▶ Goal: Reduce instream water temperatures.
 - Objective: Increase main channel shade through riparian revegetation planting and long-term shading.
 - Objective: Increase hyporheic and floodplain flow storage and discharge through strategically constructing engineered log jams (ELJs) to deflect and increase flows into adjacent floodplain and gravel bar features.

HYDROLOGIC AND HYDRAULIC ASSESSMENT

The primary goals of NSD’s hydrologic assessments and hydraulic modeling are to evaluate current low flow and flood conditions, as well as the impact of flooding on adjacent properties. Additionally, NSD aims to iteratively assess the proposed design and gain an understanding of habitat-forming processes.

Hydrology

Peak flows are shown in Table 3 were estimated from USGS Gage Station 12452990 “Entiat River nr Entiat, WA” near Keystone Bridge (USGS 2001) and from the FEMA Flood Insurance Study at Fish Hatchery Road (FEMA 2004). The USGS gage data was available from 1996-2022 was used to estimate peak flows for the 1.25-, and 2-year recurrence intervals. Daily mean flow values during the summer months of 2023 were averaged to estimate a typical summer flow. The weighted skew method using regional skew values from Mastin et al. (2016) were applied to these flows for a more accurate estimation for the specific area. These flows were then scaled using the Drainage Area Ratio Method in Mastin et al. (2016) to produce model inflows near the Entiat Fish Hatchery upstream. This was necessary because the model inflow is located approximately 3 mi upstream of the gage, and thus has a smaller drainage area (391 sq mi compared to 419 sq mi) and therefore lower peak flows. For the 10- and 100-year flows, the estimates from the FEMA FIS study were used because it is upstream of the model inflow and is more similar to the USGS gage flow than the scaled estimate.

Table 3: Estimated Flows for Recurrence Intervals for model runs

RECURRENCE INTERVAL (YR)	FLOW AT USGS GAGE (CFS)	FLOW FROM FEMA FIS STUDY (CFS)	SCALED ENTIAT RIVER FLOW (CFS)	ENTIAT RIVER MODEL INFLOW (CFS)
Typical Summer Flow	112	-	100	100
1.25	2,412	-	2,370	2,370
2	3,174	-	3,130	3,130
10	5,125	5,600	4,030	5,600
100	8,020	8,300	5,460	8,300

Hydraulic Model Development

A 2-D unsteady hydraulic model was developed using the United States Army Corps Hydrologic Engineering Center’s (HEC) River Analysis System (RAS) 6.4.1. The model domain spans approximately 1.5 river miles, beginning approximately 0.5 miles upstream of the cross vane within the project area and ending approximately

0.75 miles downstream of Dinkelman Canyon Rd. The model geometry utilizes topobathymetric data from 2022 provided by the Department of Natural Resources. The mesh consists of various refinement regions that have cell sizes spanning from 10 ft to 30 ft, depending on the location within the floodplain.

The model domain includes two bridges: Dinkelman Rd bridge and the upstream Entiat River Rd bridge. These structures were put into the model using as much information as possible from as-built designs that were available, and estimations were made for the rest from point cloud data and photos.

Roughness

Hydraulic resistance is characterized in the model by polygons that represent different land cover areas such as buildings, crops, or vegetation. Each roughness type is assigned a manning's n roughness coefficient. The roughness values for each category were determined through the calibration process described below. Roughness categories for the model were assigned by hand based on aerial imagery.

The nine roughness categories – main channel, vegetated bars, engineered log jams, dense mature vegetation, sparse vegetation, crops, bare ground, roads, and buildings – were assigned discharge-varying roughness values (Table 4) due to the large span of discharge values used in model simulations.

Table 4: Calibrated manning's n roughness values for three flow regimes.

LAND COVER TYPE	LESS THAN 1,000 CFS	2,000-5,500 CFS	>5,500 CFS
Bare Ground	0.025	0.025	0.025
Building	0.015	0.015	0.015
Crop	0.04	0.04	0.04
Dense-Mat Veg	0.07	0.07	0.07
Main Channel	0.055	0.035	0.03
Road	0.02	0.02	0.02
Sparse Veg	0.07	0.05	0.038
Veg Bar	0.075	0.055	0.04
Side Channel ELJ	0.20	0.20	0.20

Calibration

The model was calibrated by comparing the modeled (or simulated) discharge and water surface elevation at the USGS gage location to the USGS rating curve (Figure 12). This was done for three different flow regimes since manning's n varies based on water depth. The roughness was adjusted to get the closest fit to the USGS rating curve.

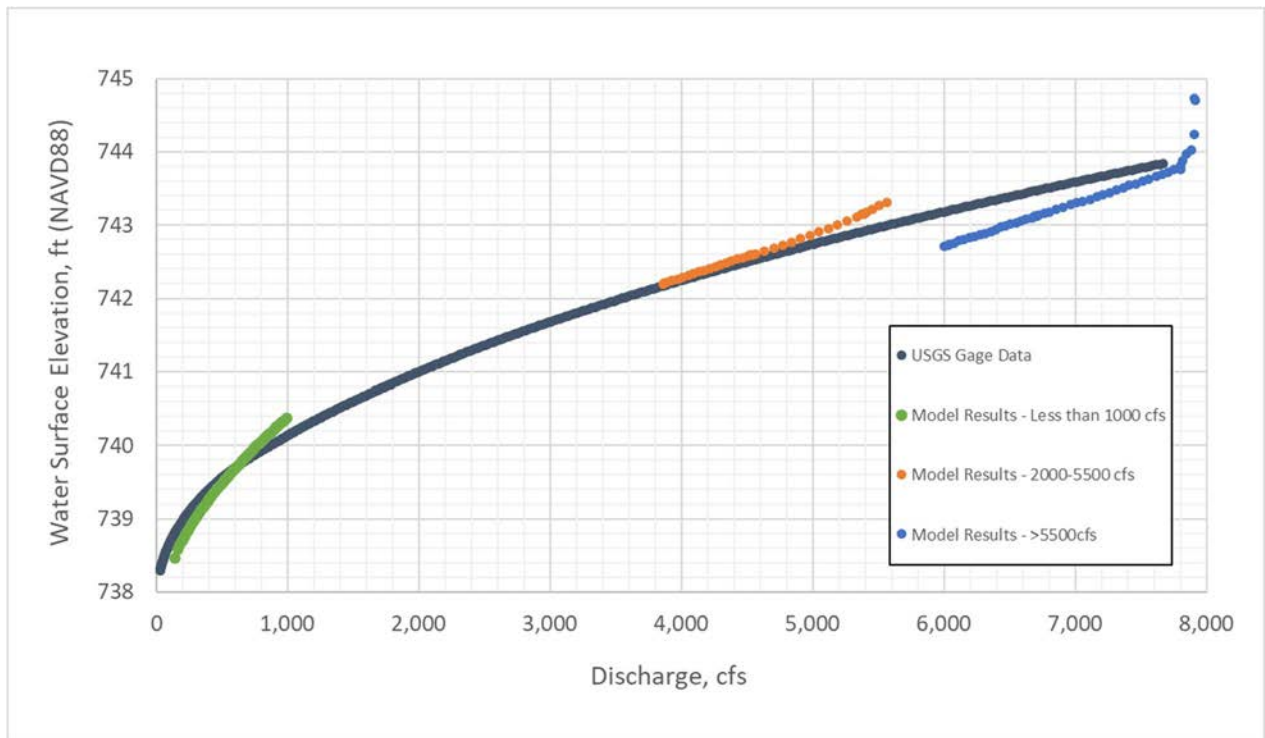


Figure 12. Roughness was calibrated for the model by comparing the USGS rating curve at gage 12452990 to the modeled rating curve for three different flow regimes.

Preliminary Hydraulic Model Results

The 2D hydraulic model was used to verify field observations and inform design development. Differences in hydraulic conditions between current existing conditions and proposed conditions after ELJ placement were evaluated for a typical summer low flow (100 cfs), 1.25-yr (2,370 cfs), 2-yr (3,130 cfs), 10-yr (5,600), and 100-yr (8,300 cfs) recurrence intervals. Visual depictions of hydraulic model outputs are provided in Appendix B.

Results indicate minimal effects on depth and velocity during a typical summer flow but show significant differences localized around proposed ELJs during the recurrence intervals that were evaluated. Localized trends indicate an average increase in depth of up to one foot around ELJs throughout the reach. Furthermore, the ELJs tend to reduce velocity in the main channel and increase velocity/conveyance in the floodplain, which occurs when discharge is around 5,000 cfs. Depths and velocities were averaged for the entire reach, including the floodplain, and can be viewed in Table 5. Overall, proposed ELJs resulted in no change in average depths except for the 100-year recurrence interval, where average depths decreased due to depths increasing in the floodplain. Averaged proposed velocities remained the same as existing in the Summer and 2-year recurrence intervals, but decreased in the 1.25-year, 10-year, and 100-year intervals. Results show no impact from ELJs on water surface elevation at either the Dinkelman Road Bridge or the Entiat Road Bridge downstream of the project area for any of the modeled scenarios.

Table 5. Reach-Averaged Depth and Velocity from Existing Conditions and Proposed Conditions Model Simulations

Flow	Existing Conditions Reach-Averaged Depth, ft	Proposed Conditions Reach-Averaged Depth, ft	Existing Conditions Reach-Averaged Velocity, ft/s	Proposed Conditions Reach-Averaged Velocity, ft/s
Typical Summer (100 cfs)	0.8	0.8	1.8	1.8
1.25 yr (2,370 cfs)	2.7	2.7	7.0	6.9
2 yr (3,3130 cfs)	3.1	3.1	7.4	7.4
10 yr (5,600 cfs)	3.4	3.4	8.2	8.1
100 yr (8,300 cfs)	3.3	3.1	7.0	6.6

Typical Summer Flow Event Results Summary

The Summer Flow event inundates one side channel, and depth is not larger than three feet for both existing and proposed. Depth and velocity change is very minimal and localized to the proposed ELJ locations in the main channel.

1.25-year Recurrence Interval Event Results Summary

The 1.25-year flow event inundates three side channels. Depth in the side channels is 4 feet and lower, and the main channel ranges from 1 to 7 feet deep. The proposed ELJs generally influence hydraulics locally. The ELJs increase depth upstream up to 2 feet, and decrease depth immediately downstream around 0.5 feet. The most upstream proposed deflector on the left bank increases flow to the right bank side channel, increasing the water depth around 1 foot. See Figure 13.

100-year Recurrence Interval Event Results Summary

The 100-year flow increases water depth in the main channel around 1 to 2 feet upstream of the proposed ELJs. Depths are also increased on the floodplain, up to 1 feet, see Figure 14. Structures on the left bank are currently inundated in the existing conditions 100-year event, but depth is slightly increased in proposed conditions at the structures by 0.25 feet. ELJ placement and modeling updates will need to be further investigated at future design phases to understand the ultimate effects of the project on local landowners.

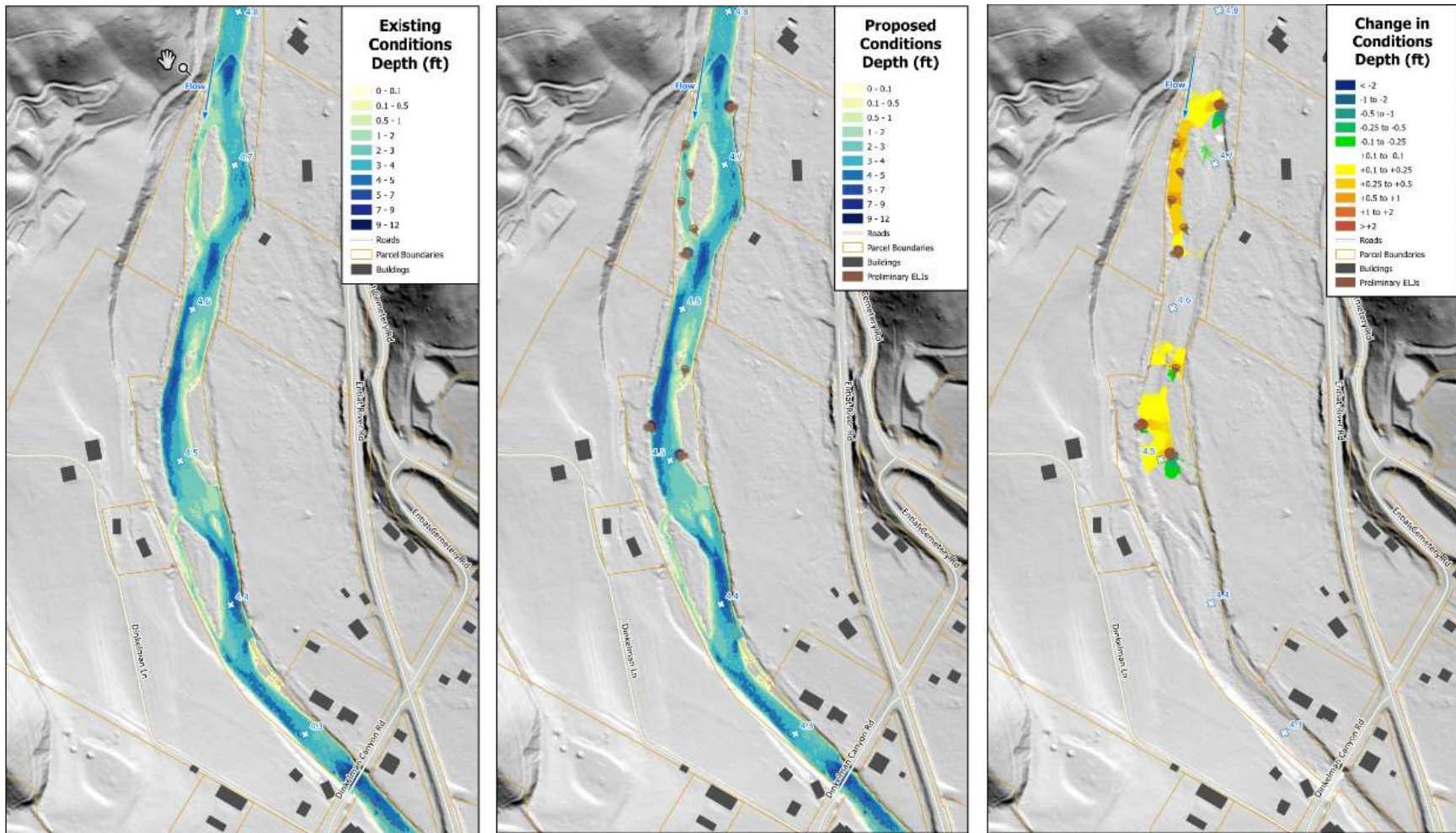


Figure 13: EC and PC 1.25-year hydraulic depth and change in depth

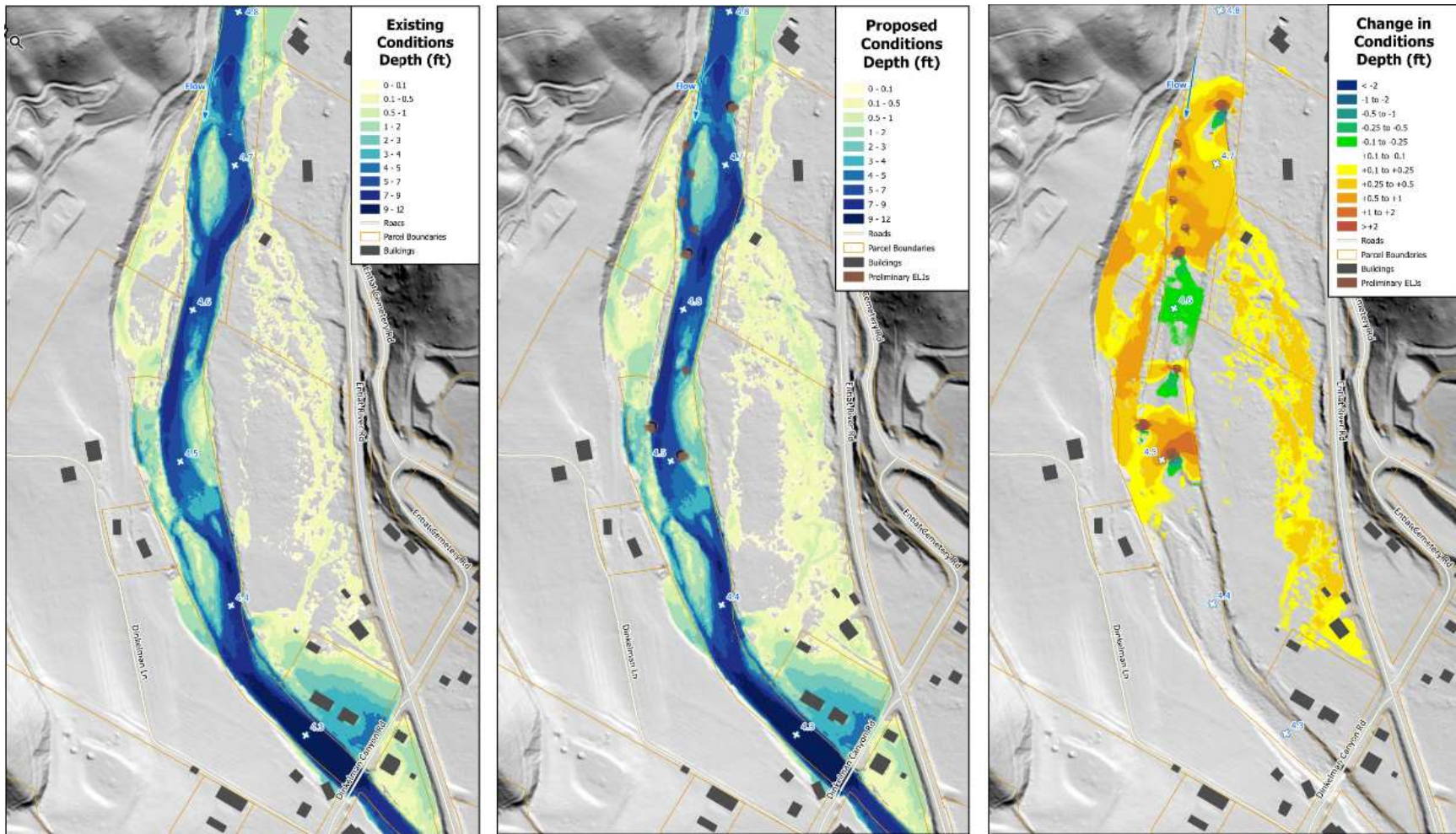


Figure 14: EC and PC 100-year hydraulic depth and change in depth

DESIGN DEVELOPMENT

Design History

Alternatives Analysis

In 2021 NSD presented key considerations for design and construction for the project reach (NSD 2021). Opportunities identified in the project reach included large swaths of riparian plantings, apex jams at island heads, and deflector jams at side channel outlets. The analysis also recommended looking into restoring the Hanan-Detwiler fish return channel.

These recommendations were used to guide the development of conceptual and preliminary plans and ELJ layout.

Conceptual Design

The conceptual design included 17 ELJs, divided into seven design groups, that function independently from one another. The design groupings were arranged so the County and stakeholders could choose which treatments to move forward with in future design phases. Similarly, the riparian treatment options include two scenarios of planting areas of high and low priority. The higher priority plantings are closest to the river's edge with optional secondary plantings extending farther into the floodplain. See Figure 15 below.

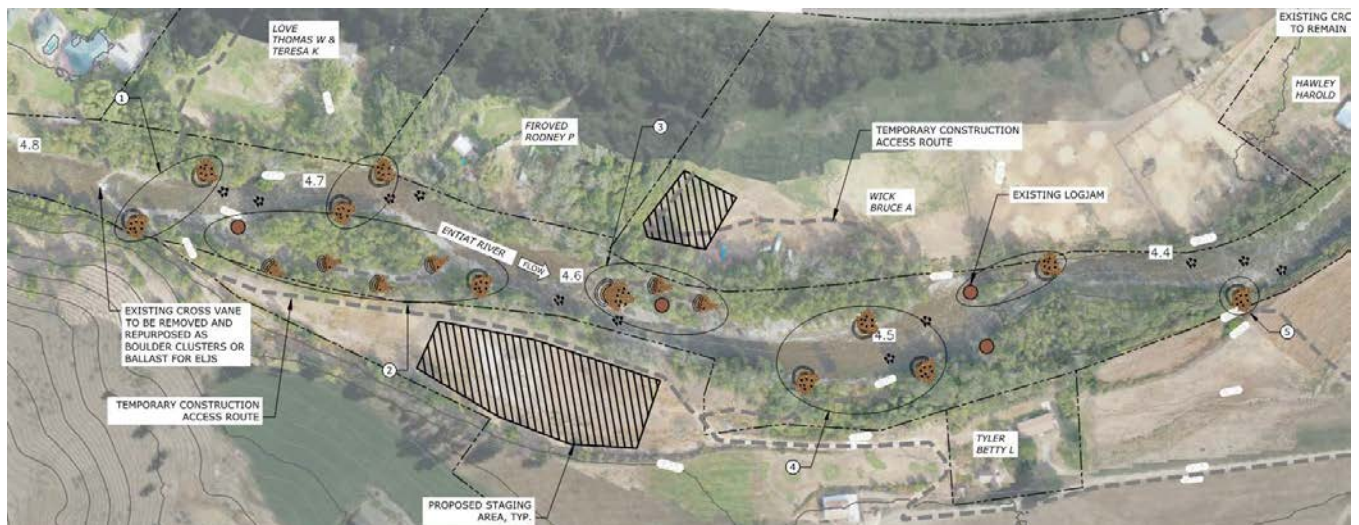


Figure 15: Conceptual Design overview from sheet 5 of the plans dated January 4, 2024

Deflector groups

The deflector groups include an array of 2-3 structures per group on the banks to provide in-stream complexity and allow wood to rack on the front of the structure. The deflector groups will provide cover, slow water down and increase pool habitat and placed in sections of the river that are deeper and slower, to have the most impact on river hydraulics and allow the formation of pools.

Side channel groups

The side channel groups proposed during the conceptual phase consisted of an apex at the head of each island (two of the three side channels have an existing island head jam, so no apex was proposed at those island

heads), and, where appropriate, smaller bank jams within the side channel. Additionally, a deflector was proposed at the outlet of each side channel. The apex jam was intended to split flows and rack loose wood. The smaller jams within the side channel were proposed to provide hydraulic complexity within the side channels and help form pools for resting areas. Deflector jams at the outlet of each side channel will encourage backwater and form pools.

Boulder clusters

The first upstream cross vane was proposed to be taken out and repurposed as boulder clusters to provide in-stream complexity or ballast for the ELJs. The downstream cross vane 75 ft upstream of Dinkleman Canyon Road bridge was proposed to stay in place.

Riparian Planting

Native trees and shrubs were proposed to be planted to increase riparian health and stream shading, establish wood recruitment potential, and provide an enhanced habitat corridor. High priority planting was proposed to extend at least 50 feet from the river's edge to provide a buffer. Additional lower priority planting 100-200 feet further onto the floodplain was recommended pending landowner approval.

Preliminary Design

Preliminary designs were developed for the Lower Entiat based on an understanding of current geomorphic processes, the project goals and objectives, as well as basin-specific knowledge and expertise pertaining to similar projects. All project actions included in the preliminary design are intended to address specific project objectives directly or indirectly, and ultimately, the documented ecological concerns. Preliminary design plans are attached in Appendix A.

The preliminary design included the following analyses and updates:

- ▶ Updated hydraulic analysis and refinement of ELJ placement to further optimize desired hydraulic effects. This included building the ELJs into the surface to better understand expected effects.
- ▶ Refinement of ELJ structure design to improve structure stability and increase habitat benefits.

The hydraulic updates made during the preliminary design process show an increase in water surface elevation on the floodplain, with some rise to surrounding homeowners. Due to the confined area with private landowners on both sides of the river, water surface elevation rise is sensitive. To reduce rise, the ELJ count went from seventeen ELJs in conceptual to thirteen ELJs at the start of the preliminary process.

After discussions with the County, additional design adjustments were made to account for difficult construction access, culturally sensitive areas, and landowner restrictions. These updates resulted in a final ELJ count of nine. Figure 16 shows the water surface elevation for the Conceptual, Preliminary 1, and Preliminary 2 design stages. In summary, the following changes and updates were made for the final preliminary design:

- ▶ Keep the upstream cross vane in place to limit permitting hurdles and difficult construction access.
- ▶ Eliminate the boulder clusters that were proposed as they were planned to be sourced from the cross vane removal.
- ▶ The removal of the Group One right bank deflector ELJ, due to keeping the cross vane.
- ▶ The removal of the Group Three deflectors because of increased water surface elevation rise at the Firoved property.
- ▶ The removal of the Group Four apex ELJ due to increased left bank floodplain water surface elevation rise.

- ▶ The removal of the most downstream Group Five right bank deflector ELJ to encourage more flow to the downstream right bank side channel.
- ▶ The removal of the Group Six deflector because of increased left bank floodplain water surface elevation rise.
- ▶ The removal of the Group Seven deflector due to a culturally sensitive area.
- ▶ The limiting of priority riparian buffer on the left bank to 25 feet from the river's edge, down from 50 ft. The right bank secondary riparian buffer was removed, and priority planting buffers were changed to cluster planting due to landowner plans to establish land for cattle.

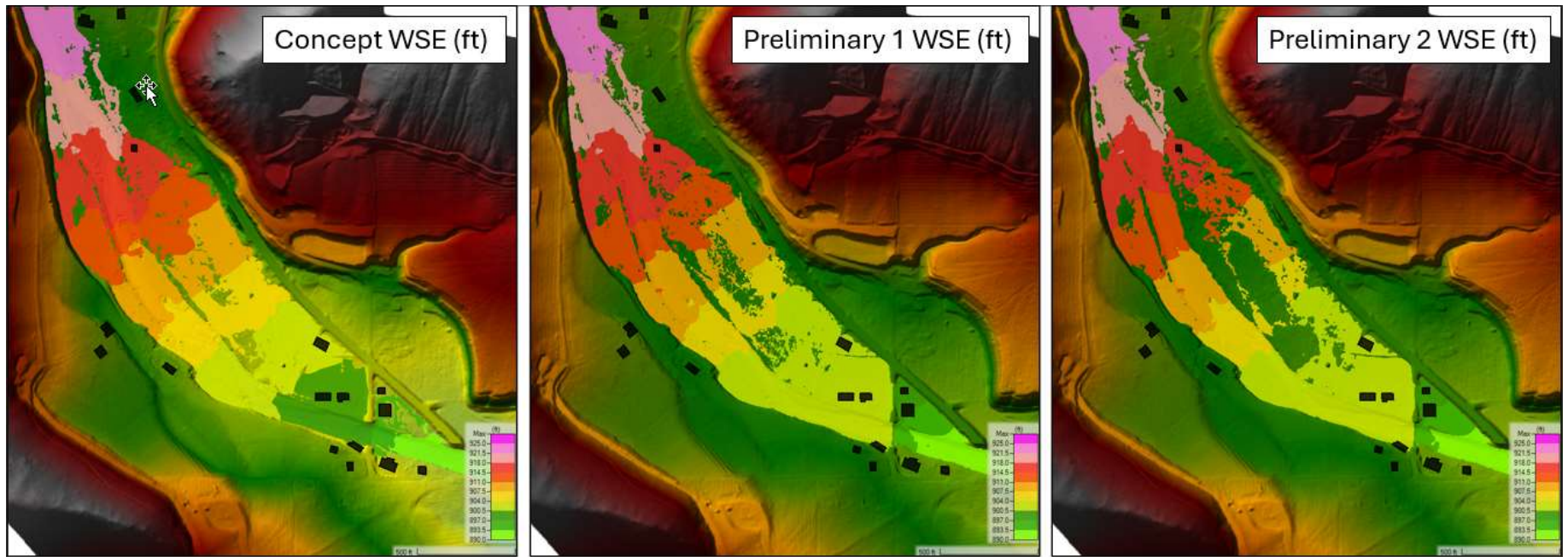


Figure 16 : Concept, Preliminary 1, and Preliminary 2 design 100-year WSE (ft).

Engineered Log Jam Design

The goals of the ELJs remain the same from the conceptual design; The deflector groups will provide cover, slow water down and increase pool habitat and placed in sections of the river that are deeper and slower, to have the most impact on river hydraulics and the maintain the scour pool that will be constructed. The smaller jams within the side channel will provide hydraulic complexity within the side channels and help form pools for resting areas while slowing down flows. Both types of jams include a scour pool that will be excavated in front of the structure to provide immediate pool habitat.

The ELJs will utilize rootwad posts with some installed at a batter angle. The ELJs will need to be excavated prior to post placement. Post elevations (10 ft below thalweg for the side channel ELJs, and 15 ft below thalweg for the deflector ELJs) were determined based on stability calculations. Rootwad posts are recommended to be used instead of piles due to the large cobbles within the streambed. For both the side channel and deflector ELJs, racking and slash material is placed particularly on the upstream end and flanks of the ELJ to provide complex instream cover. The structures are designed such that scour will not destabilize the structure. If scour occurs, the structure is intended to “self-settle”, essentially lowering the overall elevation of the structure in conjunction with scour; however the racking material at the front of the structure which is countersunk below the bed elevation should serve as a buffer against potential scour. The deflectors will include three bolted connections, at the final (top) layer of the ELJ with the large rootwads pinned to the rootwad posts. This is to prevent the top logs from floating away.

Reviewing the Reach Assessment report by the BOR, they recommend that to have the best impact, structures need to occupy at least 30% of active/bankfull channel and force significant flow divergence to maintain scour pools because of the coarse bed armor (USBR 2009). For the deflectors, the average active channel is approximately 100 feet in width, using the 1.25-year flow. This results in a structure that protrudes at least 30 feet perpendicular to flow. The design team updated the deflector jam design to extend 30 feet into the active channel and updated the location and increased the size of the scour pool based on this recommendation. To verify the effectiveness of this structure size in maintaining pool scour, we cross-checked this recommendation with our hydraulic model outputs, confirming that the proposed design should sustain pool scour under the anticipated flow conditions.

ELJ Risk-Based Design Analysis and ELJ Stability Factors of Safety

NSD applied the basic risk evaluation method as outlined in the Bureau of Reclamation (Reclamation) Large Woody Material - Risk Based Design Guidelines (Reclamation 2014) to broadly assess risk to the public and property associated with ELJ elements of the project. The Risk Guidelines make use of two risk matrices which quantify risk associated with ELJ project elements: The Property Damage Risk Matrix, and the Public Safety Risk Matrix. The Matrices quantify general characteristics of the project reach, structure setting, recreational use, and channel characteristics to categorize risk to the public and property as a result of project actions. Ratings for risks associated with public safety concerns and potential property damages result in a low or high and low, moderate, or high risks, respectively (Reclamation 2014). The ratings then result in recommended factors of safety for horizontal and vertical loads which are then applied to ELJ design.

The evaluation resulted in a public safety risk rating of “low”, and a property damage risk rating of “moderate”. Per the RBDG, these risk factors correspond to a 25-year design event with factors of safety of 1.5 and 1.75 for sliding and buoyancy, respectively. Factors of safety for rotation and overturning were determined to be not applicable for all structure types and were not considered. A summary of ELJ design parameters is provided in Table 6, a summary of required and calculated factors of safety (FOS) for the various ELJ types is included in Table 7.

Table 6. Summary of Risk-based ELJ Design (Reclamation 2014) Ratings and Resulting Factors of Safety

Design parameter	Design Factor
Design Event, RI, year	25
Design Event, Q, cfs	6,500
Public Safety Risk	Low
Property Damage Risk	Moderate
Buoyancy Factor of Safety, Required	1.75
Sliding Factor of Safety, Required	1.5

Table 7. ELJ Factors of Safety

Structure Type	Required Buoyancy FOS	Calculated Buoyancy FOS	Required Sliding FOS	Calculated Sliding FOS
Deflector Jam	1.75	2.58	1.5	1.5
Side Channel Jam	1.75	2.92	1.5	2.5

Site Restoration and Enhancement

A site restoration plan was developed for preliminary design which includes various forms of stabilization for areas disturbed during construction activities, as well as the enhancement of existing riparian areas that can benefit from diversification of forested cover, particularly through the reintroduction of coniferous species. Plant species schedules and planting quantities will be developed at a later design stage. The following site restoration and enhancement types are included in the preliminary design:

- ▶ **Floodplain Planting** – Primarily comprised of floodplain areas that currently have little to no existing vegetation. These areas are located along the river's edge, close to newly constructed ELJs. Areas would be revegetated with native trees and shrubs to be selected for adaptation to fluctuating levels of inundation and drought tolerance. The goal of this planting area is to reestablish mixed deciduous and coniferous riparian forest cover along with a dense shrub understory. Top dressing with wood chip mulch is recommended for areas that are not frequently inundated with overbank flows to retain moisture while canopy cover develops. Coordination with landowners to locate appropriate clusters for floodplain planting will be necessary.
- ▶ **Seeding** – Seeding is proposed for any areas not planted immediately following construction activities. For any seeding activities, a regionally appropriate permanent native seed mix of grasses and forbs will be used to stabilize exposed soils. Following application, certified weed-free straw mulch will be applied to seeded areas at a rate of 2,000 pounds per acre

Future Design Considerations

The following bullets are recommendations for the next phase of design:

- ▶ Complete wetland delineation survey to inform side channel and floodplain enhancement design and permitting pathways.
- ▶ Complete a cultural assessment within the project limits. Adjust restoration design, construction access and staging to minimize impacts as needed.
- ▶ Determine ESA permitting pathway to incorporate design and construction criteria into the next design phase.

- ▶ Continue to engage landowners on project updates, construction access and locations for riparian restoration opportunities.
- ▶ Continue refining ELJ placement and modeling updates to better understand project influence on local landowners.
- ▶ Within the project reach, the Entiat River is a regulatory floodway with adjacent Zone A areas and includes a mapped 100-year flood boundary and base flood elevations. Based on preliminary proposed model outputs and current design elements, a Conditional Letter of Map Revision (CLOMR) will likely need to be pursued.

ESTIMATED CONSTRUCTION COSTS AND METHODS

The preliminary level construction cost estimate is provided in Appendix C. The primary assumptions incorporated into the construction cost estimate are:

- ▶ All preliminary ELJs are being constructed and the riparian buffer and cluster planting areas are being planted.
- ▶ 35% contingency is added to all items to account for design and construction uncertainties.
- ▶ 8.5% sales tax is included in the construction subtotal.
- ▶ An assumed 10% (non-compounding) annual inflation rate is applied to estimate construction cost in 2026.
- ▶ 10% mobilization is included in the construction subtotal.
- ▶ Wood prices are included in the unit costs for each structure type and are based on similar projects in the region and can greatly vary by the time construction occurs.

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APPENDICES

Appendix A: Preliminary Design Plans

Appendix B: Preliminary Hydraulic Model Results

Appendix C: Preliminary Construction Cost Estimate

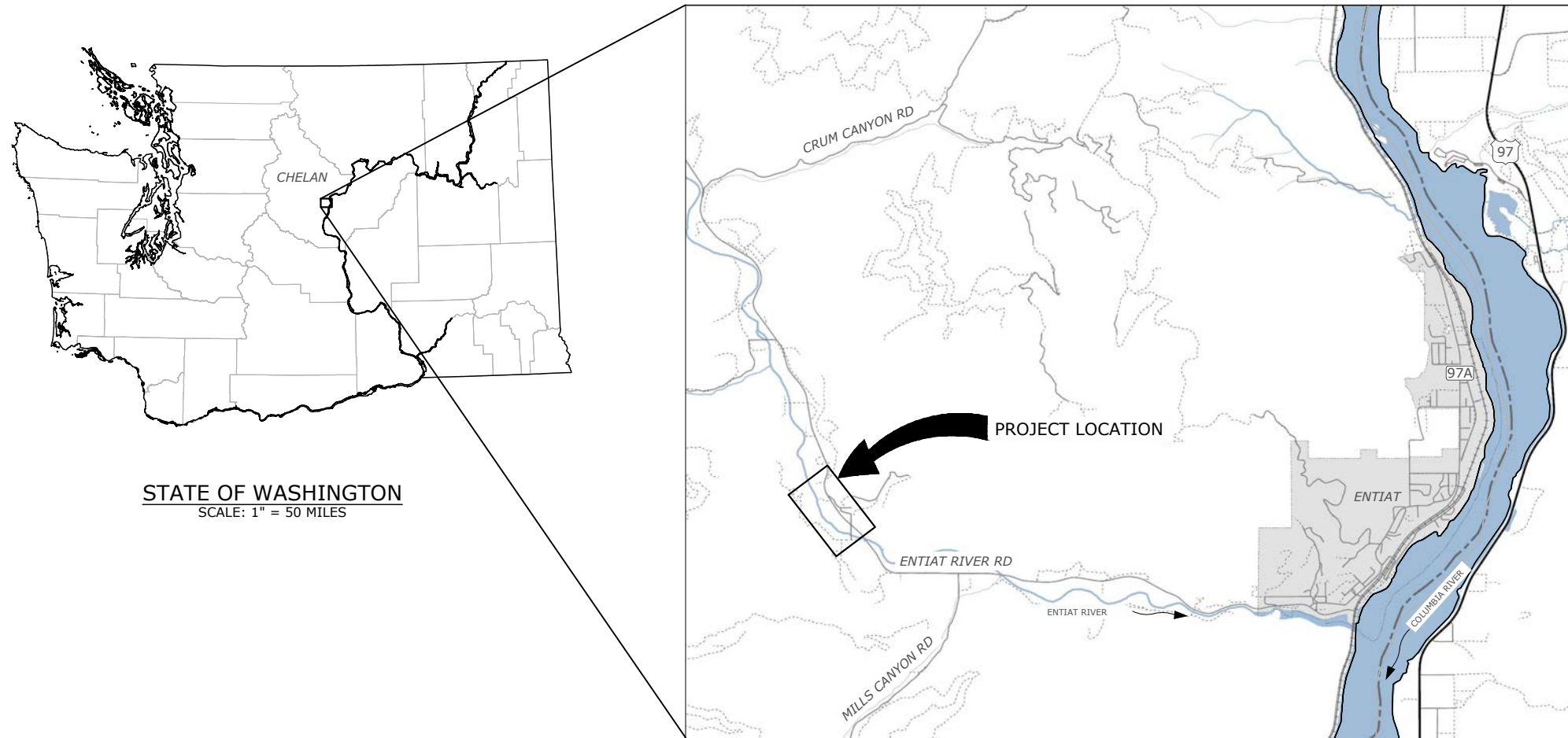
Appendix A

Preliminary Design Plans

LOWER ENTIAT 1D REACH

RIVER MILE 4.3 - 4.8 HABITAT ENHANCEMENT PROJECT

CHELAN COUNTY NATURAL RESOURCE DEPARTMENT



SHEET LIST	
SHEET #	TITLE
1	COVER SHEET
2	GENERAL NOTES
3	LEGEND
4	EXISTING CONDITIONS
5	PROPOSED CONDITIONS
6	DEFLECTOR ELJ
7	DEFLECTOR LAYERING PLAN
8	DEFLECTOR LAYERING PLAN
9	SIDE CHANNEL ELJ
10	SIDE CHANNEL ELJ LAYERING PLAN
11	STABILIZE EXISTING LOGJAM
12	ACCESS, STAGING, AND SITE ISOLATION PLAN
13	REVEGETATION PLANS
14	ELJ DETAILS
15	SITE ISOLATION DETAILS
16	TESC DETAILS

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ENGINEER: NATURAL SYSTEMS DESIGN, INC
1900 N NORTHLAKE WAY, SUITE 211
SEATTLE, WA 98103
(206) 834-0175

CONTRACTING AGENCY: CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
411 WASHINGTON STREET, SUITE 201
WENATCHEE, WA 98801
(509) 667-6533



CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
LOWER ENTIAT 1D REACH (RM 4.3 - 4.8) HABITAT
ENHANCEMENT PROJECT
COVER SHEET
PRELIMINARY

DATE 12/23/2024
COUNTY CHELAN COUNTY
LATITUDE 47°40'20"N
LONGITUDE 120°18'27"W
TIN/SC/RG T25N/S10/R20E
DESIGN_GB DRAWN_KS
CHECK_NT CHECK_NT

0 1
IF THIS BAR DOES NOT MEASURE
1" THEN DRAWING IS NOT
PLOTTED TO ORIGINAL SCALE.

SHEET
1 of 16

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GENERAL NOTES

1. THESE PLANS HAVE BEEN PREPARED FOR THE EXCLUSIVE USE OF CHELAN COUNTY NATURAL RESOURCE DEPARTMENT (CCNRD), HEREAFTER REFERRED TO AS "OWNER", AND THEIR AUTHORIZED AGENTS.
2. NATURAL SYSTEMS DESIGN, HEREAFTER REFERRED TO AS "ENGINEER" IS RESPONSIBLE FOR THE PREPARATION OF THESE ORIGINAL PLANS AND ASSOCIATED SPECIFICATIONS; AND WILL NOT BE RESPONSIBLE FOR, OR LIABLE FOR, UNAUTHORIZED CHANGE, OR USE, OF THESE PLANS WHICH INCLUDES ALTERATION, DELETION, OR EDITING OF THIS DOCUMENT WITHOUT EXPLICIT WRITTEN PERMISSION FROM THE ENGINEER. ANY OTHER UNAUTHORIZED USE OF THIS DOCUMENT IS PROHIBITED.
3. THE LOCATION OF ALL FEATURES SHOWN IS APPROXIMATE. FINAL LOCATIONS SHALL BE FLAGGED IN THE FIELD BY THE ENGINEER PRIOR TO CONSTRUCTION.

PERMIT NOTES

1. THE CONTRACTOR SHALL CONDUCT THE ACTIVITIES SHOWN IN THESE PLANS IN A MANNER THAT MINIMIZES THE ADVERSE IMPACT ON WATER QUALITY, FISH AND WILDLIFE, AND THE NATURAL ENVIRONMENT.
2. ALL WORK SHALL BE IN COMPLIANCE WITH PERMIT CONDITIONS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO HAVE COPIES OF ALL PERMITS ON THE JOB SITE, UNDERSTAND AND COMPLY WITH ALL PERMIT CONDITIONS.
3. IF AT ANY TIME FISH ARE OBSERVED IN DISTRESS, A FISH KILL OCCURS, OR WATER QUALITY PROBLEMS DEVELOP (INCLUDING EQUIPMENT LEAKS OR SPILLS), OPERATIONS SHALL CEASE AND THE OWNER SHALL BE NOTIFIED IMMEDIATELY.
4. AVOID AND MINIMIZE ADVERSE IMPACTS TO WATERS OF THE UNITED STATES, INCLUDING MINIMIZING THE NUMBER, DURATION, AND EXTENT OF WORK BELOW ORDINARY HIGH WATER AND EQUIPMENT CROSSINGS OF WETTED CHANNELS.
5. IF, DURING CONSTRUCTION, ARCHAEOLOGICAL REMAINS ARE ENCOUNTERED, CONSTRUCTION IN THE VICINITY SHALL BE HALTED, AND THE STATE OFFICE OF HISTORIC PRESERVATION AND THE OWNER SHALL BE NOTIFIED IMMEDIATELY.

SURVEY NOTES

1. SURVEY/LIDAR FOR THIS PROJECT WAS COLLECTED IN 2022 AND IS REPRESENTATIVE OF 2021 CONDITIONS. THE VERTICAL DATUM IS NAVD88 (FT). THE HORIZONTAL DATUM IS NAD83 WASHINGTON STATE PLANE NORTH AND THE UNIT IS US SURVEY FEET.
2. GATES, FENCELINES, AND UTILITIES WERE NOT SURVEYED. CONTRACTOR TO VERIFY IN FIELD.
3. PARCEL BOUNDARIES ARE FROM CHELAN COUNTY AND ARE NOT SURVEYED.
4. AERIAL IMAGERY WAS COLLECTED IN 2023 (CCNRD).

CONSTRUCTION NOTES

1. THE CONTRACTOR SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY.
2. CONSTRUCTION HOURS SHALL BE WEEKDAYS BETWEEN 7:00 A.M. AND 6:30 P.M. UNLESS PRIOR APPROVAL IS RECEIVED FROM THE OWNER.
3. ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE OWNER PRIOR TO PROCEEDING WITH THE WORK.
4. THE CONTRACTOR SHALL PROTECT ALL EXISTING STRUCTURES, VEGETATION, AND IMPROVEMENTS NOT INDICATED FOR REMOVAL.
5. THE CONTRACTOR SHALL KEEP THE JOB SITE CLEAN AND HAZARD FREE.
6. THE CONTRACTOR SHALL DISPOSE OF ALL DIRT, DEBRIS, AND RUBBISH GENERATED BY THE WORK. UPON COMPLETION OF WORK, CONTRACTOR SHALL REMOVE ALL MATERIAL AND EQUIPMENT NOT SPECIFIED AS REMAINING ON THE PROPERTY.
7. NO TREES OR VEGETATION SHALL BE REMOVED UNLESS NOTED ON THE PLANS OR SPECIFIED ON-SITE BY THE OWNER OR THE ENGINEER. NO GRADING SHALL TAKE PLACE WITHIN THE DRIP LINE OF TREES NOT TO BE REMOVED UNLESS OTHERWISE APPROVED.
8. THE CONTRACTOR SHALL MAINTAIN A SET OF PLANS ON THE JOB SHOWING "AS-CONSTRUCTED" CHANGES MADE TO DATE. UPON COMPLETION OF THE PROJECT, THE CONTRACTOR SHALL SUPPLY TO OWNER A SET OF PLANS, MARKED UP TO THE SATISFACTION OF THE OWNER, REFLECTING THE AS-CONSTRUCTED MODIFICATIONS.

ELJ NOTES

1. ALL LOGS SHALL BE DOUGLAS FIR OR WESTERN RED CEDAR.
2. ALL ROOTWAD POSTS SHALL BE DOUGLAS FIR. POSTS SHALL BE FREE FROM DEFECTS, CRACKS, AND SPLITTING AT THE TIME OF PLACEMENT.
3. LOGS SHALL HAVE SPECIFIED DIAMETERS AS MEASURED AT DBH, DEFINED AS 4.5 FEET ABOVE GROUND WHEN TREE WAS STANDING.
4. EXISTING WOODY MATERIAL AT THE STRUCTURE LOCATION SHALL BE MOVED OR PROTECTED FROM CONSTRUCTION ACTIVITIES AND THEN INCORPORATED INTO THE STRUCTURE AS DIRECTED BY THE CONTRACTING OFFICER.
5. POST EMBEDMENT DEPTH FOR EACH ELJ SHALL BE MEASURED RELATIVE TO THE CHANNEL THALWEG. EXCAVATION DEPTHS AND QUANTITIES IN THE STRUCTURE SCHEDULE ARE BASED ON LIDAR COLLECTED IN 2022, AND EXISTING GRADE ELEVATIONS AND ASSOCIATED EXCAVATION DEPTHS MAY BE OFF BY SEVERAL FEET. ACTUAL EXCAVATION DEPTHS SHALL BE PROVIDED BY THE ENGINEER WHEN THE STRUCTURE LOCATION IS STAKED PRIOR TO CONSTRUCTION.
6. KEY LOGS, FRAMING LOGS, AND PILES SHALL HAVE AN ALUMINUM TAG AFFIXED PER RCW 77.85.050(5E). ALUMINUM TAGS SHALL BE A MINIMUM OF 1 ¼ INCHES IN DIAMETER. AT CONSTRUCTION COMPLETION, A RECORD OF THE TAG NUMBERS BROKEN DOWN BY STRUCTURE ID SHALL BE PROVIDED TO THE OWNER.

SUMMARY OF QUANTITIES			
ITEM #	ITEM DESCRIPTION	QTY	UNIT
1	MOBILIZATION	1	LS
2	TEMPORARY EROSION AND SEDIMENT CONTROL	1	LS
3	ACCESS & STAGING	1	LS
4	SEEDING	1	LS
5	DEFLECTOR ELJ	4	EA
6	SIDE CHANNEL ELJ	5	EA
7	STABILIZE EXISTING LOGJAM	1	EA

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CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
 LOWER ENTIAI 1D REACH (RM 4.3 - 4.8) HABITAT
 ENHANCEMENT PROJECT
GENERAL NOTES
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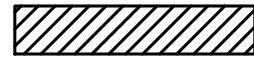
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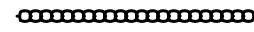
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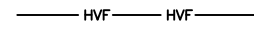
 EXISTING NATURALLY OCCURRING LOGJAM

SITE PREPARATION AND DEWATERING

 TEMPORARY ACCESS ROUTE

 STAGING AREA


 COFFERDAM

 HIGH VISIBILITY FENCE

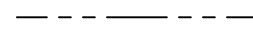
HABITAT STRUCTURES

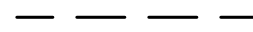
 DEFLECTOR ENGINEERED LOGJAM


 SIDE CHANNEL ENGINEERED LOGJAM

 STABILIZED EXISTING LOGJAM

SURVEY AND LEGAL BOUNDARIES

 EXISTING PROPERTY LINE

 EXISTING RIGHT OF WAY

 EXISTING BUILDING FOOTPRINTS

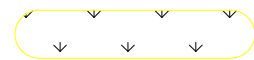
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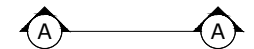
 EXISTING MINOR CONTOUR


 EXISTING MAJOR CONTOUR

VEGETATION & SITE RESTORATION

 PRIMARY RESTORATION AREA


 SEEDING


 SECTION LINE

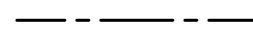
 SECTION LINE WITH SHEET REFERENCE

NATURAL RESOURCES

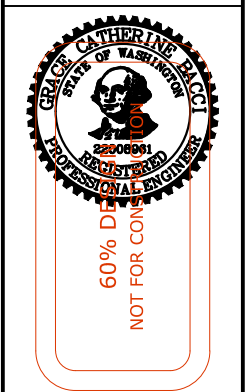
 LOW FLOW CHANNEL

 ORDINARY HIGH WATER LINE

 EXISTING WETLAND

 EXISTING CHANNEL THALWEG

 RIVER MILE



CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
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LEGEND
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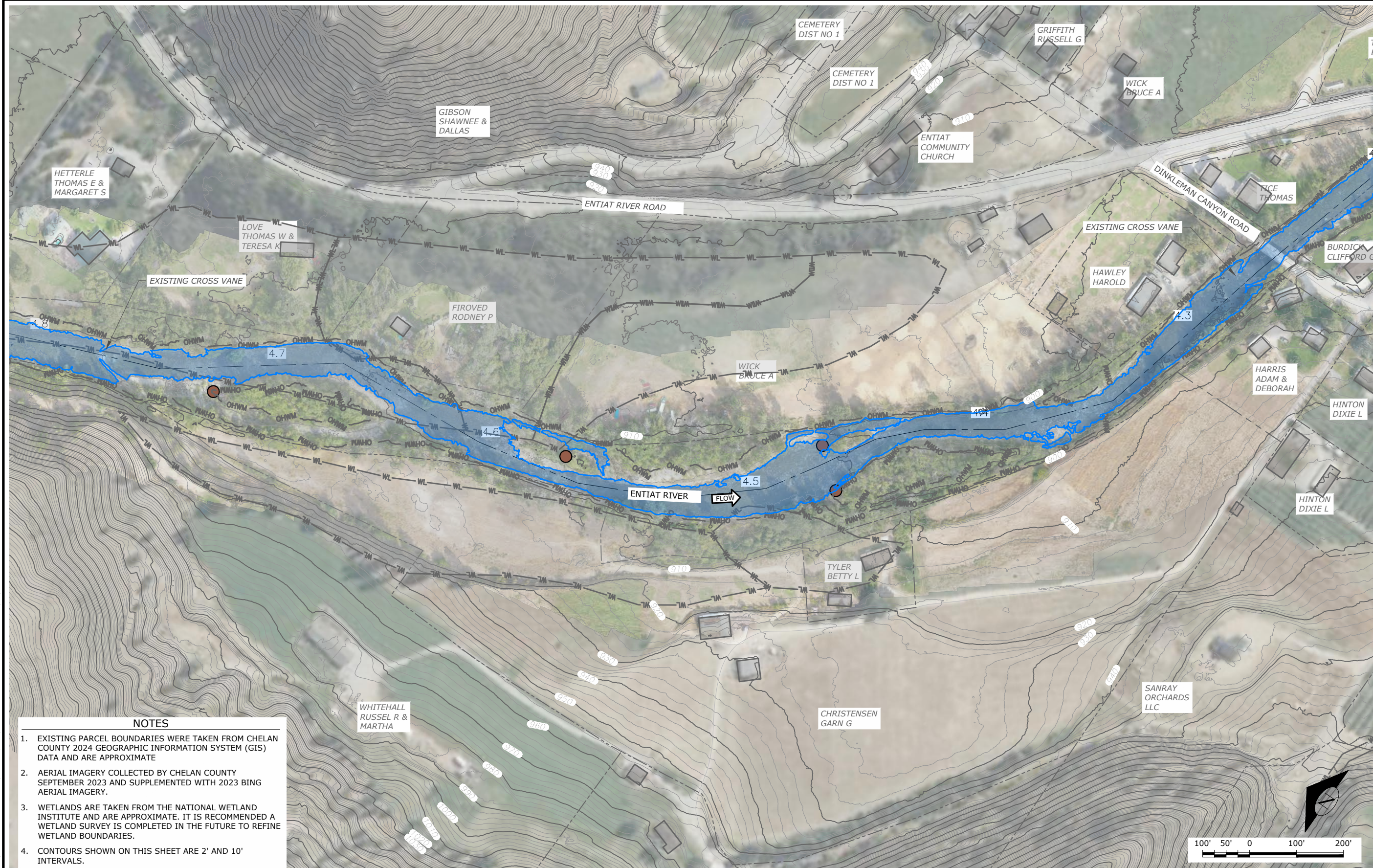
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SHEET
 3 OF 16

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NOTES

1. EXISTING PARCEL BOUNDARIES WERE TAKEN FROM CHELAN COUNTY 2024 GEOGRAPHIC INFORMATION SYSTEM (GIS) DATA AND ARE APPROXIMATE
2. AERIAL IMAGERY COLLECTED BY CHELAN COUNTY SEPTEMBER 2023 AND SUPPLEMENTED WITH 2023 BING AERIAL IMAGERY.
3. WETLANDS ARE TAKEN FROM THE NATIONAL WETLAND INSTITUTE AND ARE APPROXIMATE. IT IS RECOMMENDED A WETLAND SURVEY IS COMPLETED IN THE FUTURE TO REFINE WETLAND BOUNDARIES.
4. CONTOURS SHOWN ON THIS SHEET ARE 2' AND 10' INTERVALS.



GRACE CATHERINE BECK
STATE OF WASHINGTON
LICENSE NO. 2200001
PROFESSIONAL ENGINEER
60% DESIGN
NOT FOR CONSTRUCTION

CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
LOWER ENTIAT 1D REACH (RM 4.3 - 4.8) HABITAT
ENHANCEMENT PROJECT
EXISTING CONDITIONS
PRELIMINARY

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CHECK_NT	CHECK_NT

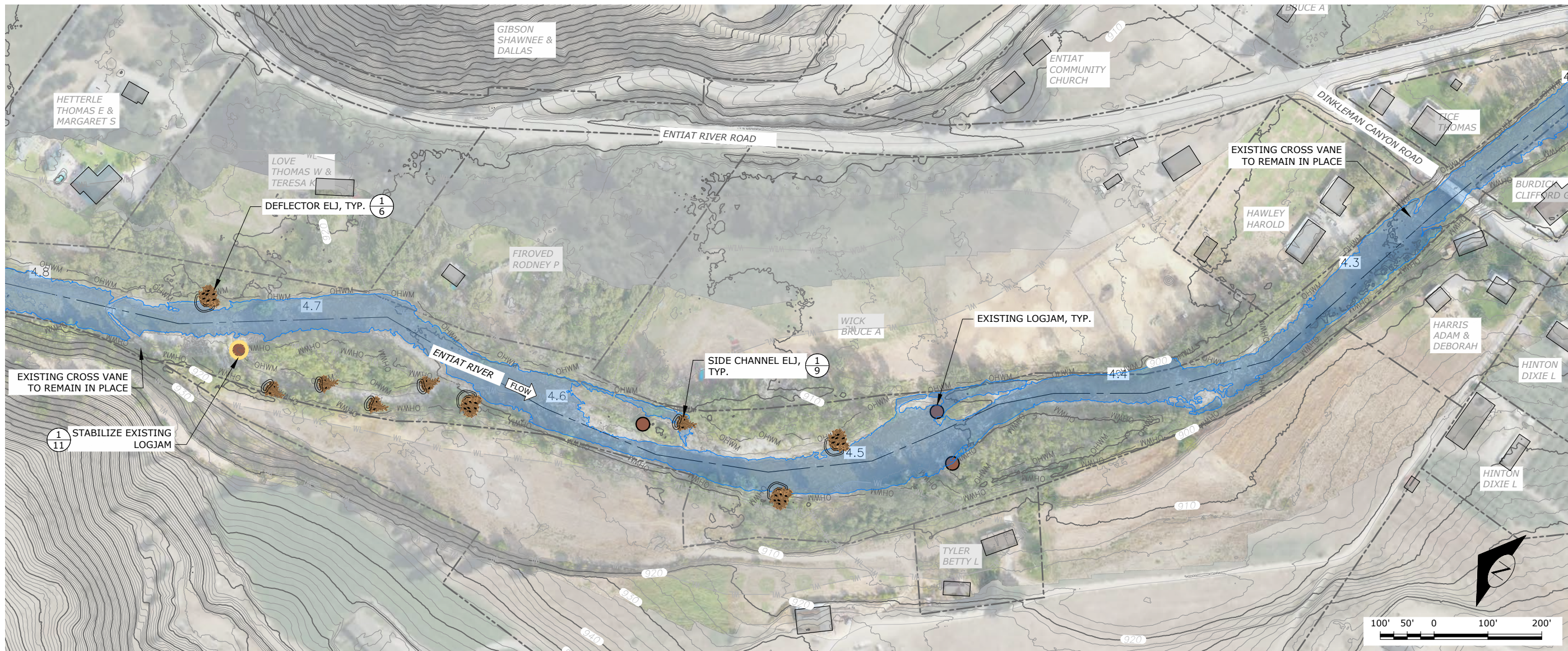
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Natural Systems Design
+ Coastal Geologic Services



60% DESIGN
NOT FOR CONSTRUCTION



PROPOSED CONDITIONS
SCALE: 1" = 100'

NOTES

1. LOCATIONS SHOWN ARE APPROXIMATE AND WILL BE ADJUSTED IN THE FIELD BY THE ENGINEER.
2. AERIAL IMAGERY COLLECTED BY CHELAN COUNTY SEPTEMBER 2023 AND SUPPLEMENTED WITH 2023 BING AERIAL IMAGERY.
3. WETLANDS ARE TAKEN FROM THE NATIONAL WETLAND INSTITUTE AND ARE APPROXIMATE. IT IS RECOMMENDED A WETLAND SURVEY IS COMPLETED IN THE FUTURE TO REFINE WETLAND BOUNDARIES.
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CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
LOWER ENTIAT 1D REACH (RM 4.3 - 4.8) HABITAT
ENHANCEMENT PROJECT

PROPOSED CONDITIONS

PRELIMINARY

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SHEET
5 of 16

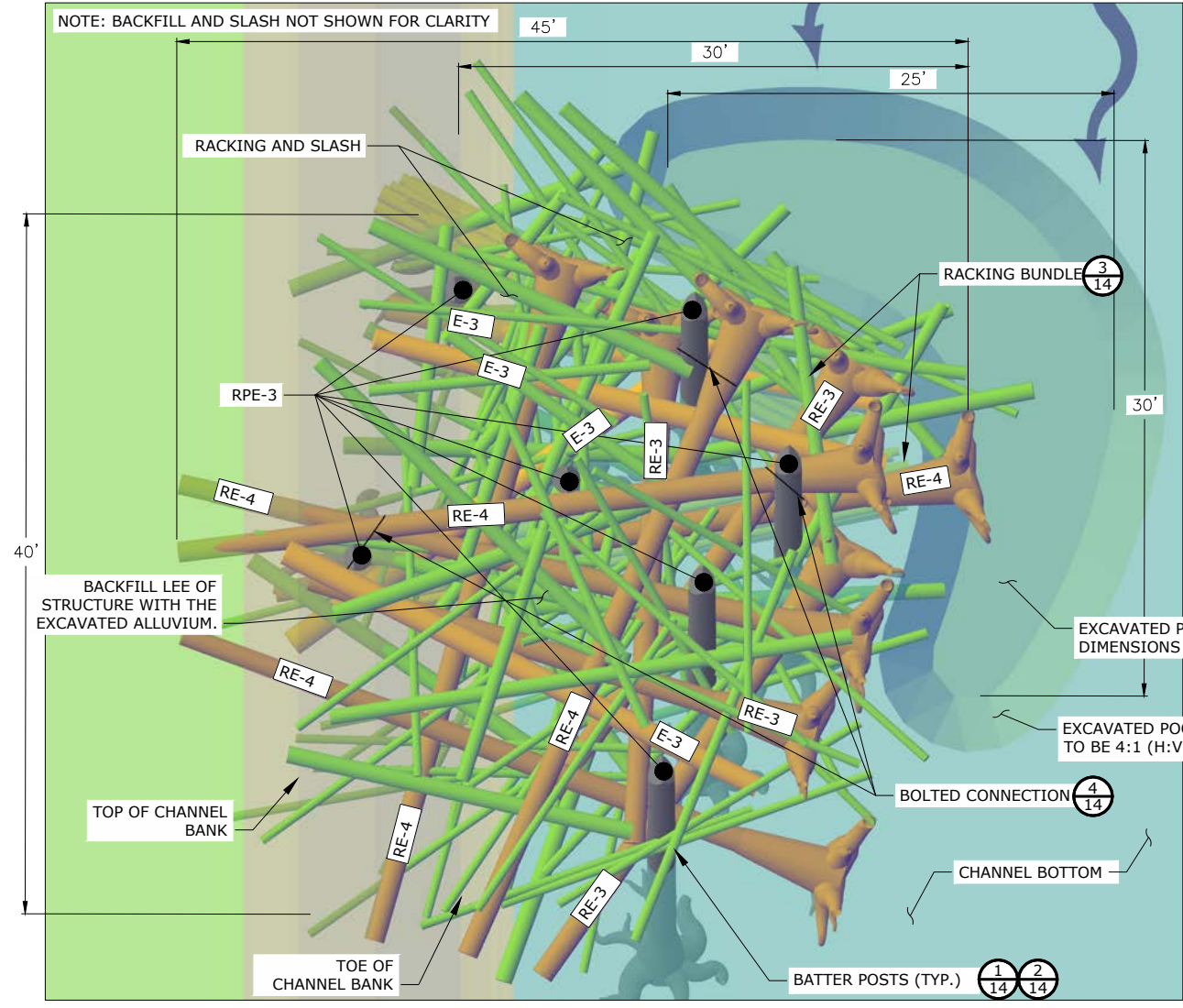


CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
LOWER ENTIAT 1D REACH (RM 4.3 - 4.8) HABITAT
ENHANCEMENT PROJECT
DEFLECTOR ELJ
PRELIMINARY

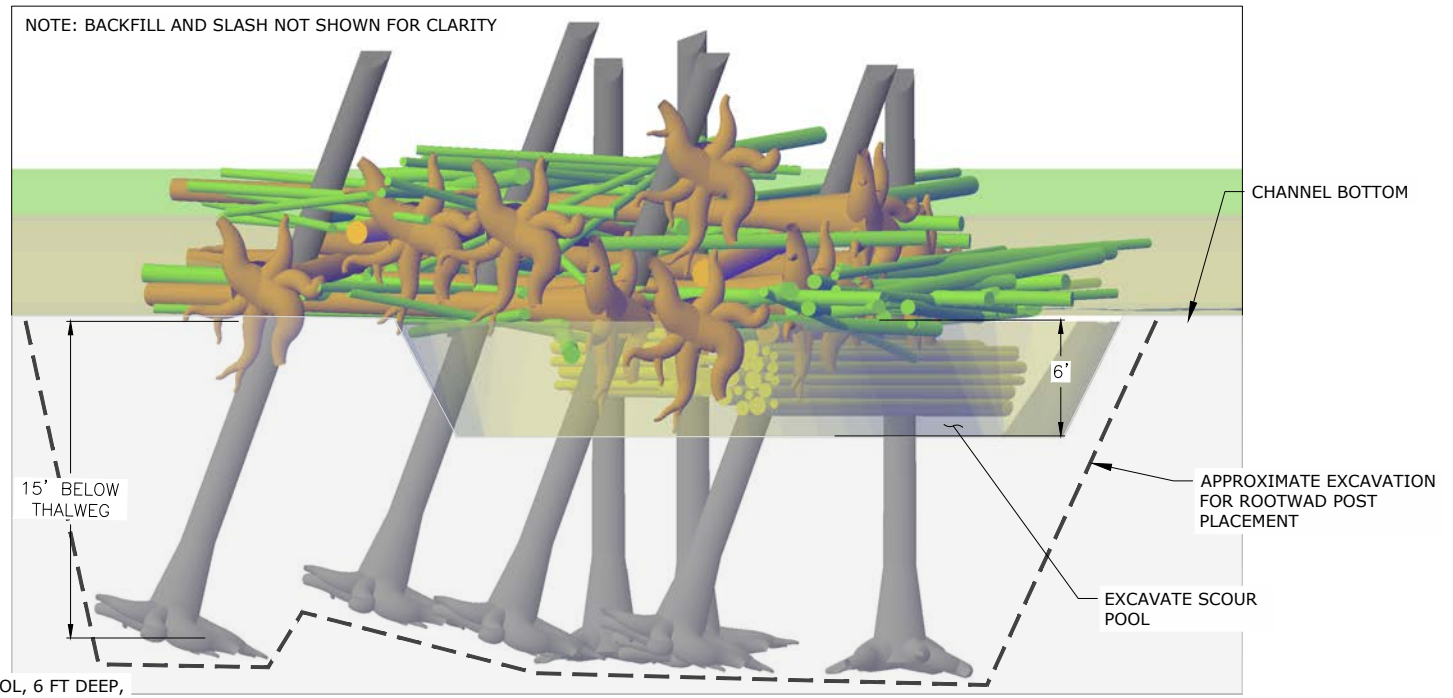
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SHEET
6 OF 16



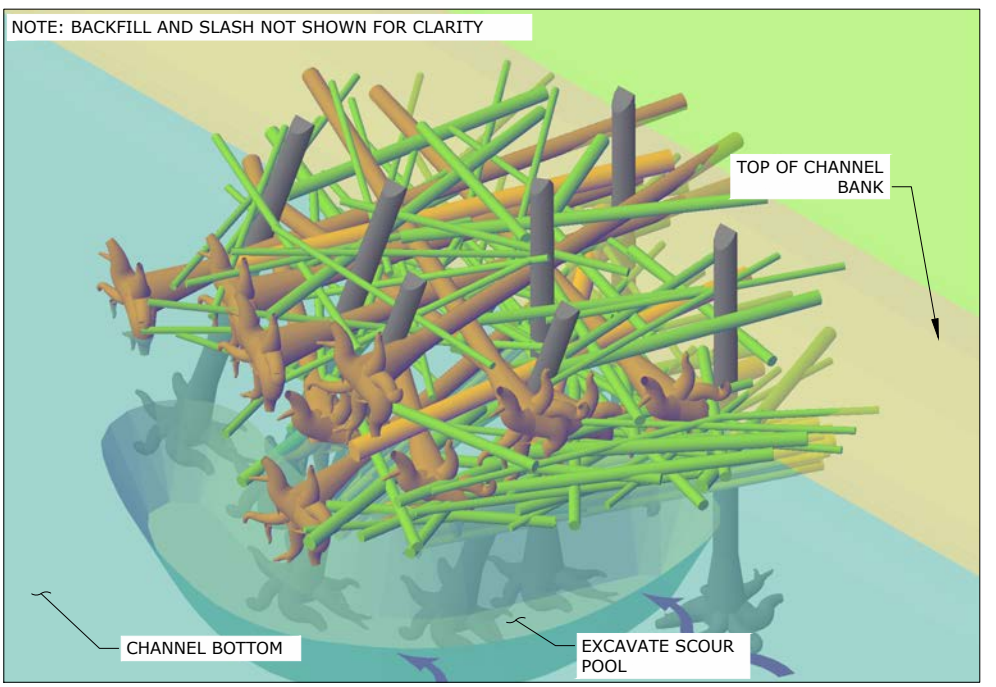
DEFLECTOR ELJ PLAN
SCALE: 1" = 5'



DEFLECTOR ELJ PROFILE
SCALE: 1" = 5'

DEFLECTOR ELJ MATERIALS SCHEDULE				
LOG ID	DIA (INCHES)	LENGTH (FT)	ROOTWAD (Y/N)	QUANTITY PER STRUCTURE
RPE-3	18	30	YES	7
RE-4	18	40	YES	6
RE-3	18	30	YES	4
E-3	18	30	NO	4
RACKING BUNDLE	36	30	NO	2
RACKING	6-12	20-40	NO	100
SLASH	1-3	N/A	NO	50 CY
BOLTED CONNECTION	N/A	N/A	N/A	3

- NOTES**
1. EXTENT AND LOCATION OF SCOUR POOL IS APPROXIMATE.
 2. SOIL EXCAVATED DURING CONSTRUCTION SHALL BE TEMPORARILY STOCKPILED, AND USED AS BACKFILL ON BACKSIDE OF STRUCTURE.
 3. BACKFILL EXTENTS MAY VARY.
 4. ALL LOGS, SLASH MATERIAL, AND RACKING PIECES REQUIRED SHALL BE PROVIDED BY THE CONTRACTING AGENCY AND ARE STOCKPILED AT THE PROJECT SITE.
 5. CAREFULLY HANDLE, TRANSPORT, AND STAGE PROVIDED WOODY MATERIAL FOR ELJ CONSTRUCTION. ANY WOODY MATERIAL DAMAGED AS A DIRECT RESULT OF CONTRACTOR ACTIONS SHALL BE REPLACED IN-KIND AT NO ADDITIONAL COST TO THE CONTRACTING AGENCY.
 6. FINAL LOCATIONS OF EACH ELJ WILL BE DETERMINED IN THE FIELD BY THE ENGINEER. THE CONTRACTING AGENCY WILL INSTALL STAKES AT TWO STAKEOUT POINTS FOR EACH ELJ. THE CONTRACTOR SHALL EXPAND THIS STAKING AS NECESSARY TO DEFINE THE STRUCTURE EXTENTS, POST LOCATIONS, EXCAVATION EXTENTS, AND DESIGN ELEVATIONS.
 7. THE CONTRACTOR SHALL DETERMINE THE EXCAVATION LIMITS TO MAINTAIN A SAFE EXCAVATION DURING ELJ INSTALLATION. TEMPORARY AND PERMANENT EXCAVATION SPOILS SHALL BE PLACED TO MINIMIZE DISTURBANCE TO EXISTING VEGETATION.
 8. NO EXCAVATION WITHIN THE ACTIVELY FLOWING CHANNEL SHALL OCCUR UNTIL THE WORK AREA HAS BEEN ISOLATED AND AQUATIC LIFE HAS BEEN REMOVED FROM THE INTERIOR OF THE ISOLATION.
 9. THE EXCAVATION SHALL BE SUFFICIENTLY DEWATERED TO ALLOW COMPLETION AND INSPECTION OF ELJ INSTALLATION IN A CONTROLLED MANNER.
 10. EXISTING WOODY MATERIAL AT THE STRUCTURE CONSTRUCTION SITE SHALL BE MOVED OR PROTECTED FROM CONSTRUCTION ACTIVITIES AND THEN INCORPORATED INTO THE STRUCTURE AND BACKFILL AS APPROVED BY THE CONTRACTING OFFICER.



DEFLECTOR ELJ PERSPECTIVE
SCALE: 1" = 5'

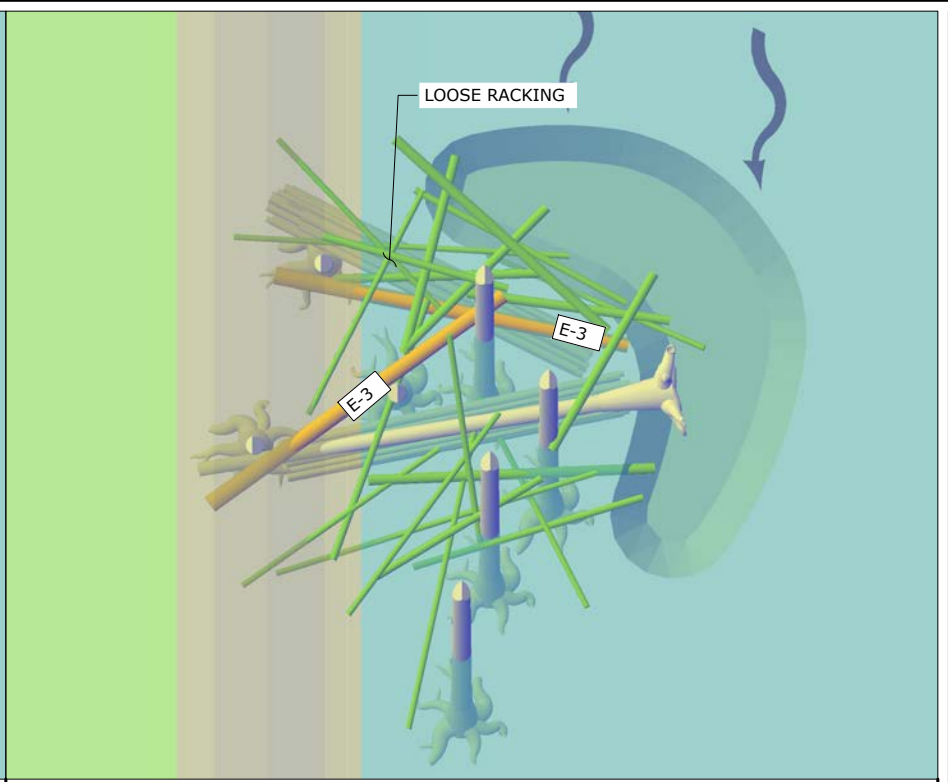
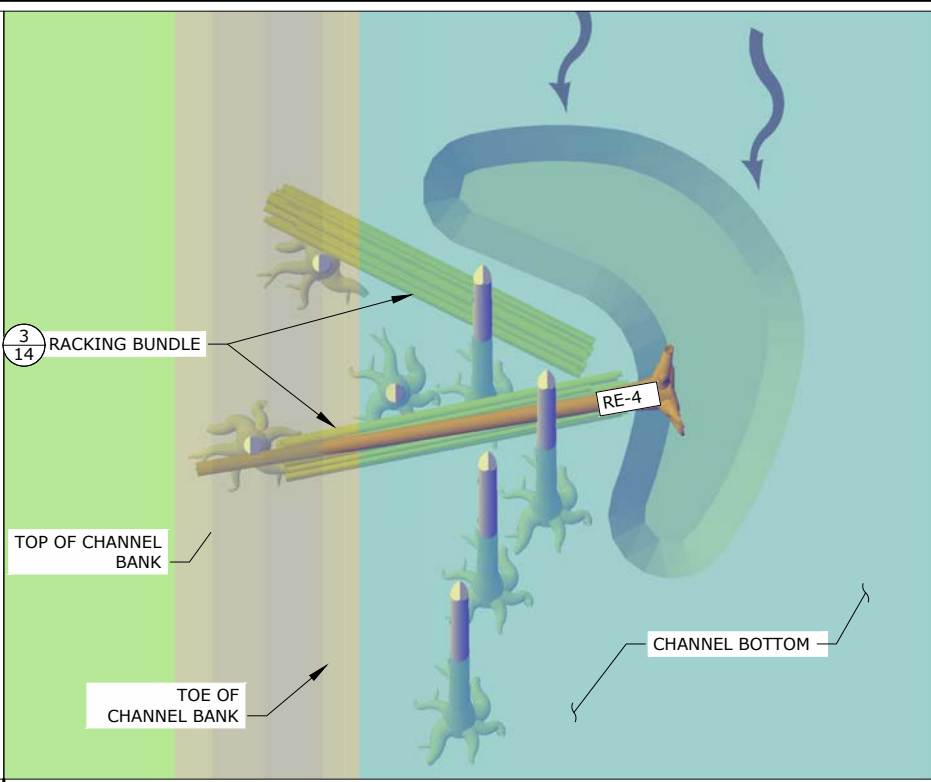
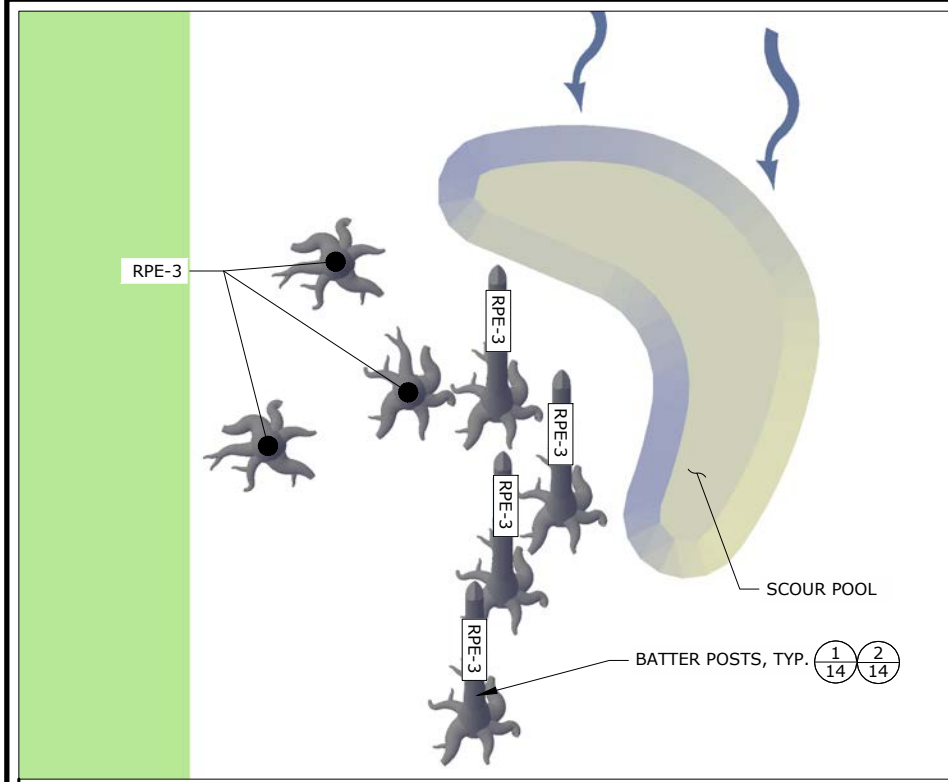


EXAMPLE OF COMPLETED DEFLECTOR ELJ

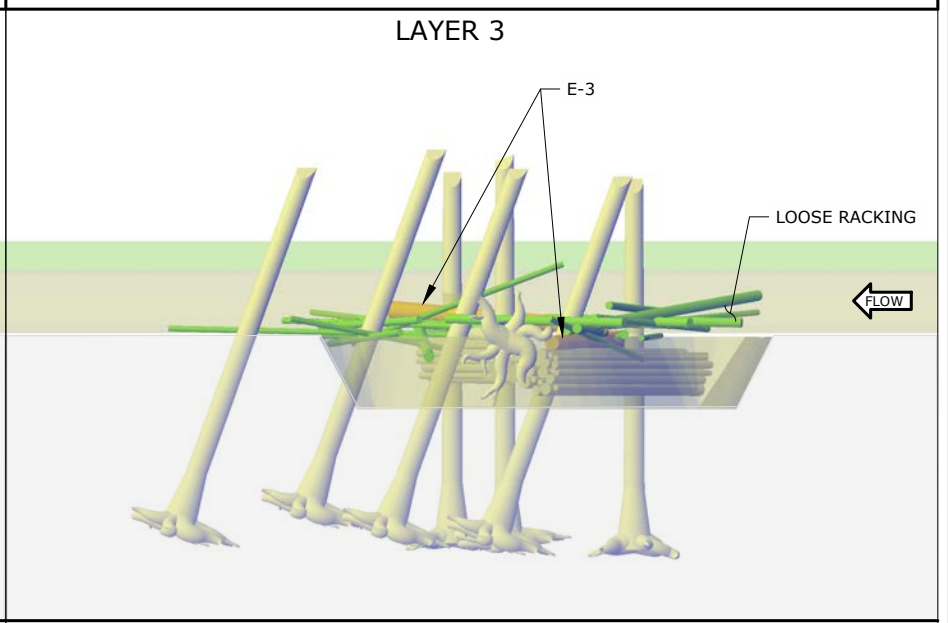
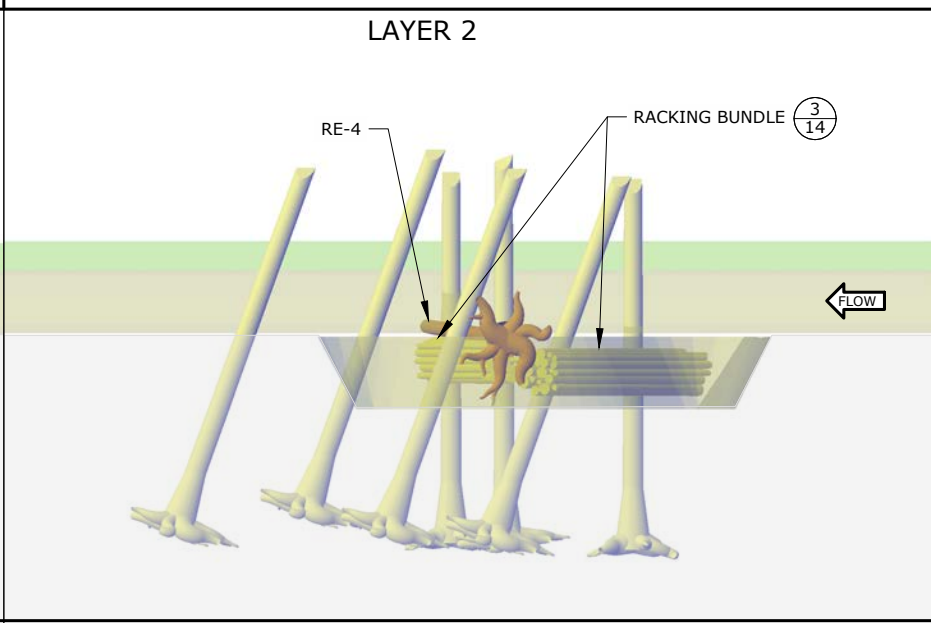
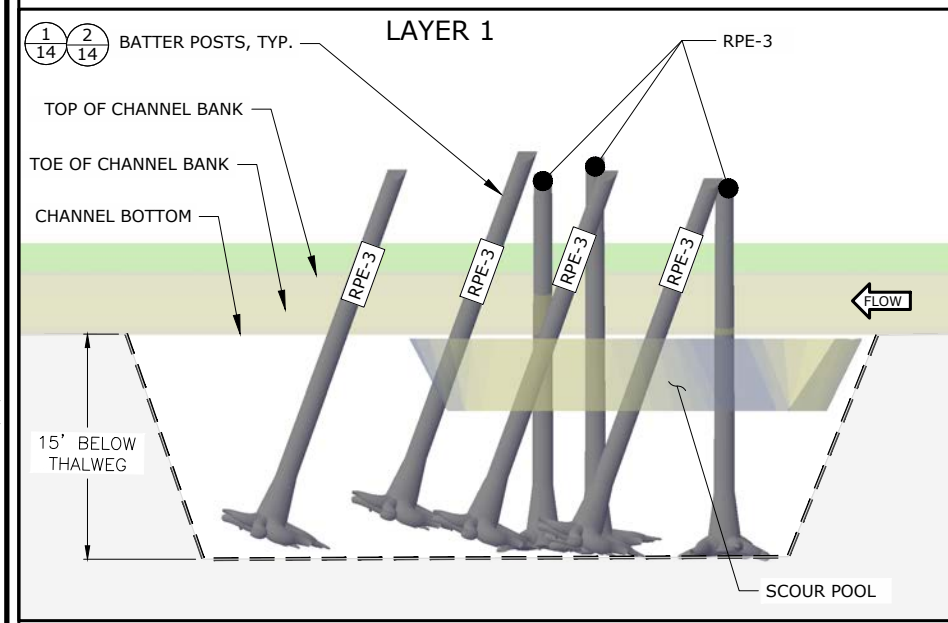
DEFLECTOR ELJ
SCALE: AS NOTED

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PLAN VIEWS



SECTION VIEWS

- EXCAVATE 15 FEET BELOW THALWEG FOR ROOTWAD POST PLACEMENT.
- EXCAVATE SCOUR POOL.
- PLACE SEVEN (7) RPE-3 ROOTWAD POSTS, BATTER FOUR (4) POSTS AS SHOWN.
- BACKFILL TO APPROXIMATELY 4 FEET BELOW GROUND SURFACE.

- PLACE TWO (2) 30-FOOT LONG RACKING BUNDLES.
- PLACE ONE (1) RE-4 ROOTWAD ON TOP OF BUNDLE.

- BACKFILL TO APPROXIMATELY 2 FEET BELOW GROUND SURFACE.
- PLACE TWO (2) E-3 LOGS.
- FILL SPACE IN BETWEEN ROOTWAD POSTS WITH LOOSE RACKING.
- BACKFILL TO GROUND SURFACE.



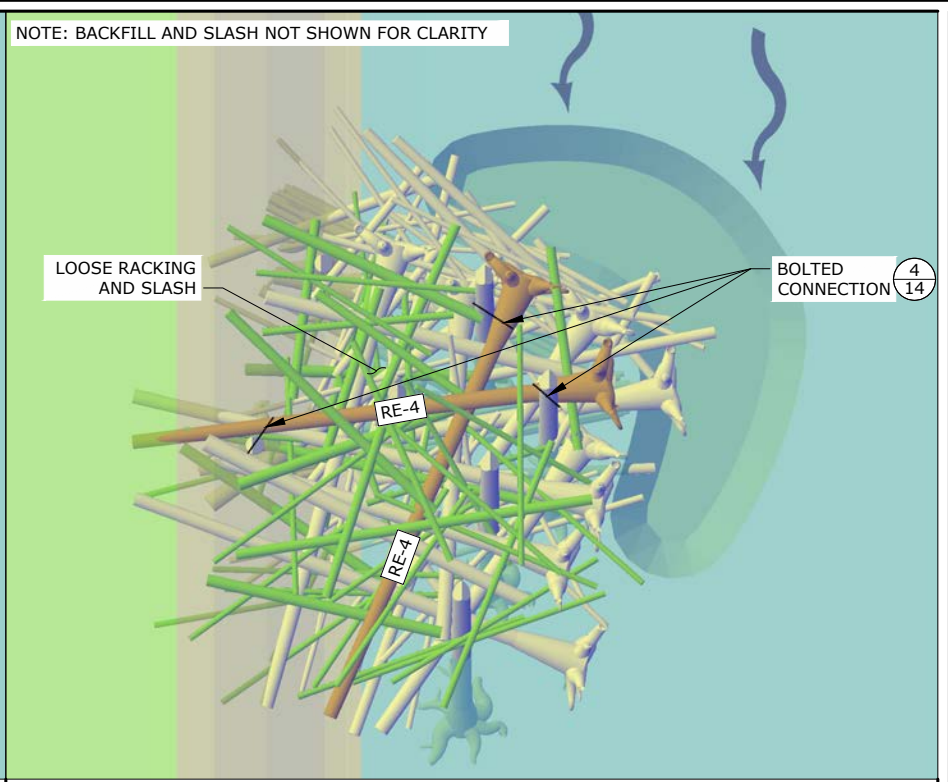
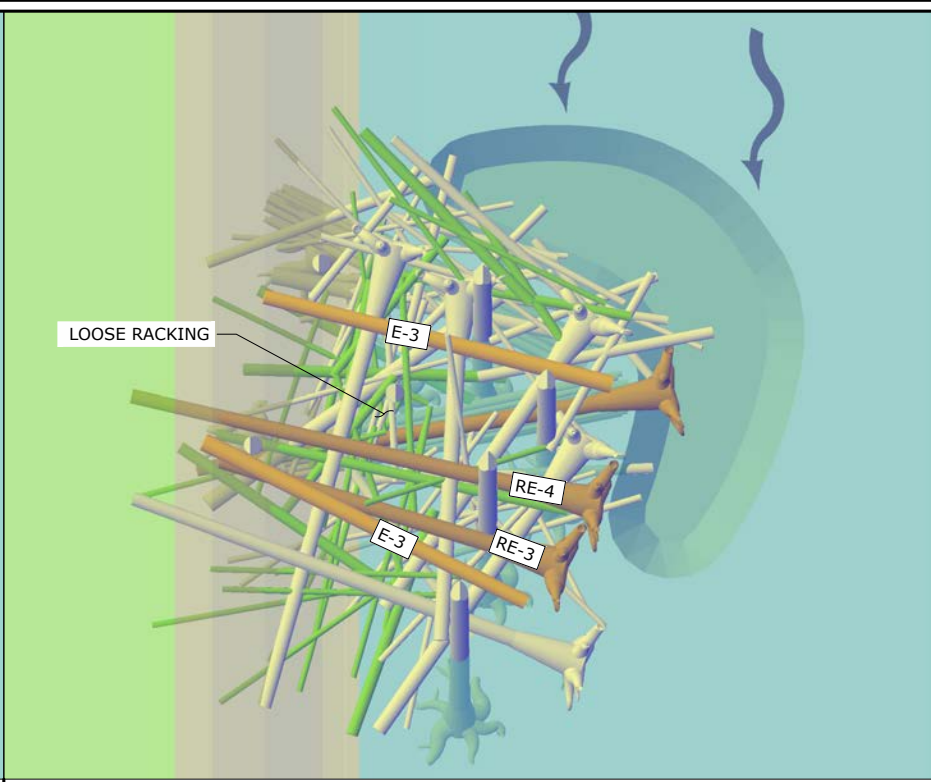
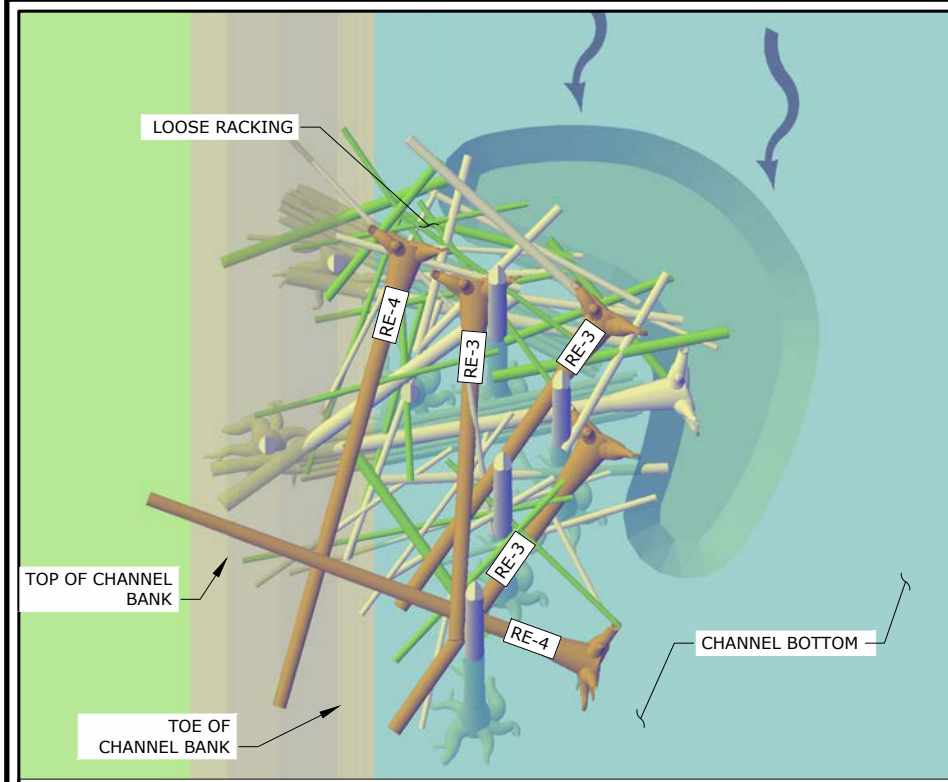
60% DESIGN
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LOWER ENTIAAT 1D REACH (RM 4.3 - 4.8) HABITAT ENHANCEMENT PROJECT
DEFLECTOR LAYERING PLAN
PRELIMINARY

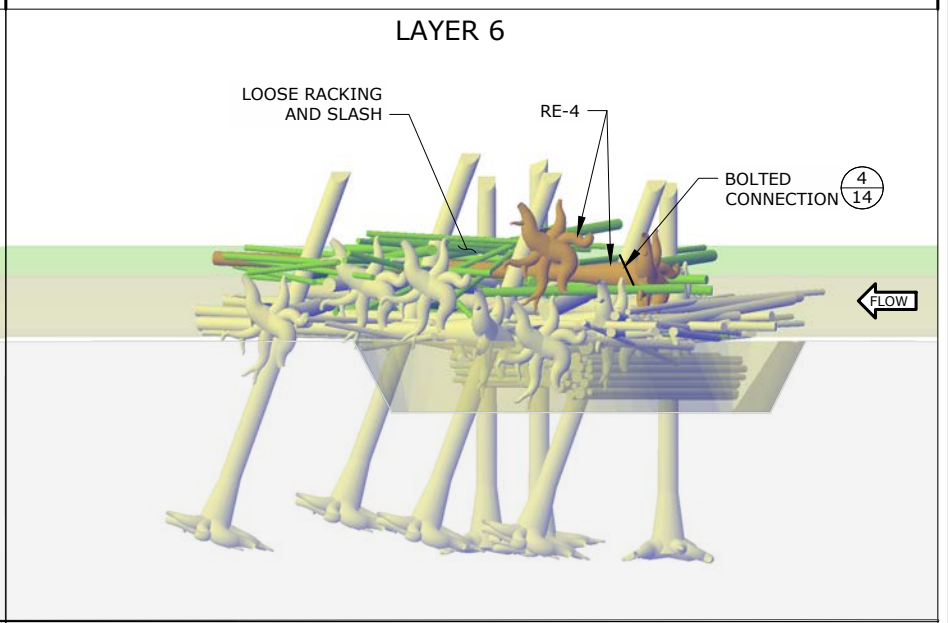
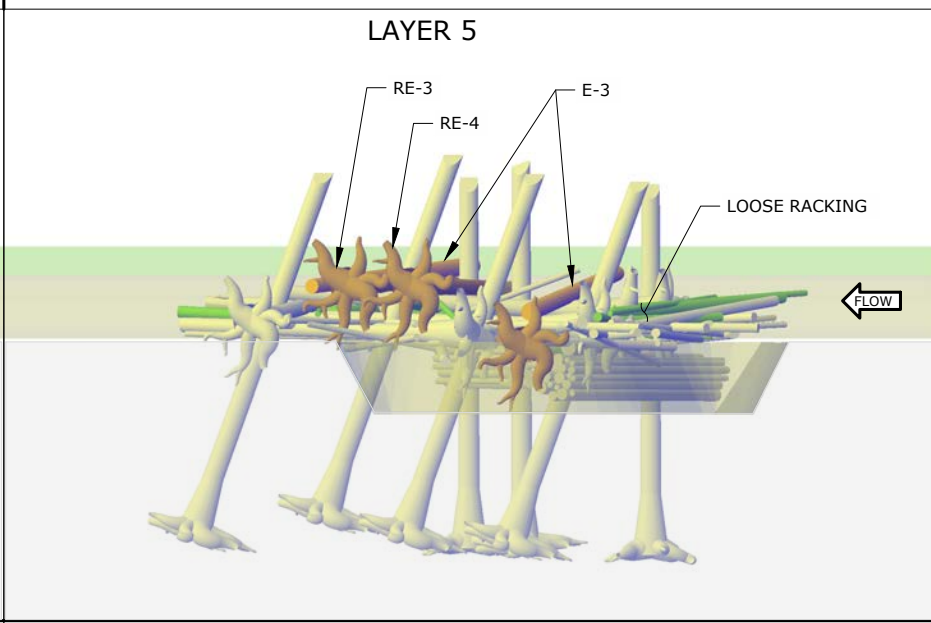
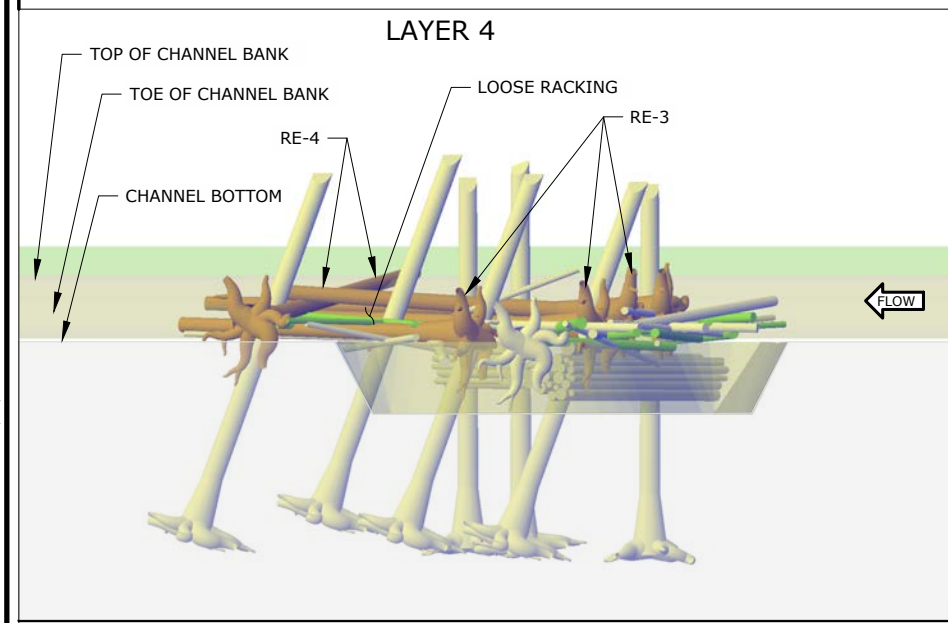
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PLAN VIEWS 8' 4' 0 8' 16'



SECTION VIEWS 8' 4' 0 8' 16'

1. WEAVE AND PLACE LOOSE RACKING BETWEEN LOGS.
2. PLACE THREE (3) RE-3 ROOTWADS.
3. PLACE TWO (2) RE-4 ROOTWADS.

1. WEAVE AND PLACE LOOSE RACKING BETWEEN LOGS.
2. PLACE ONE (1) RE-3 ROOTWAD.
3. PLACE ONE (1) RE-4 ROOTWAD.
4. PLACE TWO (2) E-3 LOGS.

1. PLACE TWO (2) RE-4 ROOTWADS.
2. ADD THREE (3) BOLTED CONNECTIONS BETWEEN BATTER POSTS AND RE-4 ROOTWADS AS SHOWN.
3. PLACE LOOSE RACKING AND SLASH IN GAPS OF ELJ.
4. CUT PILES 5 FEET ABOVE HIGHEST ROOTWAD.
5. BACKFILL APPROXIMATELY 1-FOOT ABOVE HIGHEST ROOTWAD.



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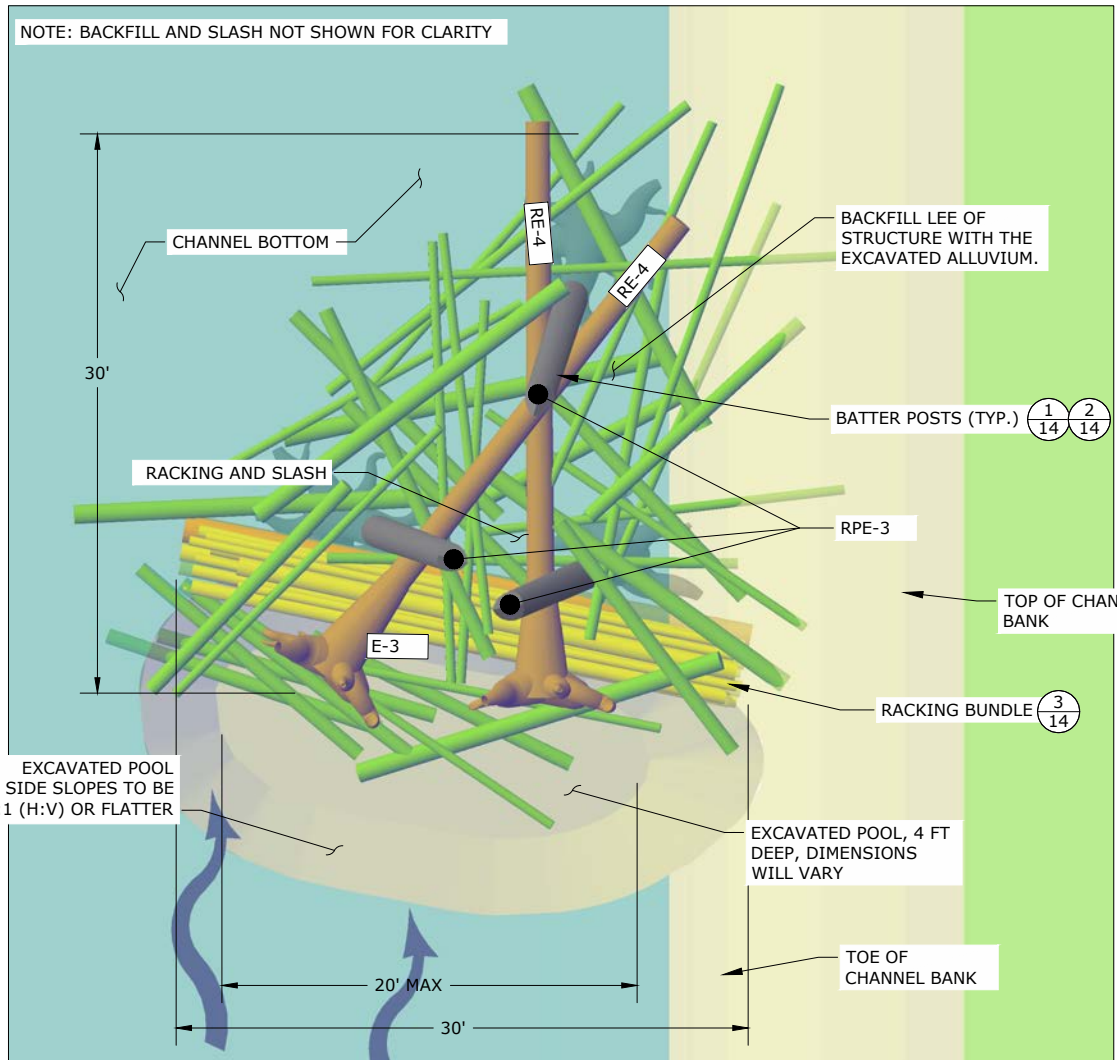
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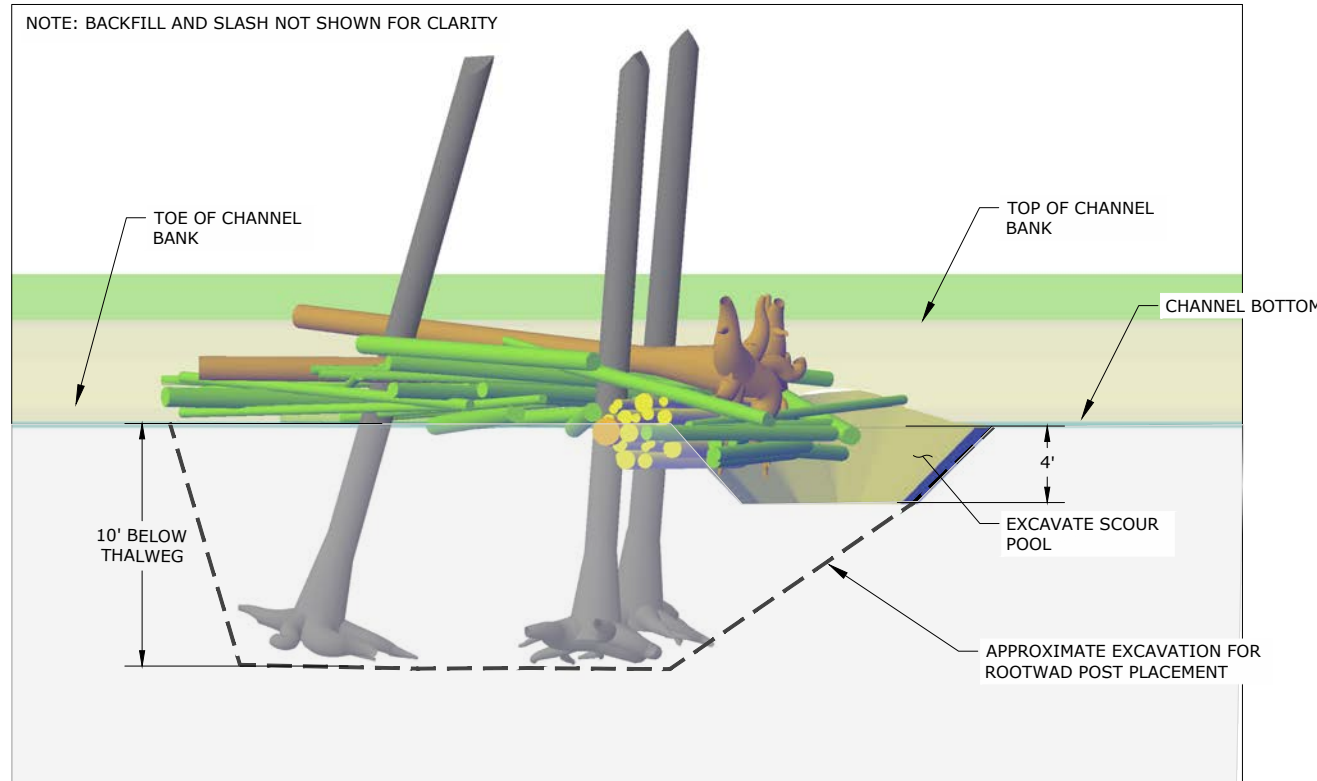
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IF THIS BAR DOES NOT MEASURE
1" THEN DRAWING IS NOT
PLOTTED TO ORIGINAL SCALE.

SHEET
8 OF 16

P:\PROJECTS\CHELAN COUNTY\LOWER ENTIA\RM 4.6\DESIGN\CAD\SIDE CHANNEL ELJ LAYERING PLAN.DWG Grace 12/31/2024 12:26:57 PM



SIDE CHANNEL ELJ PLAN
SCALE: 1" = 5'



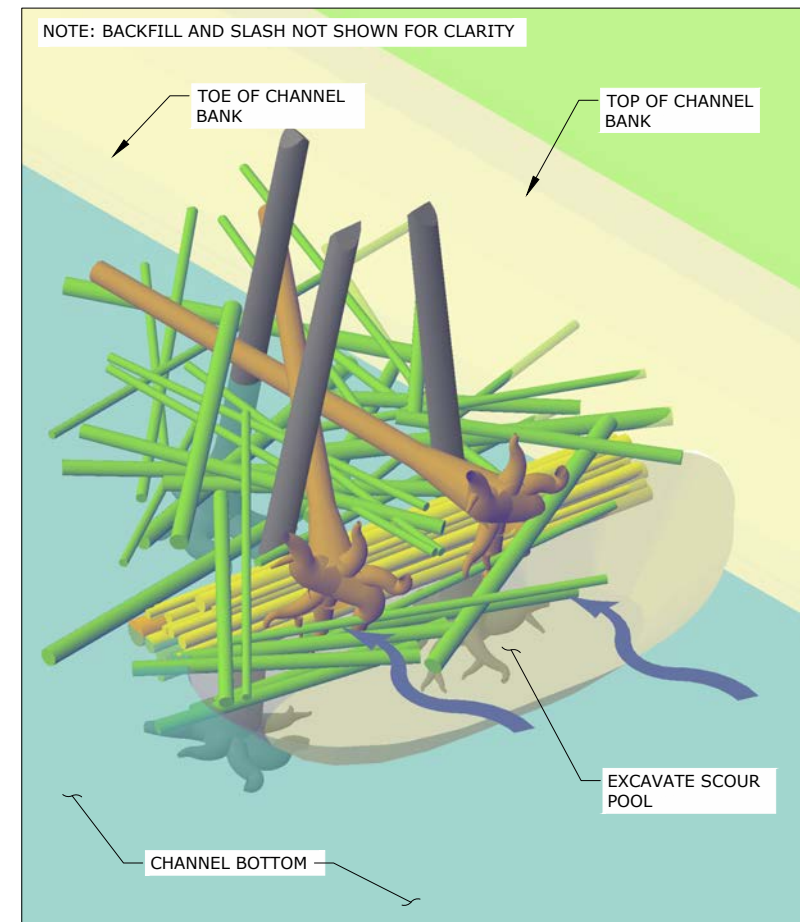
SIDE CHANNEL ELJ PROFILE
SCALE: 1" = 5'

NOTES

1. EXTENT AND LOCATION OF SCOUR POOL IS APPROXIMATE, ELJ SHOULD SPAN ROUGHLY HALF THE WIDTH OF THE SIDE CHANNEL.
2. SOIL EXCAVATED DURING CONSTRUCTION SHALL BE TEMPORARILY STOCKPILED, AND USED AS BACKFILL ON BACKSIDE OF STRUCTURE.
3. BACKFILL EXTENTS MAY VARY.
4. ALL LOGS, SLASH MATERIAL, AND RACKING PIECES REQUIRED SHALL BE PROVIDED BY THE CONTRACTING AGENCY AND ARE STOCKPILED AT THE PROJECT SITE.
5. CAREFULLY HANDLE, TRANSPORT, AND STAGE PROVIDED WOODY MATERIAL FOR ELJ CONSTRUCTION. ANY WOODY MATERIAL DAMAGED AS A DIRECT RESULT OF CONTRACTOR ACTIONS SHALL BE REPLACED IN-KIND AT NO ADDITIONAL COST TO THE CONTRACTING AGENCY.
6. FINAL LOCATIONS OF EACH ELJ WILL BE DETERMINED IN THE FIELD BY THE ENGINEER. THE CONTRACTING AGENCY WILL INSTALL STAKES AT TWO STAKEOUT POINTS FOR EACH ELJ. THE CONTRACTOR SHALL EXPAND THIS STAKING AS NECESSARY TO DEFINE THE STRUCTURE EXTENTS, POST LOCATIONS, EXCAVATION EXTENTS, AND DESIGN ELEVATIONS.
7. THE CONTRACTOR SHALL DETERMINE THE EXCAVATION LIMITS TO MAINTAIN A SAFE EXCAVATION DURING ELJ INSTALLATION. TEMPORARY AND PERMANENT EXCAVATION SPOILS SHALL BE PLACED TO MINIMIZE DISTURBANCE TO EXISTING VEGETATION.
8. NO EXCAVATION WITHIN THE ACTIVELY FLOWING CHANNEL SHALL OCCUR UNTIL THE WORK AREA HAS BEEN ISOLATED AND AQUATIC LIFE HAS BEEN REMOVED FROM THE INTERIOR OF THE ISOLATION.
9. THE EXCAVATION SHALL BE SUFFICIENTLY DEWATERED TO ALLOW COMPLETION AND INSPECTION OF ELJ INSTALLATION IN A CONTROLLED MANNER.
10. EXISTING WOODY MATERIAL AT THE STRUCTURE CONSTRUCTION SITE SHALL BE MOVED OR PROTECTED FROM CONSTRUCTION ACTIVITIES AND THEN INCORPORATED INTO THE STRUCTURE AND BACKFILL AS APPROVED BY THE CONTRACTING OFFICER.

SIDE CHANNEL ELJ MATERIALS SCHEDULE

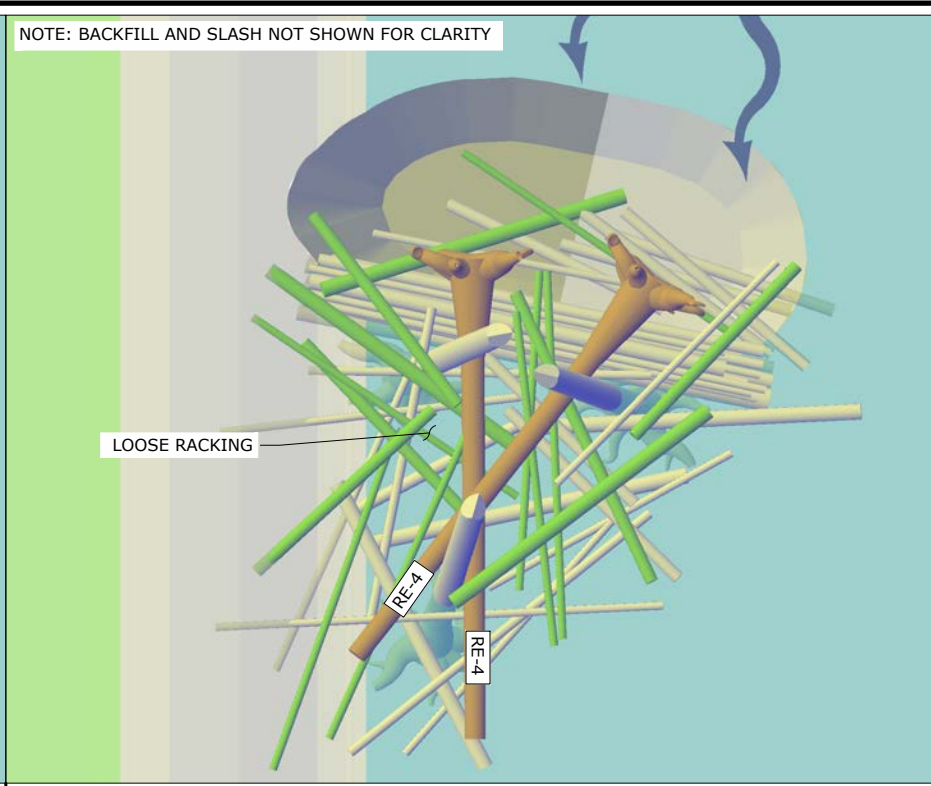
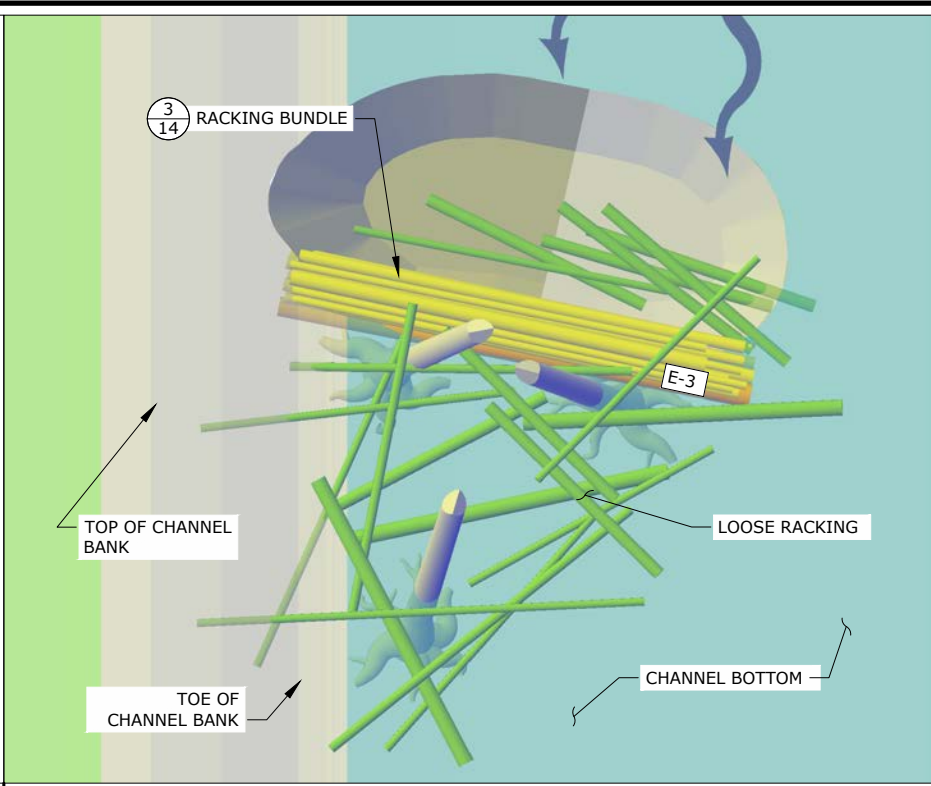
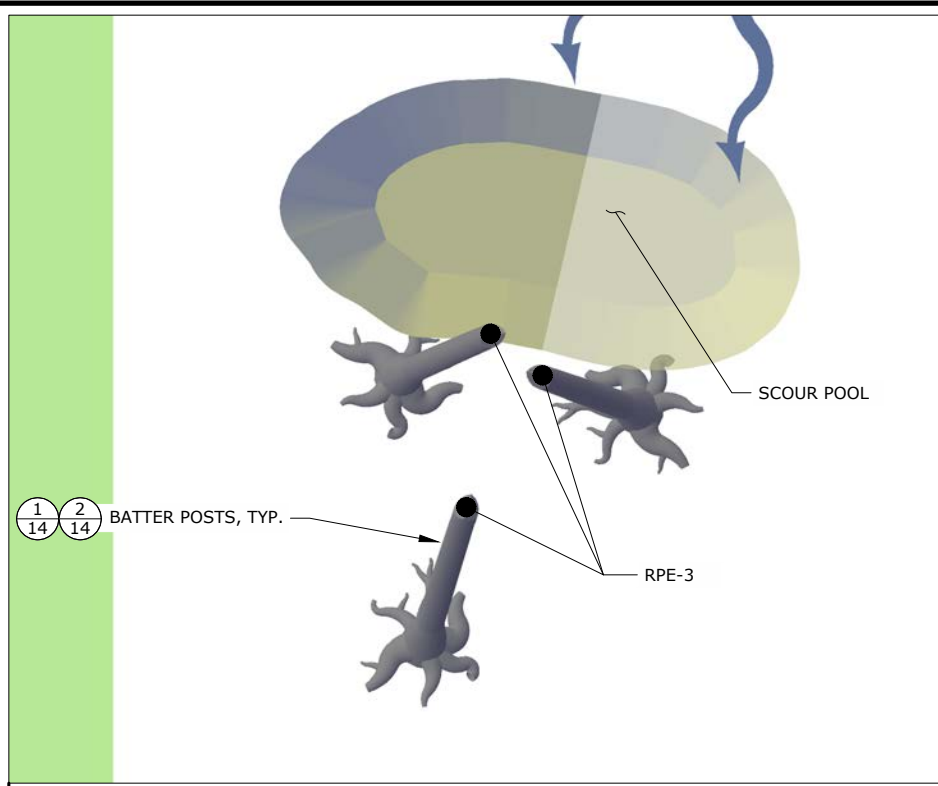
LOG ID	DIA (INCHES)	LENGTH (FT)	ROOTWAD (Y/N)	QUANTITY PER STRUCTURE
RPE-3	18	30	YES	3
RE-4	18	40	YES	2
E-3	18	30	NO	1
RACKING BUNDLE	36	30	NO	1
RACKING	6-12	20-40	NO	40
SLASH	1-3	N/A	NO	12 CY



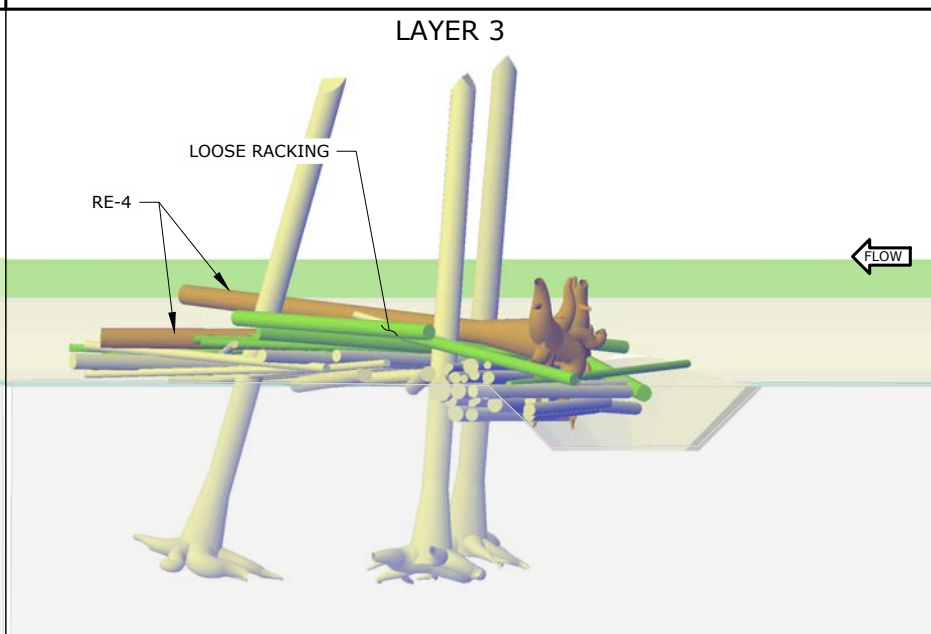
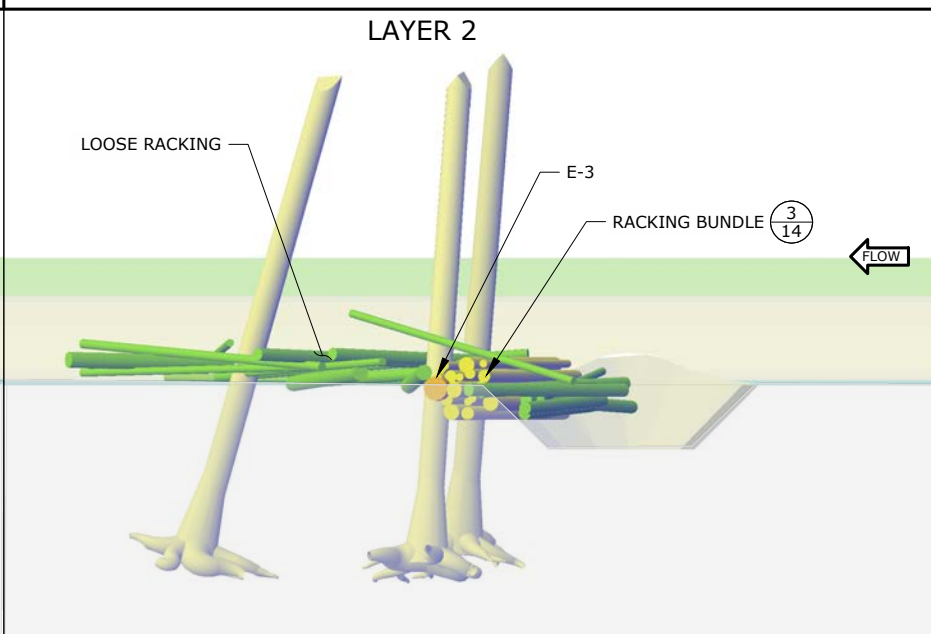
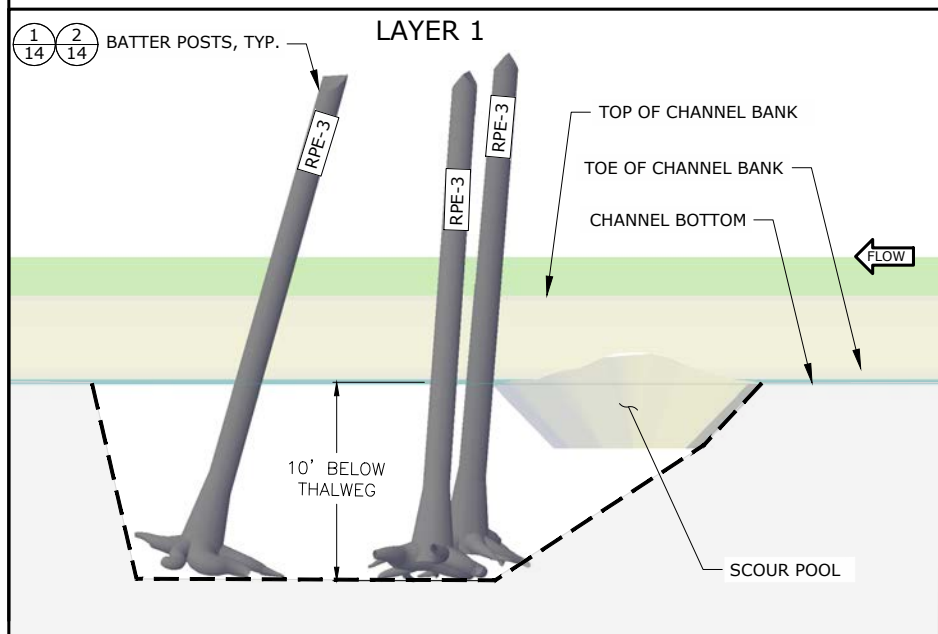
SIDE CHANNEL ELJ PERSPECTIVE
NTS

SIDE CHANNEL ELJ
SCALE: AS SHOWN

1
9



PLAN VIEWS 6' 3' 0 6' 12'



SECTION VIEWS 6' 3' 0 6' 12'

NOTE: BACKFILL AND SLASH NOT SHOWN FOR CLARITY

1. EXCAVATE 10 FEET BELOW THALWEG FOR ROOTWAD POST PLACEMENT.
2. EXCAVATE SCOUR POOL.
3. BATTER THREE (3) RPE-3 ROOTWAD POSTS AS SHOWN.
4. BACKFILL TO ONE FOOT BELOW GROUND SURFACE.

1. PLACE ONE (1) E-3 LOG IN FRONT OF TWO POSTS AT BASE OF SCOUR POOL.
2. PLACE ONE (1) 30-FOOT LONG RACKING BUNDLE IN FRONT OF E-3 LOG.
3. WEAVE AND PLACE LOOSE RACKING BETWEEN POSTS

1. PLACE TWO (2) RE-4 ROOTWADS.
2. PLACE LOOSE RACKING AND SLASH IN GAPS OF ELJ.
3. CUT PILES 5 FEET ABOVE HIGHEST ROOTWAD.
4. BACKFILL APPROXIMATELY 1-FOOT ABOVE HIGHEST ROOTWAD.



60% DESIGN
NOT FOR CONSTRUCTION

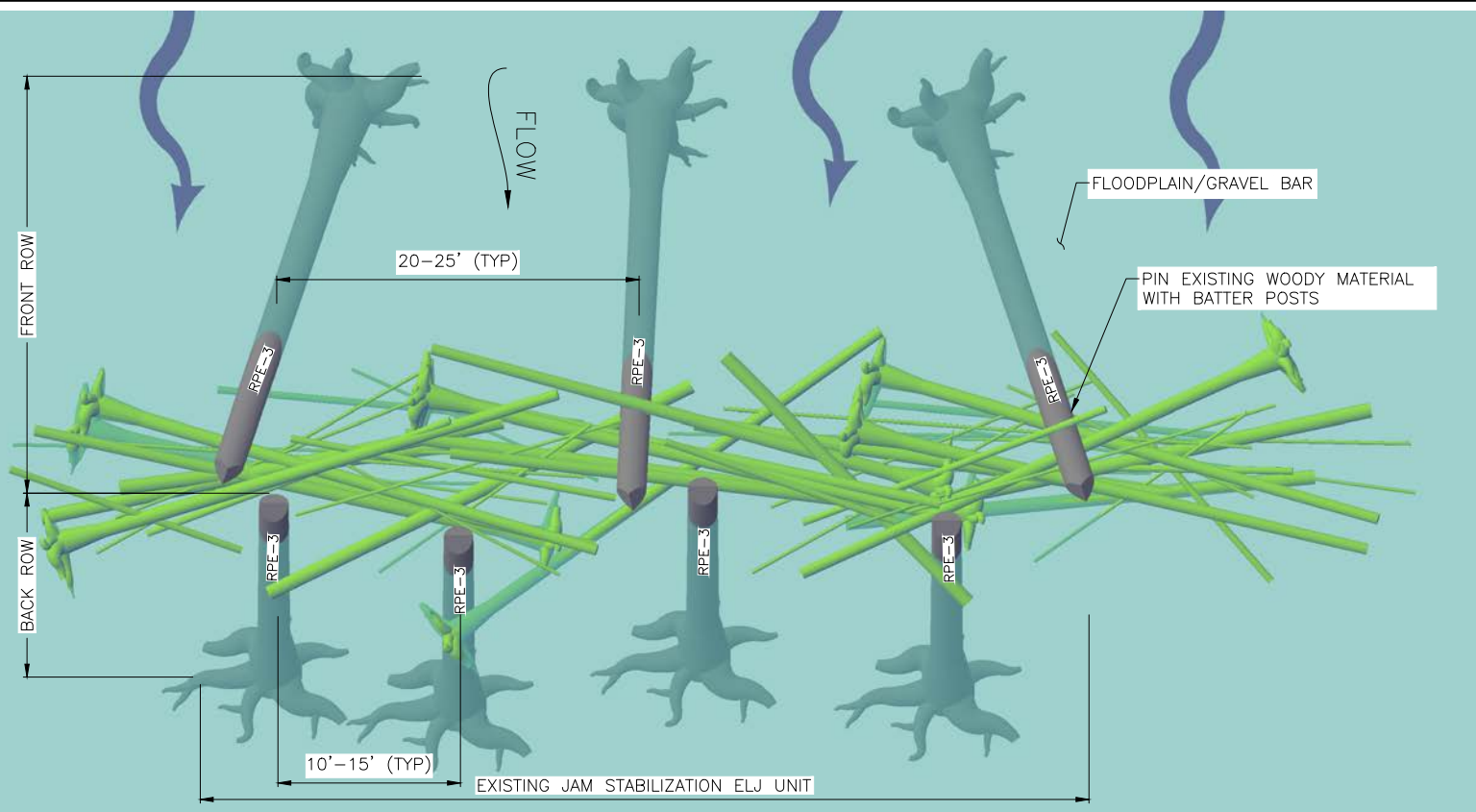
CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
 LOWER ENTIAIT 1D REACH (RM 4.3 - 4.8) HABITAT
 ENHANCEMENT PROJECT
SIDE CHANNEL ELJ LAYERING PLAN
 PRELIMINARY

DATE	12/23/2024
COUNTY	CHELAN COUNTY
LATITUDE	47°40'20"N
LONGITUDE	120°18'27"W
TN/SC/RG	T25N/S10/R20E
DESIGN_GB	DRAWN_KS
CHECK_NT	CHECK_NT

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT PLOTTED TO ORIGINAL SCALE.

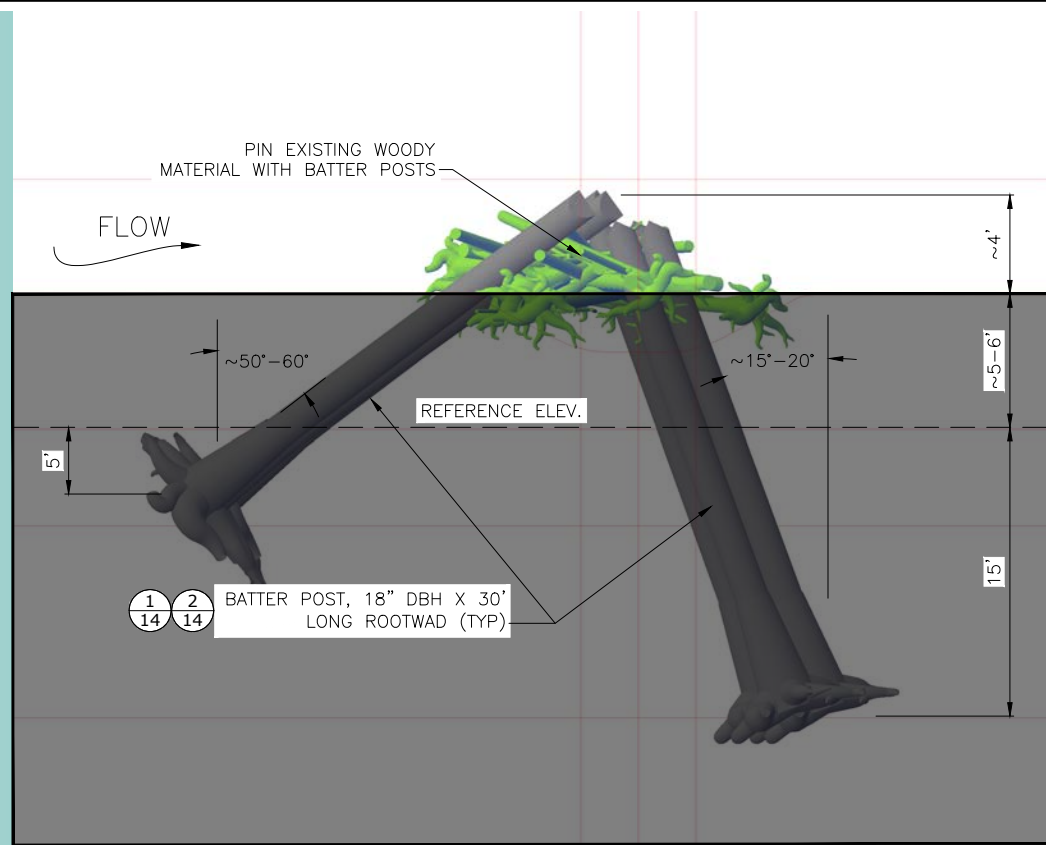
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P:\PROJECTS\CHELAN COUNTY\LOWER ENTIAI RM 4.6\DESIGN\CAD\STABILIZE EXISTING LOGJAM.DWG Grace 12/31/2024 12:27:24 PM



5' 0 5' 10'
SCALE: 1"=5'-0"

STABILIZE EXISTING LOGJAM PLAN
SCALE: 1" = 5'



STABILIZE EXISTING LOGJAM PROFILE
SCALE: 1" = 5'

5' 0 5' 10'
SCALE: 1"=5'-0"

NOTES

1. ALL LOGS REQUIRED HAVE BEEN PROVIDED BY THE CONTRACTING AGENCY AND ARE STOCKPILED AT THE PROJECT SITE.
2. CAREFULLY HANDLE, TRANSPORT, AND STAGE PROVIDED WOODY MATERIAL FOR ELJ CONSTRUCTION. ANY WOODY MATERIAL DAMAGED AS A DIRECT RESULT OF CONTRACTOR ACTIONS SHALL BE REPLACED IN-KIND AT NO ADDITIONAL COST TO THE CONTRACTING AGENCY.
3. FINAL LOCATIONS OF EACH ELJ WILL BE DETERMINED IN THE FIELD BY THE ENGINEER. THE CONTRACTING AGENCY WILL INSTALL STAKES AT TWO STAKEOUT POINTS FOR EACH ELJ AT THE START AND END OF THE ELJ. THE CONTRACTOR SHALL EXPAND THIS STAKING AS NECESSARY TO DEFINE THE POST LOCATIONS, EXCAVATION EXTENTS, AND DESIGN ELEVATIONS.
4. POSTS SHALL BE INSTALLED WITH THE TYPICAL SPACING, BATTER, AND EXCAVATION DEPTHS SHOWN ON THIS SHEET. POST LOCATIONS MAY BE FIELD FIT BASED ON CONDITIONS AT THE TIME OF CONSTRUCTION. THE NUMBER OF ELJ UNITS INSTALLED AT EACH LOCATION WILL VARY DEPENDING ON SITE CONDITIONS. THE CONTRACTOR SHALL BE PREPARED TO INSTALL A TOTAL OF 2 UNITS (8 BACK ROW POSTS AND 6 FRONT ROW POSTS) AT THE APPROXIMATE LOCATIONS SHOWN ON THE PLANS.
5. THE CONTRACTOR SHALL DETERMINE THE EXCAVATION LIMITS TO MAINTAIN A SAFE EXCAVATION DURING ELJ INSTALLATION AND ACHIEVE THE DESIGN ELEVATIONS INCLUDED ON THIS SHEET. TEMPORARY AND PERMANENT EXCAVATION SPOILS SHALL BE PLACED TO MINIMIZE DISTURBANCE TO EXISTING VEGETATION.
6. NO EXCAVATION WITHIN THE ACTIVELY FLOWING CHANNEL SHALL OCCUR UNTIL THE WORK AREA HAS BEEN ISOLATED AND AQUATIC LIFE HAS BEEN REMOVED FROM THE INTERIOR OF THE ISOLATION.
7. THE EXCAVATION SHALL BE SUFFICIENTLY DEWATERED TO ALLOW COMPLETION AND INSPECTION OF ELJ INSTALLATION IN A CONTROLLED MANNER.
8. EXISTING WOODY MATERIAL AT THE STRUCTURE CONSTRUCTION SITE SHALL BE MOVED OR PROTECTED FROM CONSTRUCTION ACTIVITIES AND THEN INCORPORATED INTO THE STRUCTURE AND BACKFILL AS APPROVED BY THE CONTRACTING OFFICER.
9. BACKFILL EXCAVATED POSTS TO THE ORIGINAL GROUND LINE, INCORPORATING ANY REMOVED WOODY MATERIAL INTO THE STRUCTURE AS SHOWN, PINNING IT IN PLACE WITH THE INSTALLED POSTS.
10. TRIM POST TOPS FOLLOWING INSTALLATION AND BACKFILL.

STABILIZE EXISTING LOGJAM
SCALE: AS NOTED



60% DESIGN
NOT FOR CONSTRUCTION

CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
LOWER ENTIAI 1D REACH (RM 4.3 - 4.8) HABITAT
ENHANCEMENT PROJECT
STABILIZE EXISTING LOGJAM
PRELIMINARY

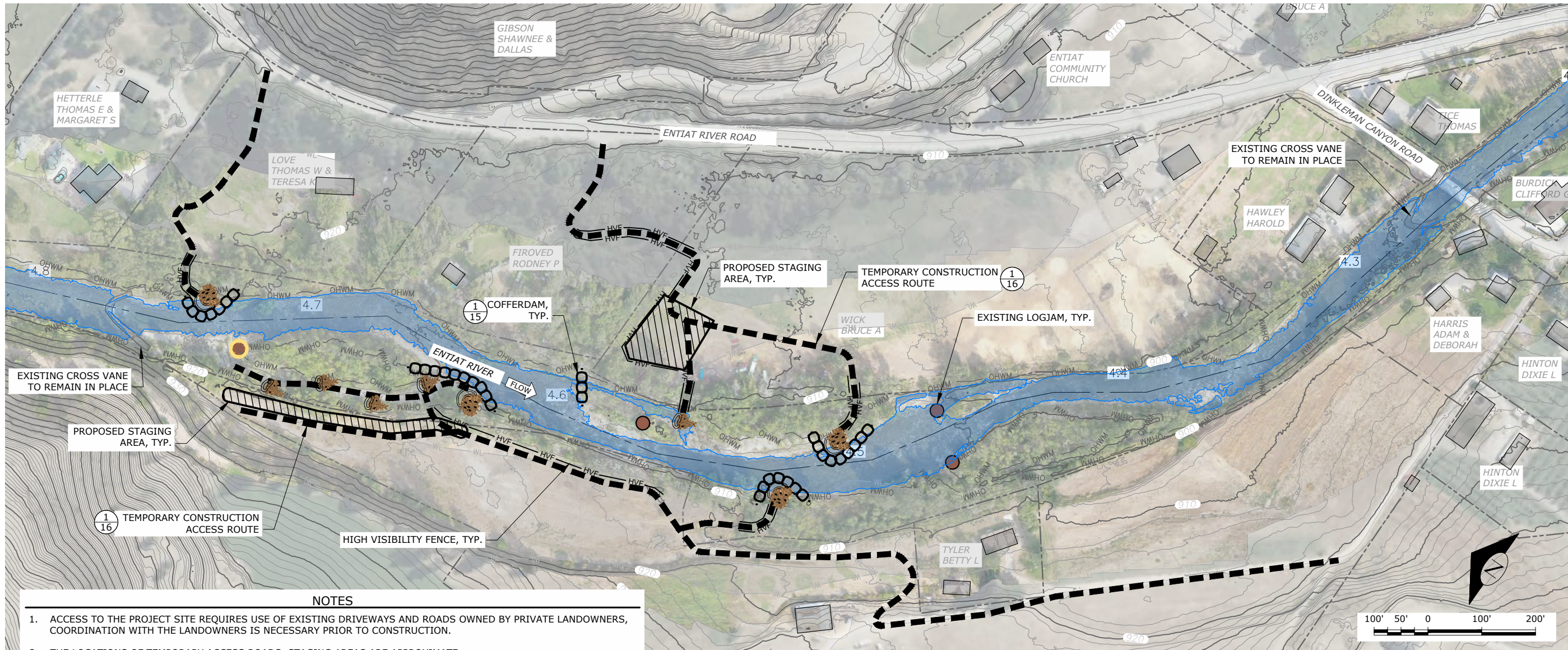
DATE	12/23/2024
COUNTY	CHELAN COUNTY
LATITUDE	47°40'20"N
LONGITUDE	120°18'27"W
TN/SC/RG	T25N/S10/R20E
DESIGN	GB
DRAWN	KS
CHECK	NT
CHECK	NT

0 1
IF THIS BAR DOES NOT MEASURE
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SHEET
11 OF 16



60% DESIGN
NOT FOR CONSTRUCTION



NOTES

1. ACCESS TO THE PROJECT SITE REQUIRES USE OF EXISTING DRIVEWAYS AND ROADS OWNED BY PRIVATE LANDOWNERS, COORDINATION WITH THE LANDOWNERS IS NECESSARY PRIOR TO CONSTRUCTION.
2. THE LOCATIONS OF TEMPORARY ACCESS ROADS, STAGING AREAS ARE APPROXIMATE.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR EXAMINING THE PROJECT SITE AND BECOMING FAMILIAR WITH THE NATURE OF TEMPORARY IMPROVEMENTS REQUIRED TO COMPLETE THE WORK ON THESE PLANS.
4. CONTRACTOR TO VERIFY ALL OVERHEAD AND UNDERGROUND UTILITIES BEFORE CONSTRUCTION.
5. EXISTING ROADS THAT WILL BE USED AS ACCESS SHALL BE STABILIZED AS NEEDED TO ACCOMMODATE EQUIPMENT.
6. PROPOSED STAGING AREAS MAY REQUIRE VEGETATION REMOVAL PRIOR TO STAGING OF MATERIALS. ALL CLEARED NATIVE TREES AND VEGETATION ARE TO BE STOCKPILED AND UTILIZED IN ELJ STRUCTURES AS DIRECTED BY THE ENGINEER.
7. ALL TEMPORARY ACCESS ROADS AND STAGING AREAS SHALL BE RESTORED AND REVEGETATED FOLLOWING CONSTRUCTION.
8. DEWATERING IN SOME LOCATIONS MAY BE NECESSARY. A DEWATERING PLAN INCLUDING POTENTIAL INFILTRATION LOCATIONS WILL BE DEVELOPED AT A FUTURE PHASE BASED ON SURROUNDING SITE CONDITIONS.
9. SITE ISOLATION MAY BE MODIFIED BASED ON SITE CONDITIONS AT THE TIME OF CONSTRUCTION. COFFERDAMS SHOWN MAY NOT BE NECESSARY.
10. FISH SHALL BE REMOVED AND ISOLATED FROM WORK AREAS FOR THE DURATION OF CONSTRUCTION.
11. AERIAL IMAGERY COLLECTED BY CHELAN COUNTY SEPTEMBER 2023 AND SUPPLEMENTED WITH 2023 BING AERIAL IMAGERY.
12. WETLANDS ARE TAKEN FROM THE NATIONAL WETLAND INSTITUTE AND ARE APPROXIMATE. IT IS RECOMMENDED A WETLAND SURVEY IS COMPLETED IN THE FUTURE TO REFINE WETLAND BOUNDARIES.
13. CONTOURS SHOWN ON THIS SHEET ARE 2' AND 10' INTERVALS.

ACCESS, STAGING, AND SITE ISOLATION PLAN

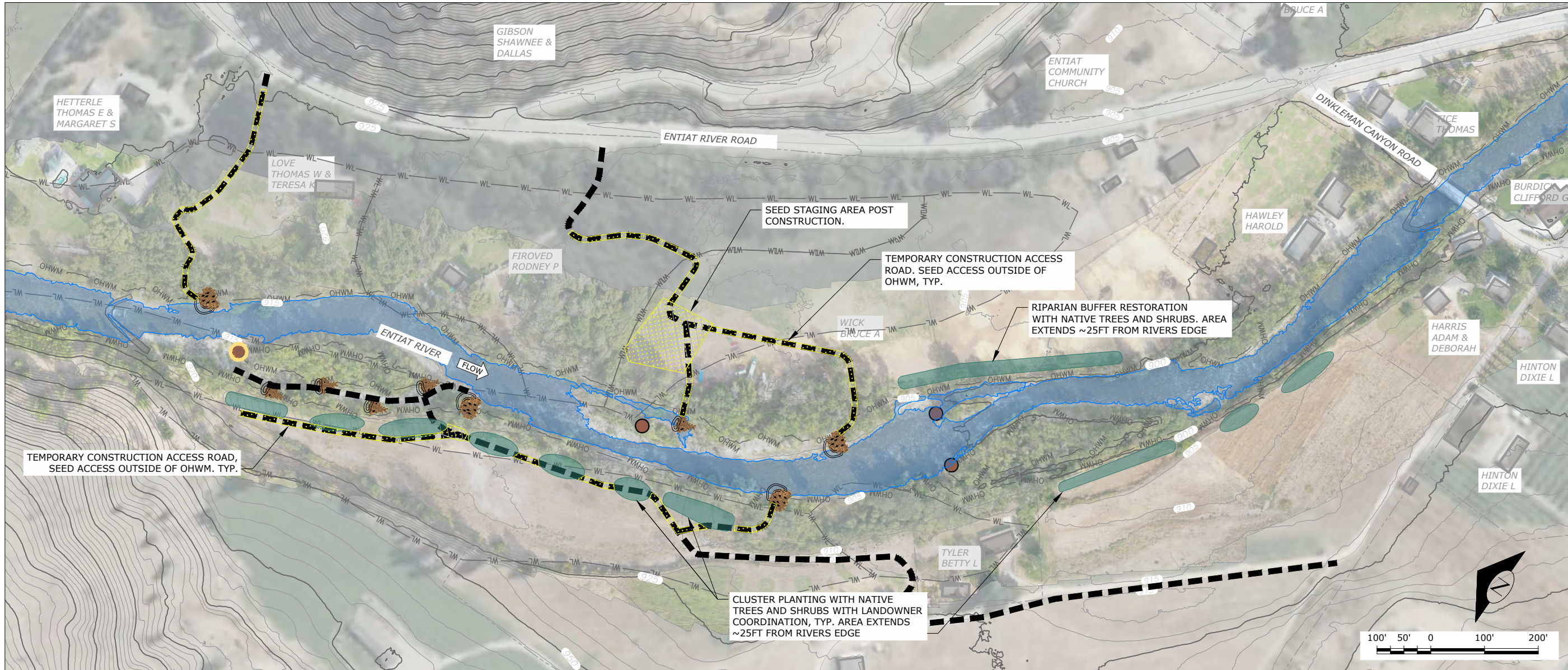
SCALE: 1" = 100'

CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
LOWER ENTIAT 1D REACH (RM 4.3 - 4.8) HABITAT
ENHANCEMENT PROJECT
**ACCESS, STAGING, AND SITE ISOLATION
PLAN**
PRELIMINARY

DATE	12/23/2024
COUNTY	CHELAN COUNTY
LATITUDE	47°40'20"N
LONGITUDE	120°18'27"W
TN/SC/RG	T25N/S10/R20E
DESIGN_GB	DRAWN_KS
CHECK_NT	CHECK_NT

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1" THEN DRAWING IS NOT
PLOTTED TO ORIGINAL SCALE.

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REVEGETATION PLAN
SCALE: 1" = 100'

NOTES

1. ALL AREAS ABOVE THE ORDINARY HIGH WATER MARK DISTURBED DURING CONSTRUCTION, INCLUDING STAGING AREAS AND TEMPORARY CONSTRUCTION ACCESS ROUTES, SHALL BE SEEDED.
2. REVEGETATION BOUNDARIES ARE THE EXPECTED LIMITS OF DISTURBANCE RESULTING FROM CONSTRUCTION ACTIVITIES. BOUNDARIES MAY VARY AT THE TIME OF PLANT INSTALLATION.
3. REVEGETATION AND SEEDING BOUNDARIES SHALL BE APPROVED BY THE CONTRACTING OFFICER OR REPRESENTATIVE PRIOR TO INSTALLATION.
4. AERIAL IMAGERY COLLECTED BY CHELAN COUNTY SEPTEMBER 2023 AND SUPPLEMENTED WITH 2023 BING AERIAL IMAGERY.
5. WETLANDS ARE TAKEN FROM THE NATIONAL WETLAND INSTITUTE AND ARE APPROXIMATE. IT IS RECOMMENDED A WETLAND SURVEY IS COMPLETED IN THE FUTURE TO REFINE WETLAND BOUNDARIES.
6. CONTOURS SHOWN ON THIS SHEET ARE 2' AND 10' INTERVALS.

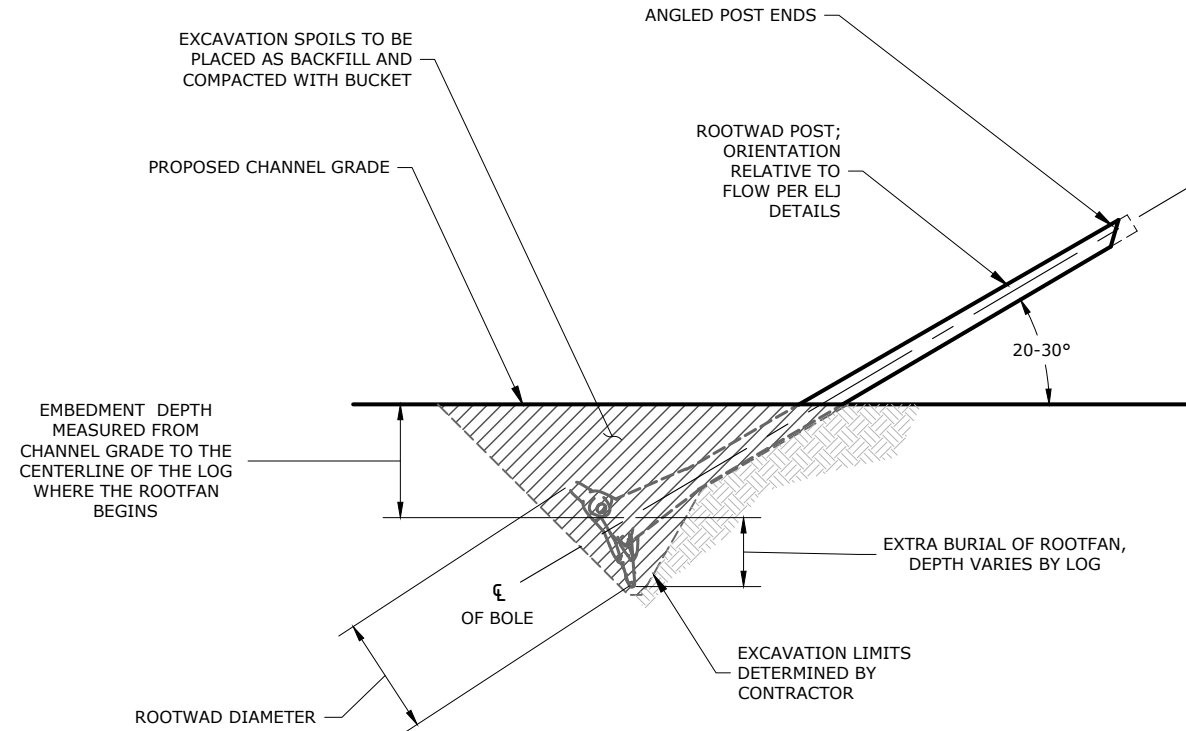


CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
 LOWER ENTIAT 1D REACH (RM 4.3 - 4.8) HABITAT
 ENHANCEMENT PROJECT
REVEGETATION PLANS
 PRELIMINARY

DATE	12/23/2024
COUNTY	CHELAN COUNTY
LATITUDE	47°40'20"N
LONGITUDE	120°18'27"W
TN/SC/RG	T25N/S10/R20E
DESIGN_GB	DRAWN_KS
CHECK_NT	CHECK_NT

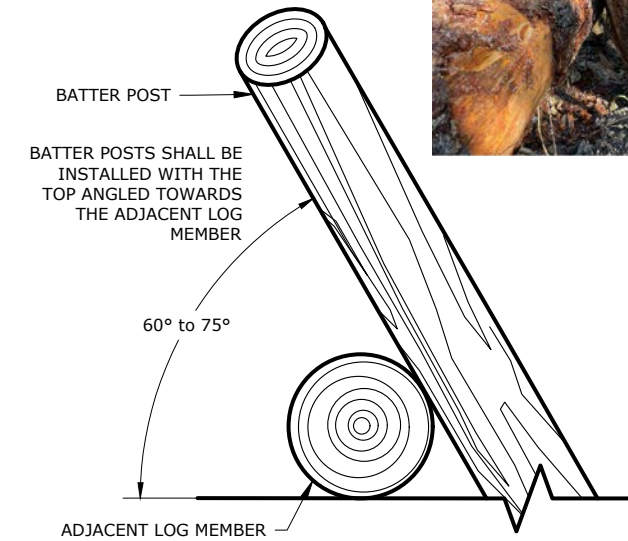
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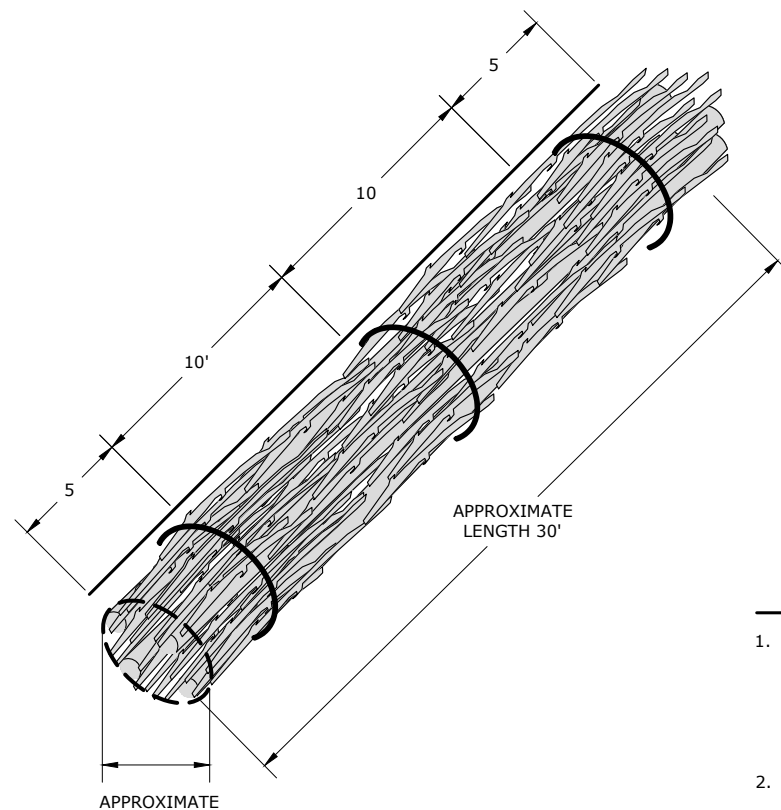
BATTER POST PLACEMENT
SCALE: 1"=6'

1
14



BATTER POST DETAIL
SCALE: 1"=1'

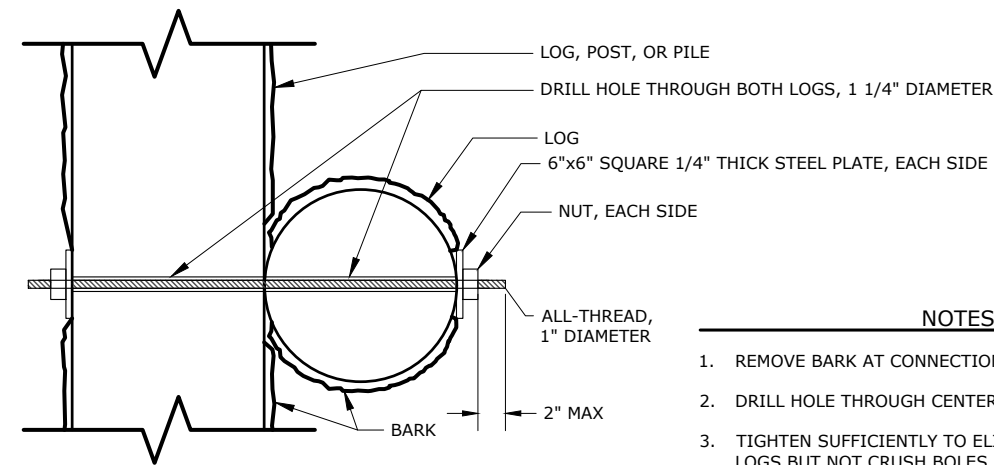
2
14



RACKING BUNDLE
SCALE: 1"=4'

- NOTES**
- RACKING BUNDLES SHALL BE SECURED WITH A MIN 1" DIA MANILA ROPE WRAPPED TWICE AROUND AND SECURED WITH A TRUCKERS HITCH OR COMPARABLE CONSTRICTOR KNOT AT MINIMUM 3 LOCATIONS AS SHOWN. BUNDLES SHALL BE TESTED TO ENSURE PIECES ARE SECURE FOR TRANSPORT.
 - SLASH SHALL BE SANDWICHED INTO THE CENTER OF THE BUNDLE.

3
14



BOLTED CONNECTION
SCALE: 1"=1'

- NOTES**
- REMOVE BARK AT CONNECTION POINTS.
 - DRILL HOLE THROUGH CENTER OF LOGS.
 - TIGHTEN SUFFICIENTLY TO ELIMINATE GAP BETWEEN LOGS BUT NOT CRUSH BOLES. PEEN THREADS OR TACK WELD NUT TO ALL-THREAD FOLLOWING TIGHTENING.
 - ALL-THREAD TO BE ASTM TYPE A 307, GRADE A. LENGTH VARIES BY CONNECTION.
 - MULTIPLE LOG CONNECTIONS AT SAME JOINT WILL USE SINGLE PIECE OF ALL-THREAD TO MINIMIZE HOLES IN POSTS.

4
14



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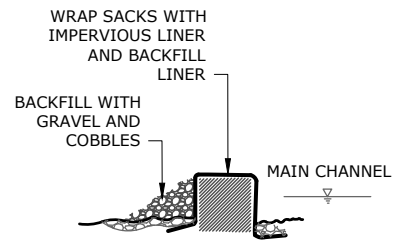
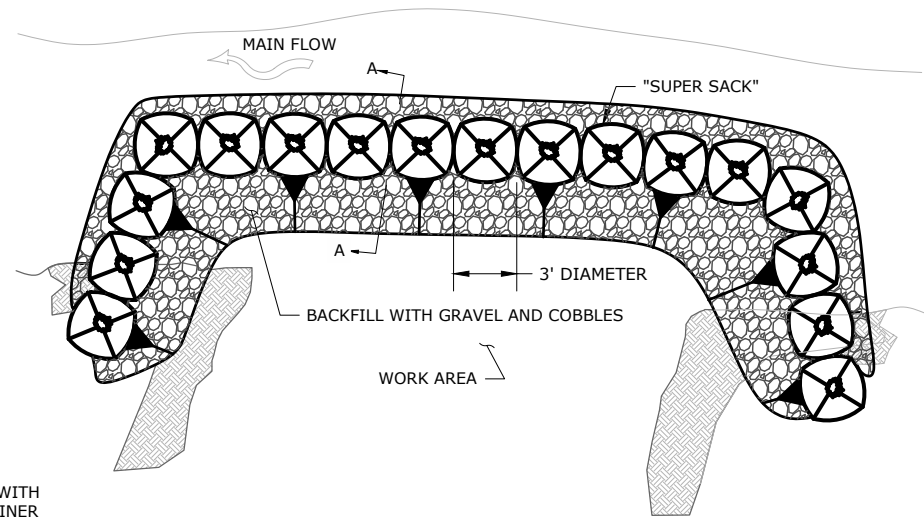
CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
LOWER ENTIAT 1D REACH (RM 4.3 - 4.8) HABITAT
ENHANCEMENT PROJECT
ELJ DETAILS
PRELIMINARY

DATE	12/23/2024
COUNTY	CHELAN COUNTY
LATITUDE	47°40'20"N
LONGITUDE	120°18'27"W
TN/SC/RG	T25N/S10/R20E
DESIGN__GB	DRAWN_KS
CHECK__NT	CHECK__NT

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SHEET
14 OF 16

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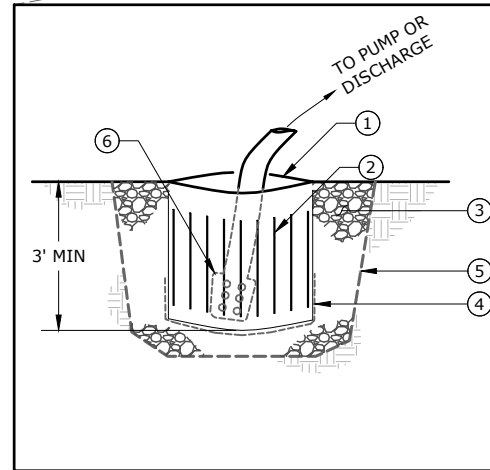
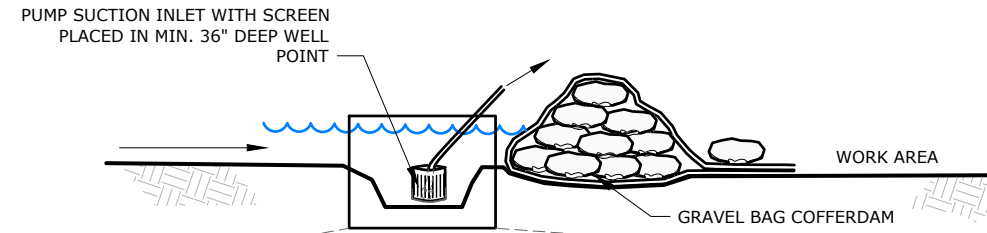
SECTION A-A

NOTES

1. WRAP "SUPER SACKS" WITH IMPERVIOUS PLASTIC LINER TO PREVENT SEEPAGE.
2. BACKFILL THE DOWNSTREAM SIDE COFFER DAM WITH NATIVE, ADJACENT ALLUVIUM FROM SIDE CHANNEL EXCAVATION.
3. USE "SUPER SACKS" AS BUTTRESSES AS REQUIRED.
4. "SUPER SACKS" MAY BE REPLACED WITH SAND BAGS IF FLOWS ALLOW AND APPROVED BY THE ENGINEER. SAND BAGS MAY BE FILLED WITH EXCAVATION FROM THE SIDE CHANNEL AND FILL MATERIAL MAY BE PLACED IN THE LBSN FOLLOWING USE. REMOVE ALL PLASTIC FROM THE SITE.

COFFERDAM
SCALE: 1":5'

1
15

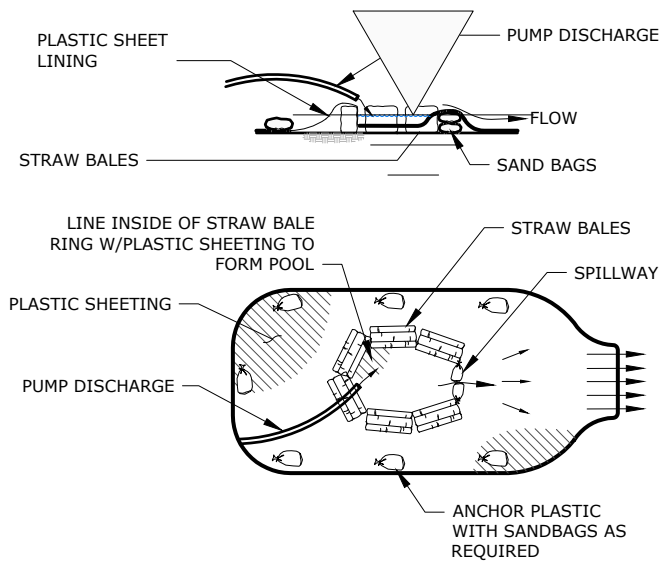


NOTES:

1. CORRUGATED PLASTIC OR METAL PIPE 36" MIN DIAMETER, ONE PER EACH PUMP.
2. 1/4" SLOTS 24" LONG AT 4" SPACING ALL THE WAY AROUND PIPE.
3. STREAMBED SEDIMENT
4. WIRE SCREEN 1/2" MESH COVERING PIPE BOTTOM, ANCHORED TO PIPE.
5. LIMIT OF EXCAVATION. INSTALL PIPE AND BACKFILL WITH STREAMBED SEDIMENT.
6. PUMP SUCTION INTAKE OR ELECTRIC SUBMERSIBLE PUMP WITH 1" SCREEN INSTALLED AT INLET OR PUMP SUCTION FACE, OR OTHER SIZE RECOMMENDED BY PUMP SUPPLIER.
7. PUMP SUCTION SHALL BE OPERATIONAL ONLY WHILE ALL CREEK FLOW IS FULLY FILTERED BY FISH BLOCK NETS AND AFTER FISH EXCLUSION IS COMPLETED. BYPASS PUMPS SHALL BE SHUTDOWN DURING ANY FAILURE OF THE FISH BLOCK NET OR ANY CONDITION THAT CAN ALLOW FISH TO ENTER THE PUMP INTAKE.

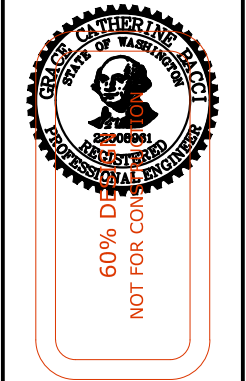
PUMP
SCALE: 1":2'

2
15



ENERGY DISSIPATOR
SCALE: 1":10'

3
15



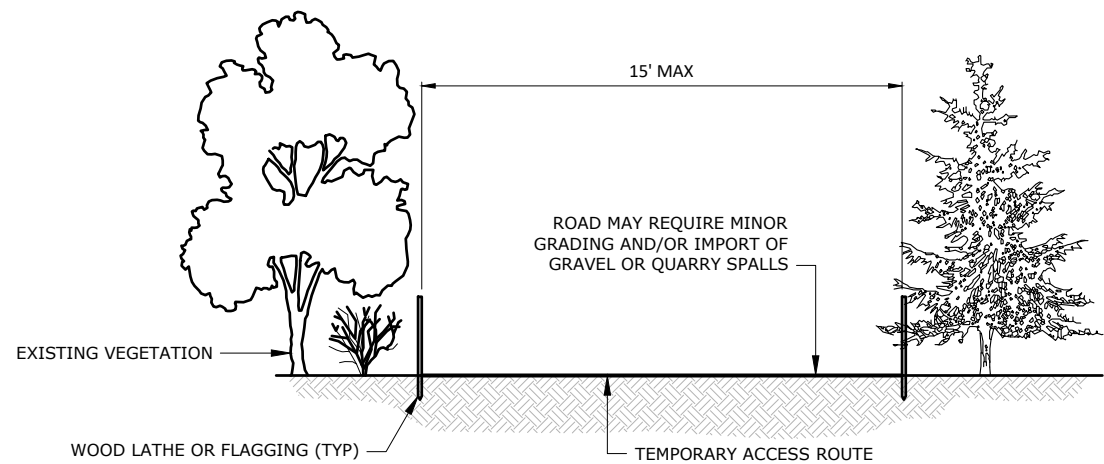
CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
LOWER ENTIAI 1D REACH (RM 4.3 - 4.8) HABITAT
ENHANCEMENT PROJECT
SITE ISOLATION DETAILS
PRELIMINARY

DATE	12/23/2024
COUNTY	CHELAN COUNTY
LATITUDE	47°40'20"N
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CHECK	NT

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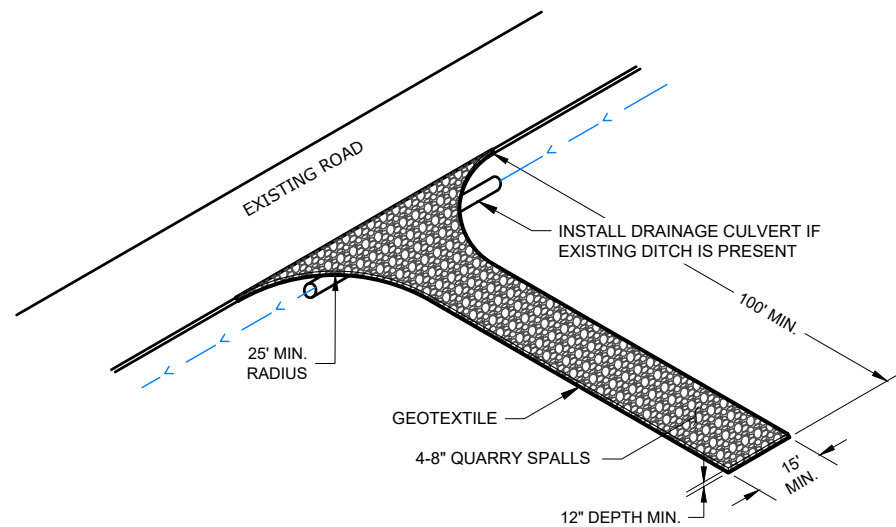


NOTES

1. CLEARED ACCESS TO BE ROUTED TO MINIMIZE VEGETATION DISTURBANCE AND FOREST CLEARING.
2. CONTRACTOR SHALL MARK CLEARING LIMITS WITH FLAGGING. CLEARING LIMITS TO BE APPROVED BY ENGINEER PRIOR TO ANY CLEARING ACTIVITIES.
3. ANY TREES GREATER THAN 12" ϕ SHALL BE REMOVED W/ ROOTWADS INTACT AND STOCKPILED FOR USE IN LOGJAM CONSTRUCTION.
4. TREES AND SHRUBS WITH 2"-12" ϕ SHALL BE STOCKPILED FOR USE AS RACKING MATERIAL IN LOGJAM CONSTRUCTION.
5. REMAINDER OF VEGETATION AND ORGANIC SOIL SHALL BE GRUBBED, STOCKPILED AND BROADCASTED ON ROAD ALIGNMENT FOLLOWING TERMINATION OF WORK.
6. ACCESS SHALL BE MAINTAINED BY MINOR GRADING AND IMPORTATION OF WOOD CHIPS, GRAVEL AND/OR QUARRY SPALLS, OR OTHER APPROVED BMPS.
7. CLEARED ACCESS SHALL BE SCARIFIED AND FULLY DECOMMISSIONED PER DIRECTION OF THE ENGINEER AT THE TERMINATION OF WORK.
8. REVEGETATION OF DISTURBED AREAS OUTSIDE OF THE APPROVED CLEARING AND ACCESS LIMITS SHALL BE PERFORMED BY CONTRACTOR AT NO COST TO THE OWNER.
9. ALL GRAVEL OR QUARRY SPALLS PLACED SHALL BE UNDERLAIN WITH A GEOTEXTILE AND REMOVED AT TERMINATION OF WORK IF UTILIZED.

TEMPORARY ACCESS ROAD
SCALE: 1":3'

1
16



CONSTRUCTION ENTRANCE
SCALE: 1":20'

2
16



CHELAN COUNTY NATURAL RESOURCE DEPARTMENT
LOWER ENTIAT 1D REACH (RM 4.3 - 4.8) HABITAT
ENHANCEMENT PROJECT
TESC DETAILS
PRELIMINARY

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TN/SC/RG	T25N/S10/R20E
DESIGN__GB__	DRAWN__KS
CHECK__NT__	CHECK__NT__

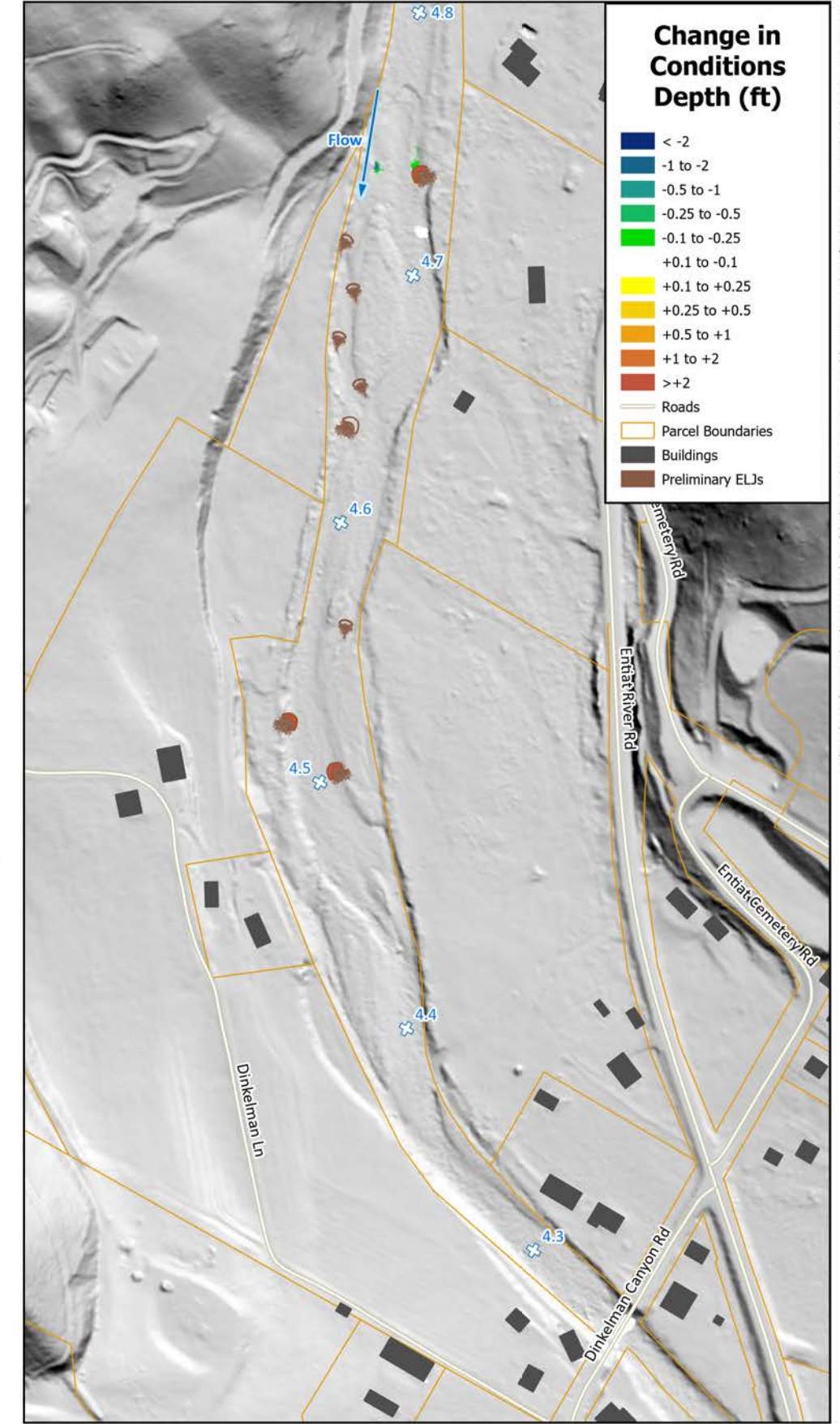
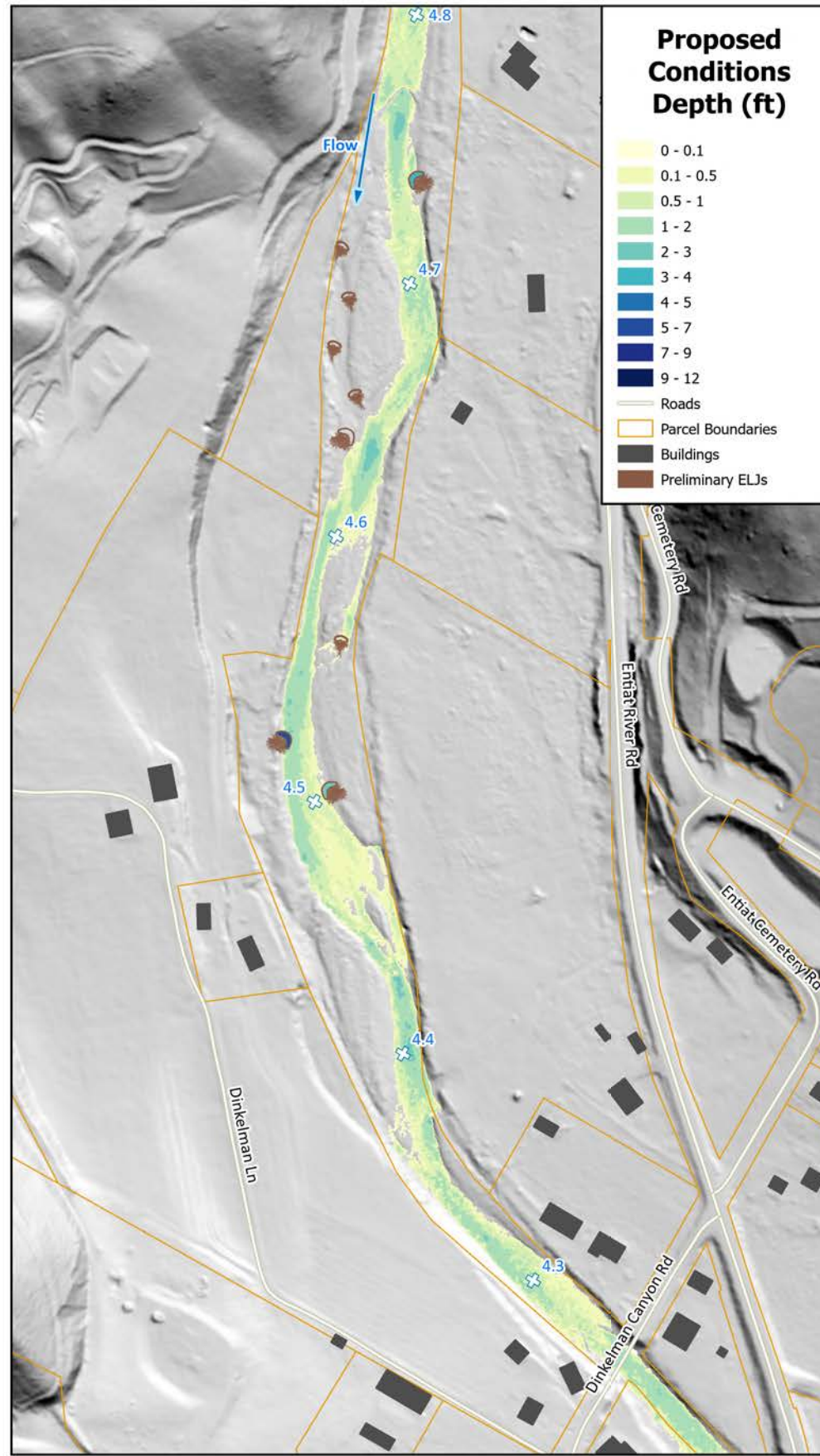
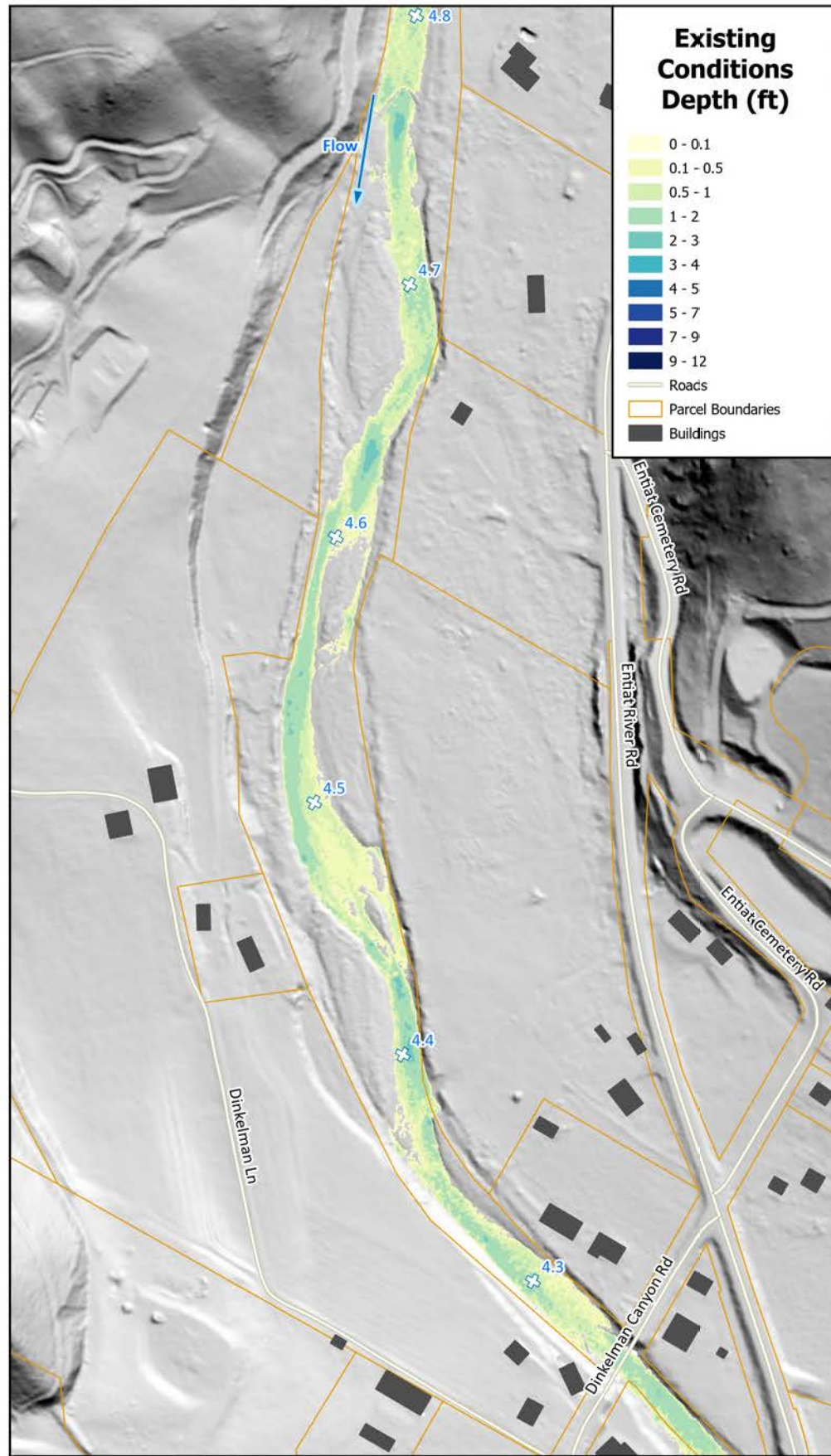


IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT PLOTTED TO ORIGINAL SCALE.

SHEET
16 OF 16

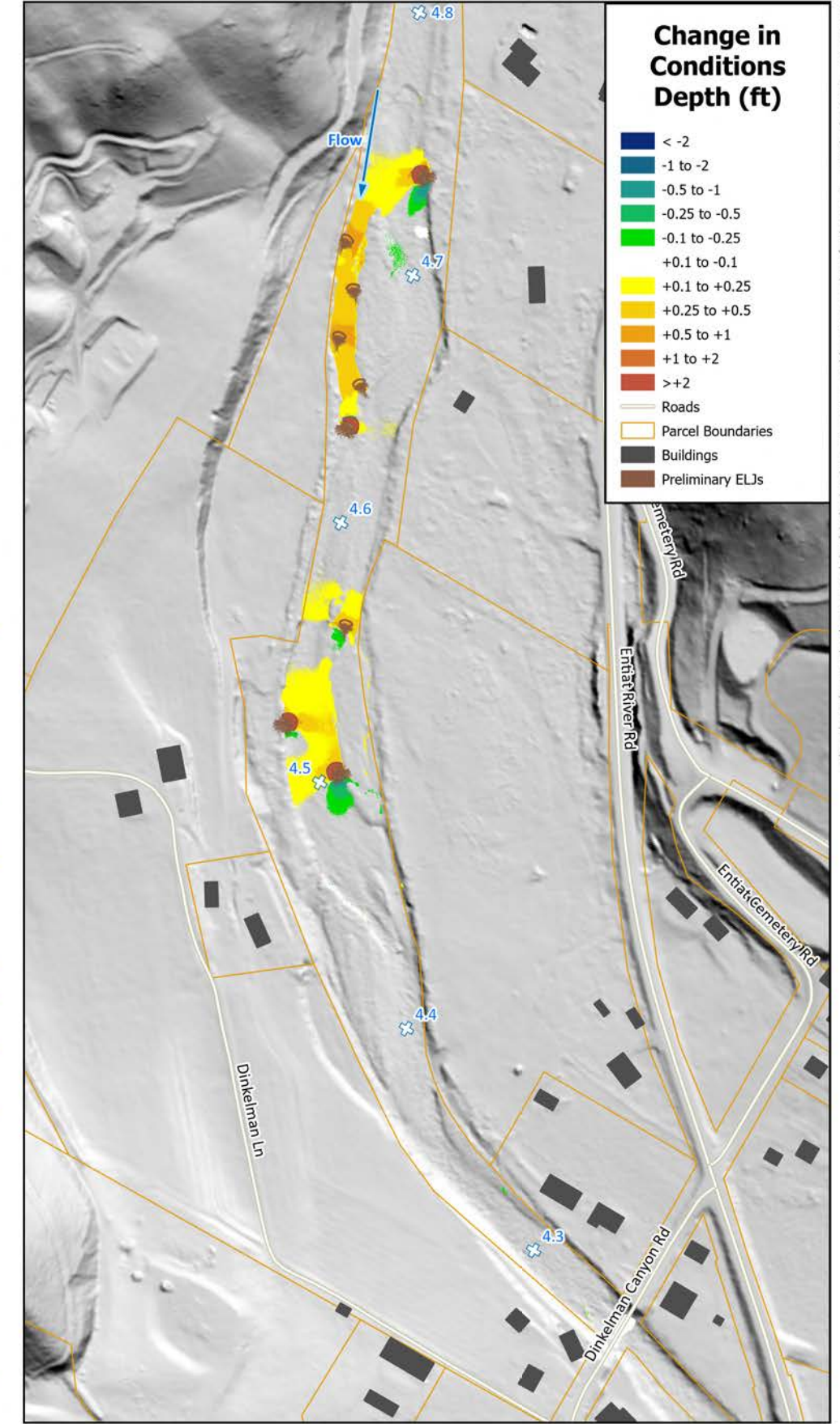
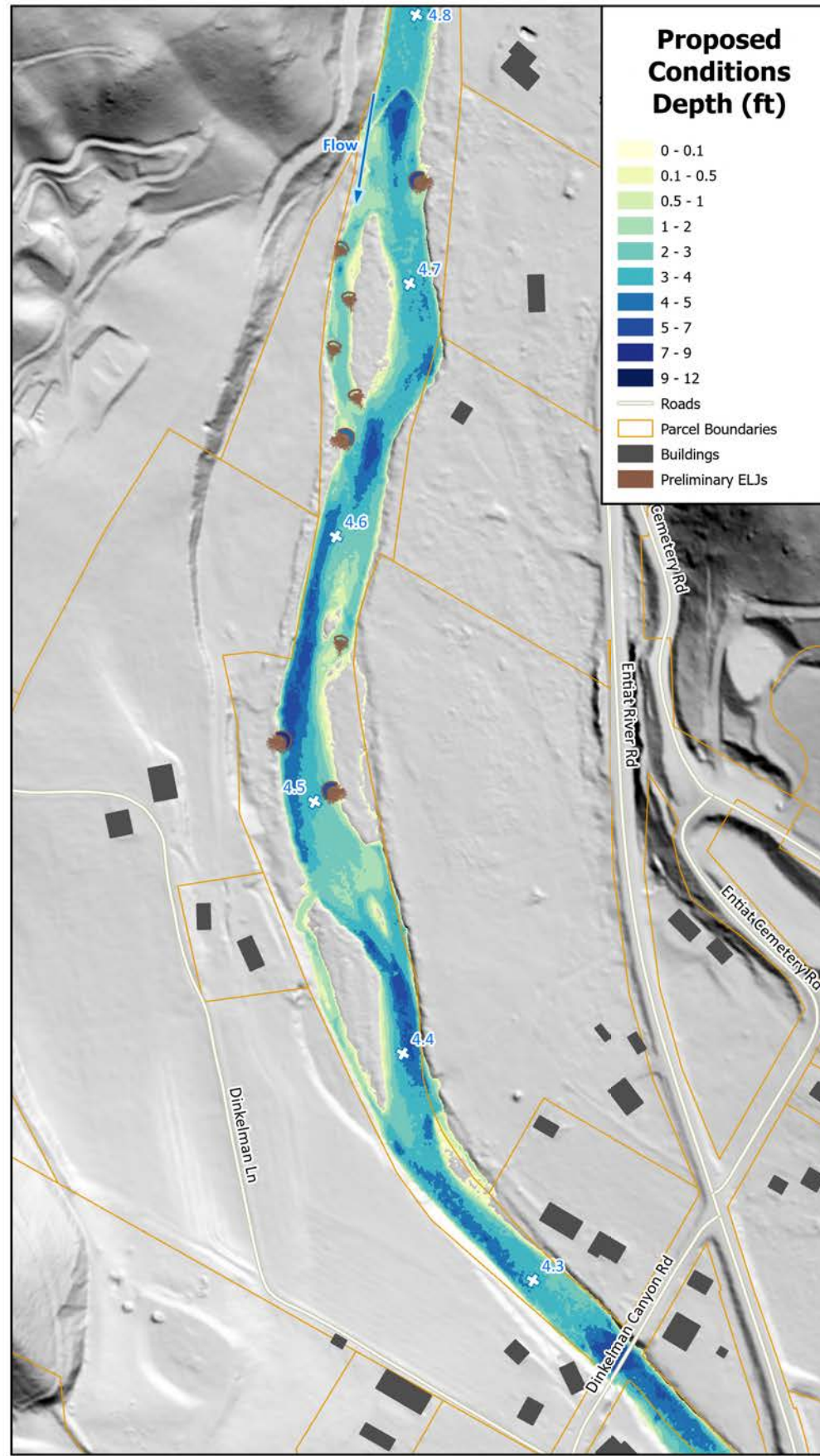
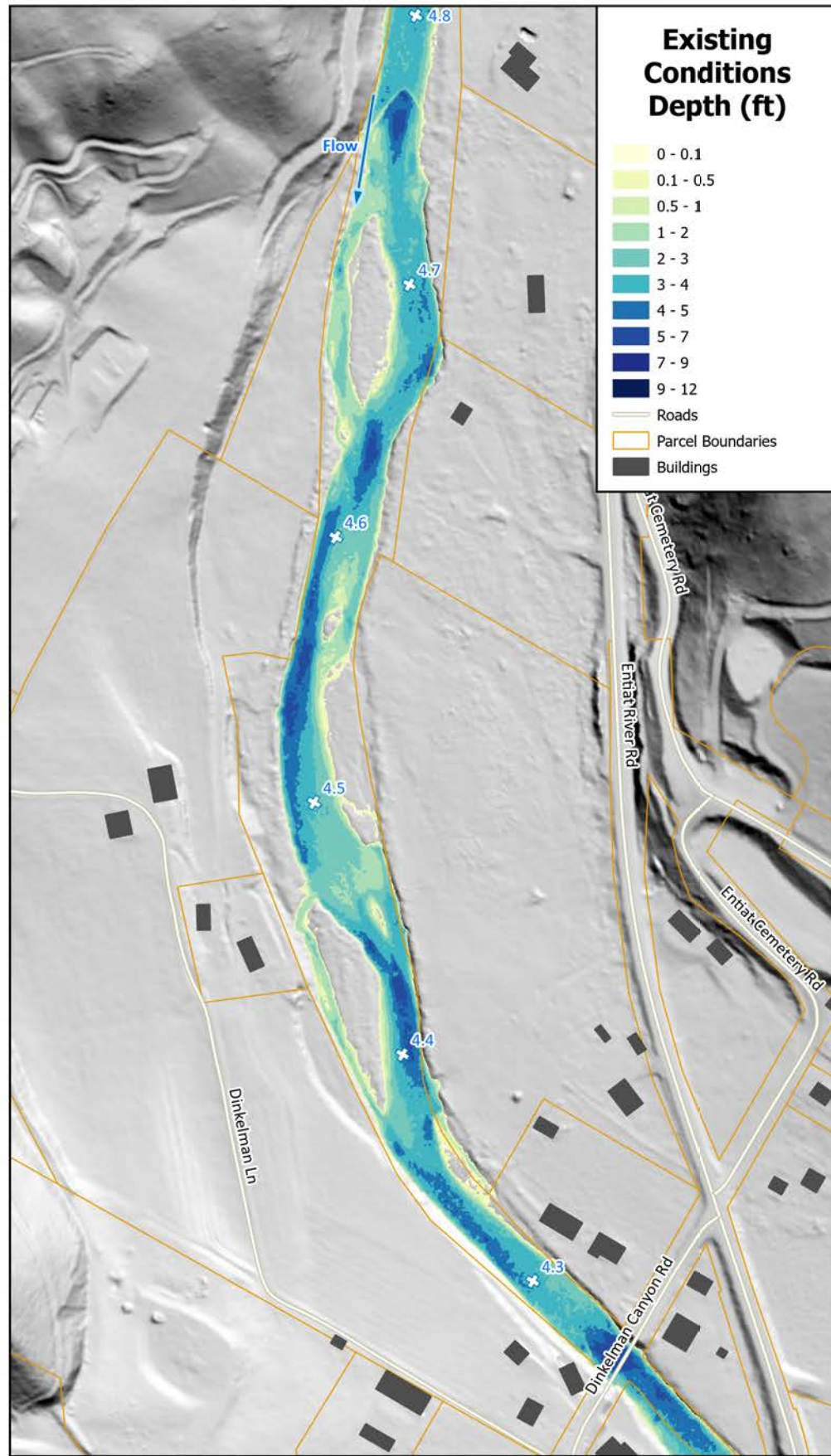
Appendix B

Hydraulic Model Results



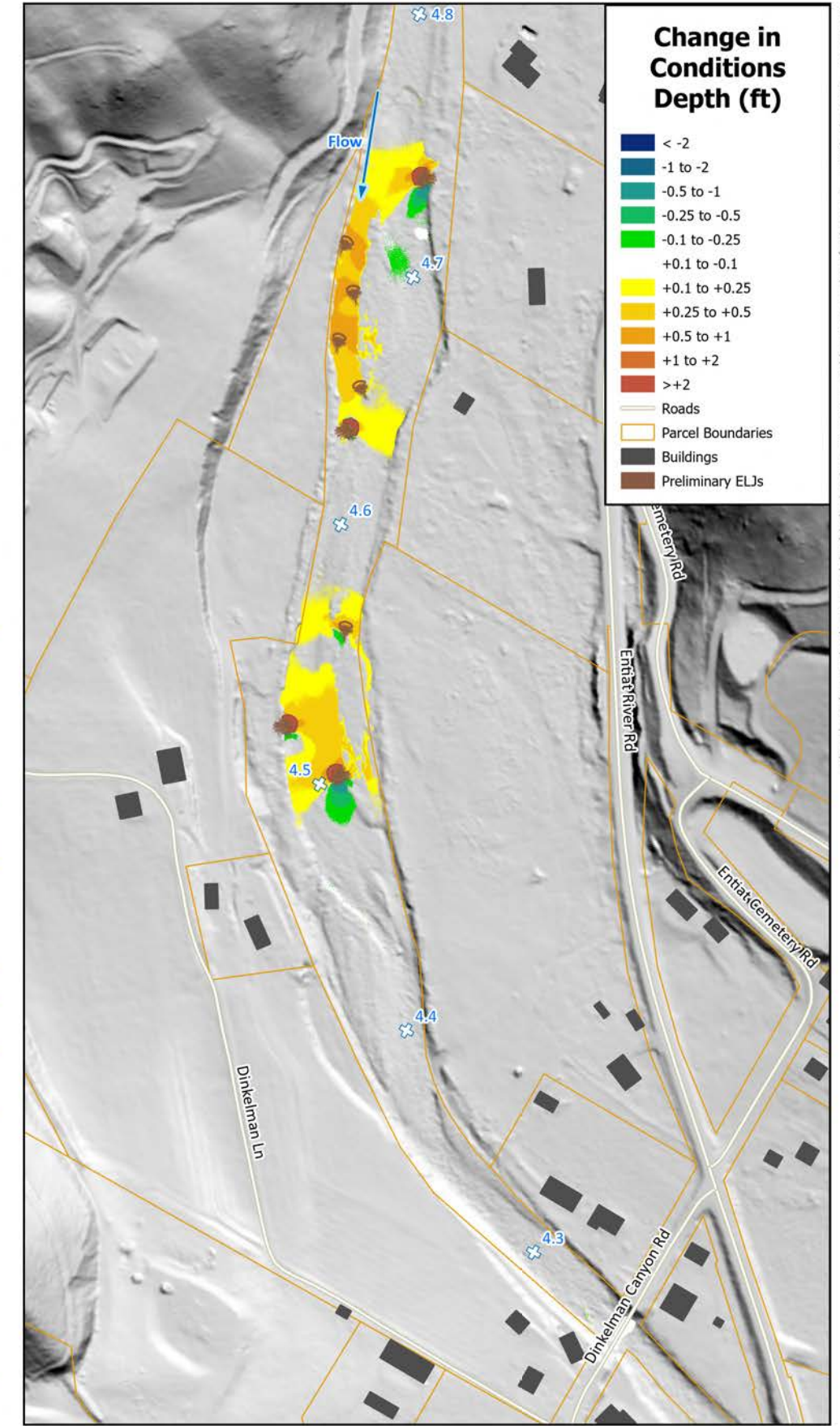
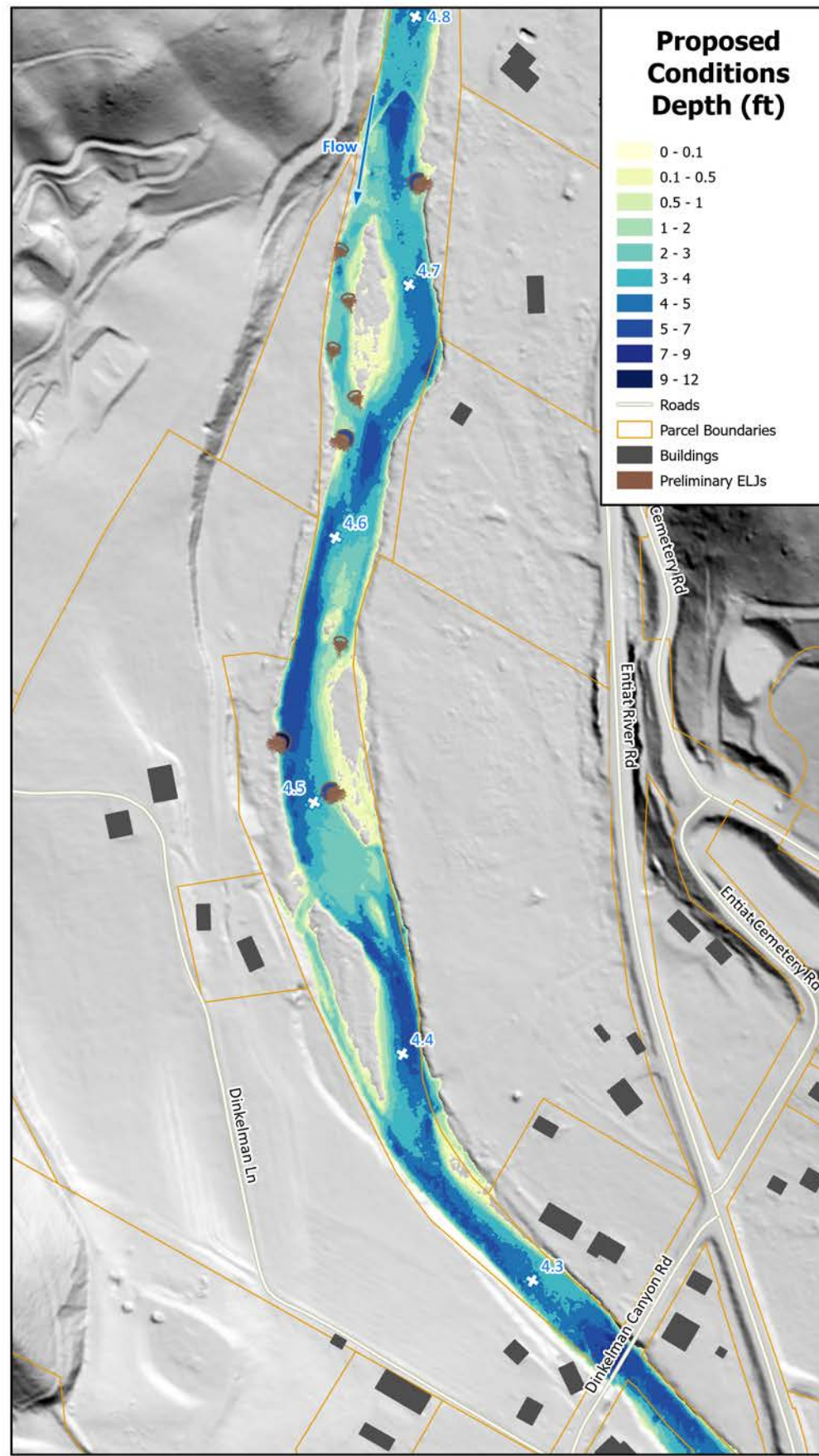
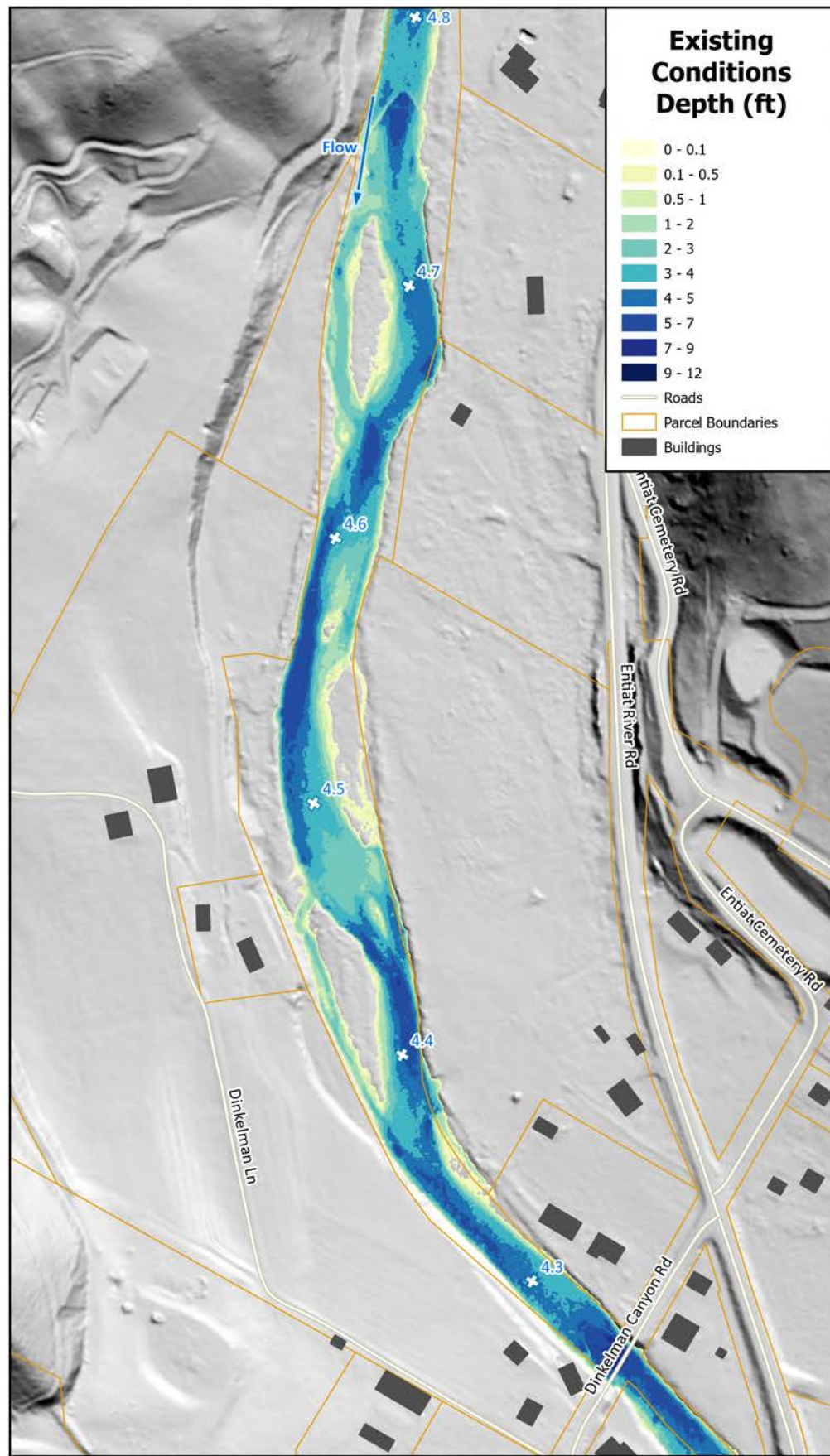
Lower Entiat 1D Reach (RM 4.3 - 4.8)
 Hydraulic Model Output - Summer Flow (100 cfs)

HEC-RAS 2D Hydraulic Model Results
 Topobathymetric DEM generated using NV5 Geospatial (2022)
 Lambert conformal conic projection, NAD 1983 State Plane
 Coordinate System (WA North Zone).



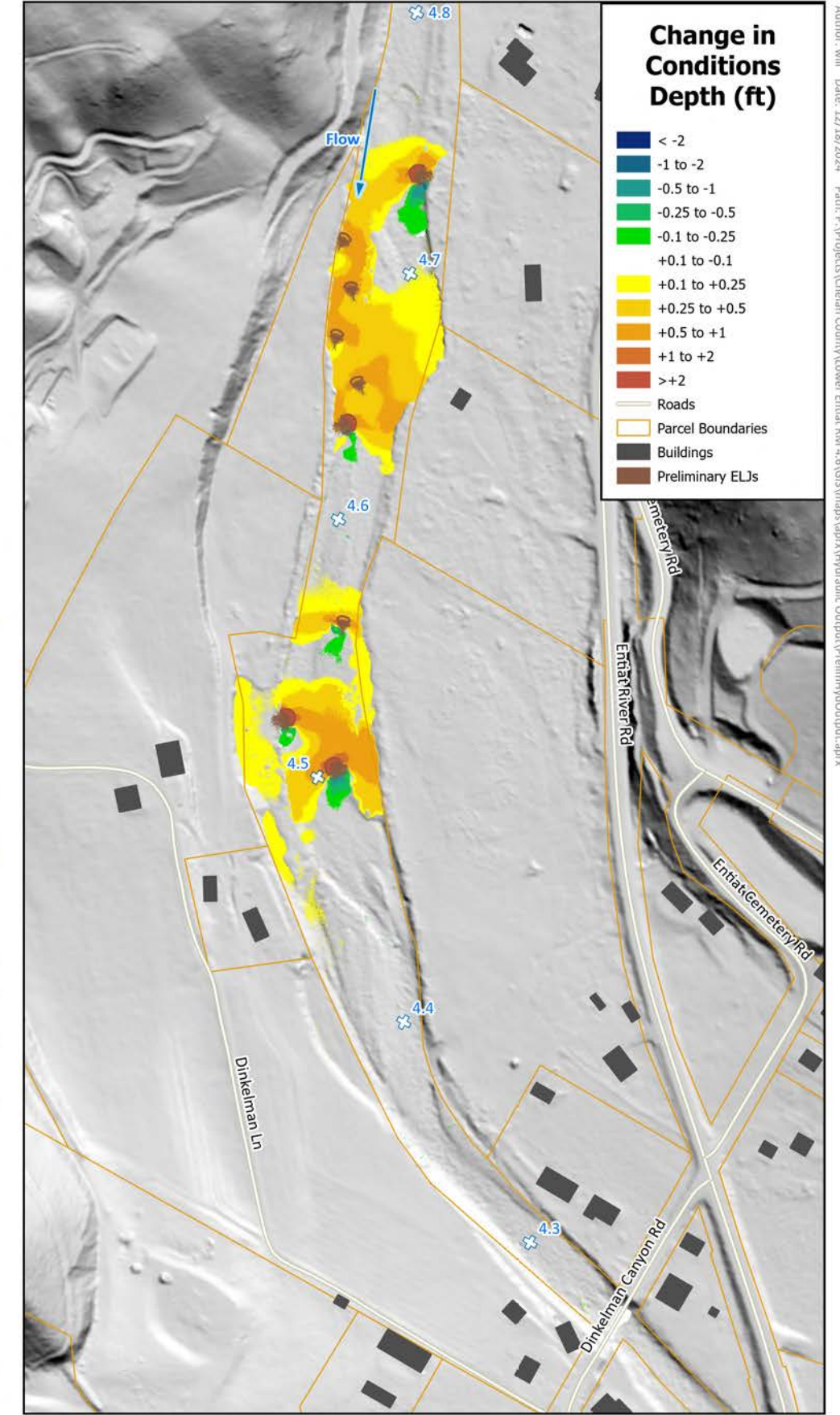
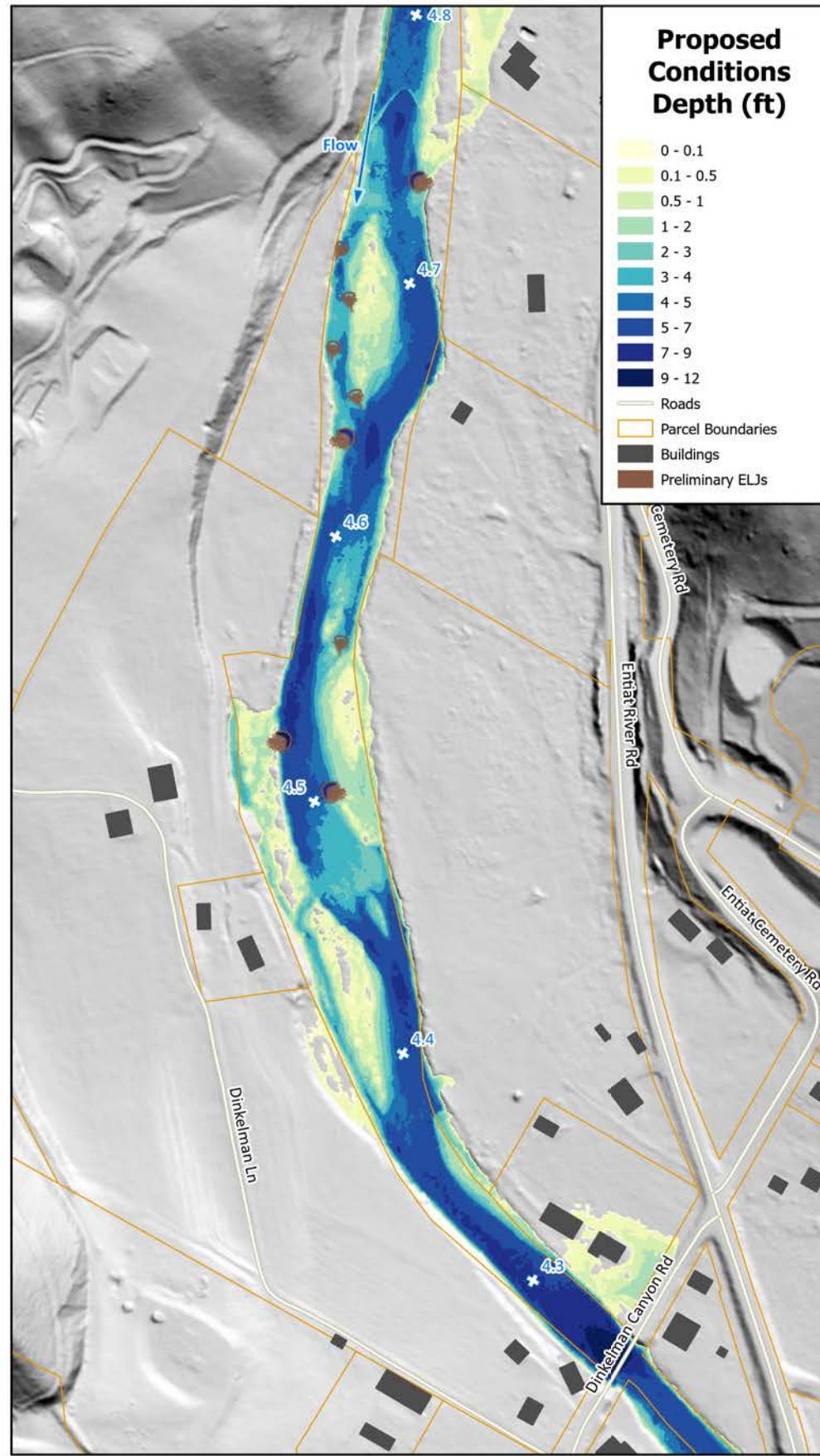
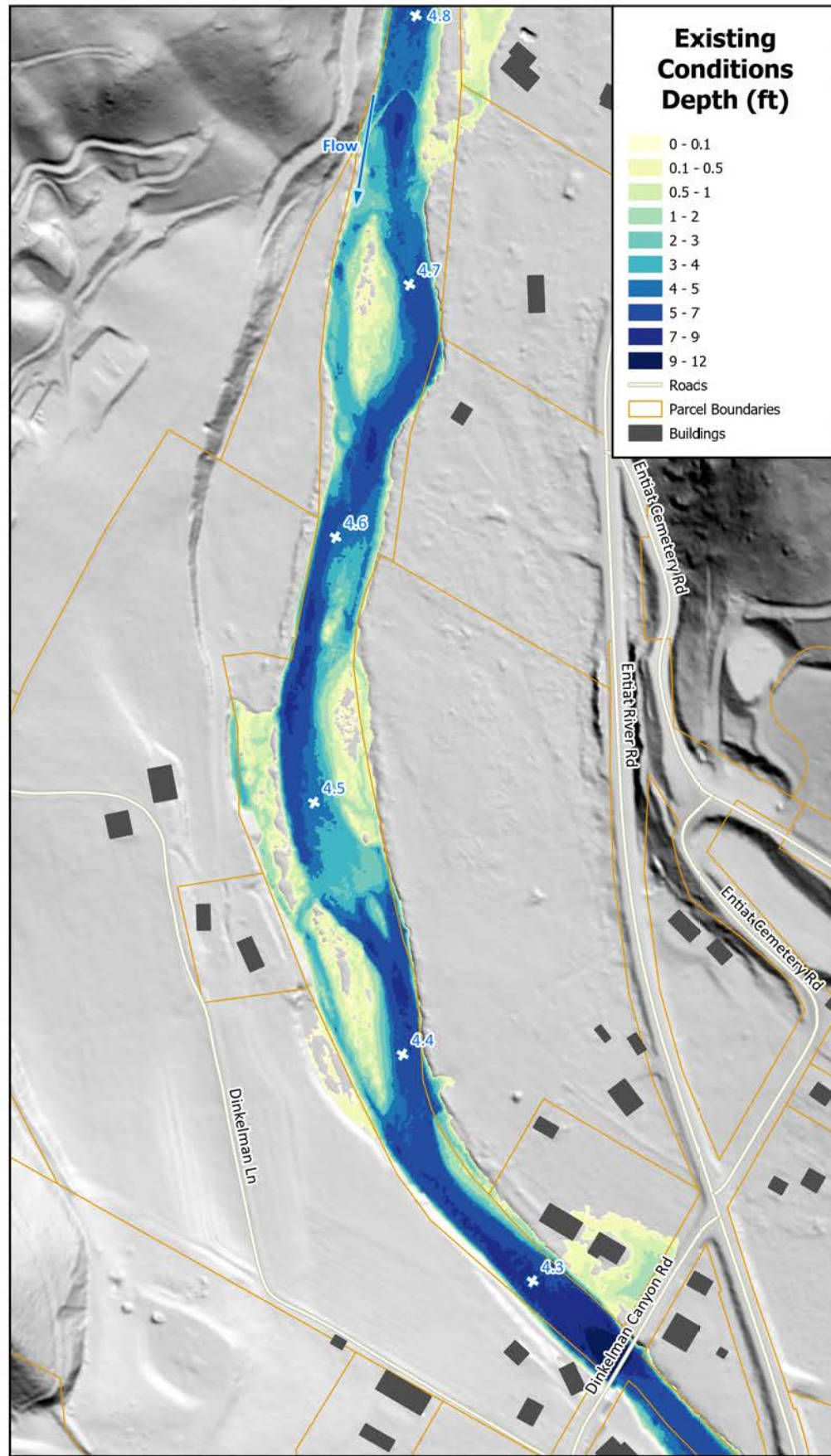
Lower Entiat 1D Reach (RM 4.3 - 4.8)
Hydraulic Model Output - 1.25yr Flow (2,370 cfs)

HEC-RAS 2D Hydraulic Model Results
Topobathymetric DEM generated using NV5 Geospatial (2022)
Lambert conformal conic projection, NAD 1983 State Plane
Coordinate System (WA North Zone).



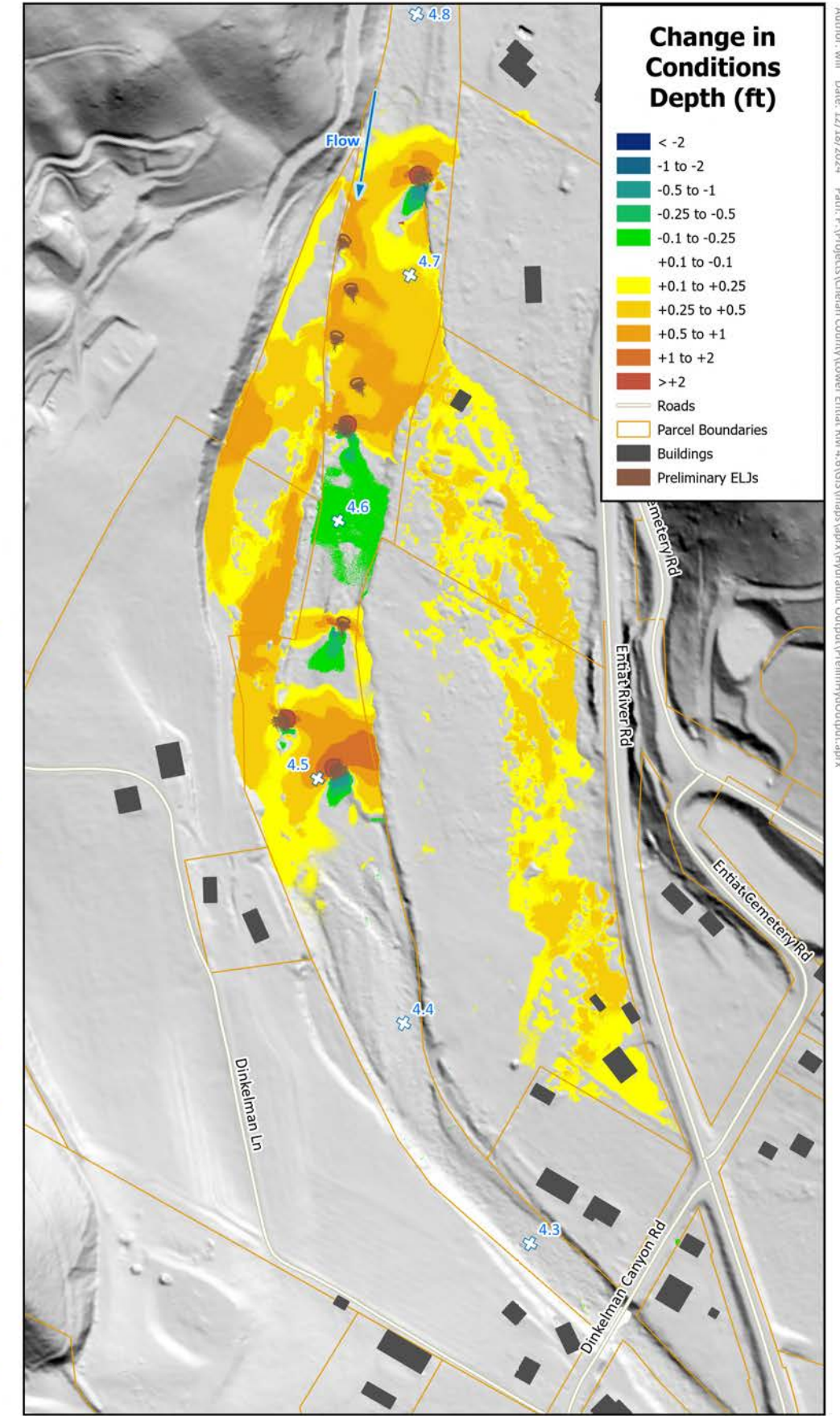
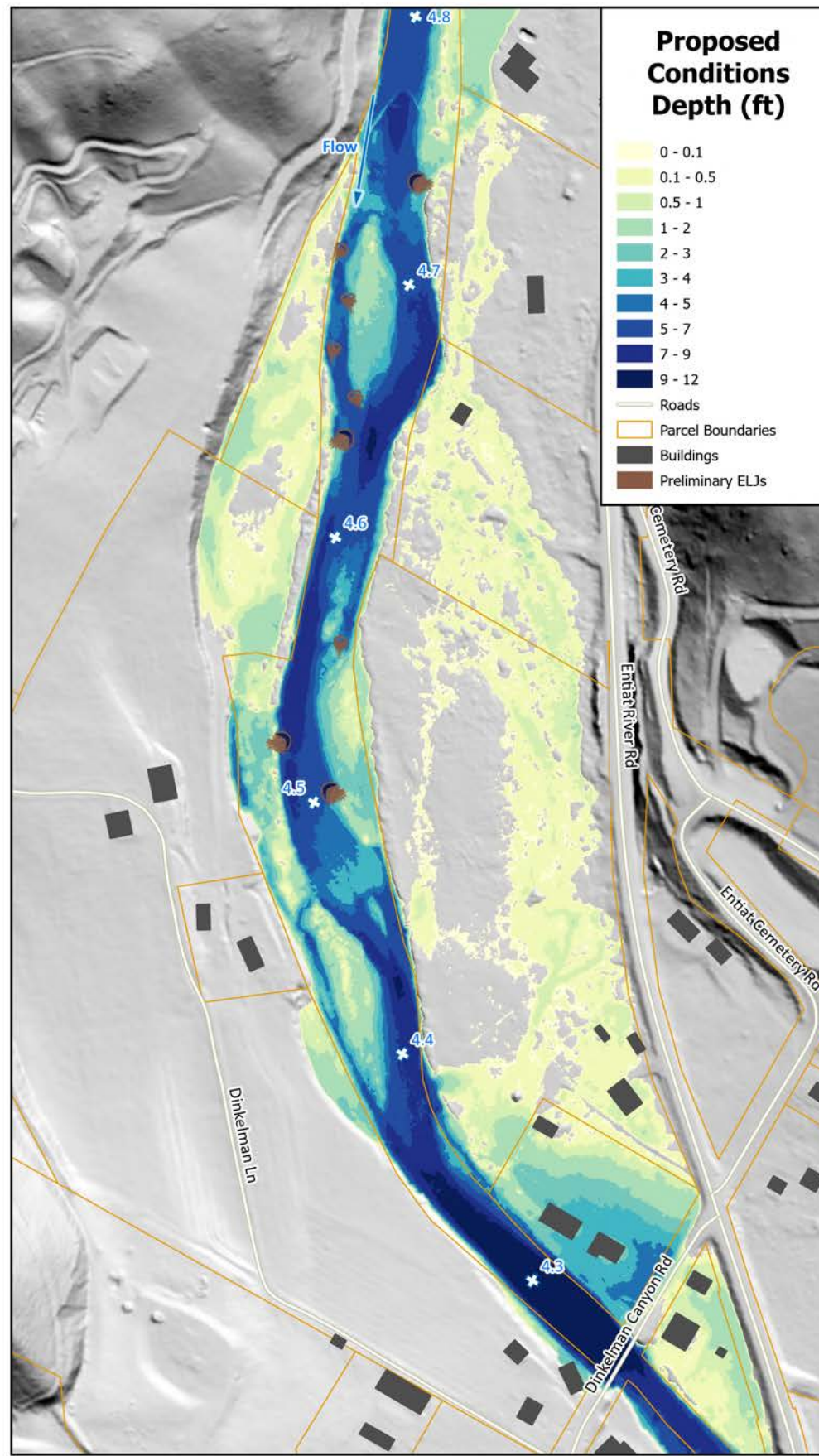
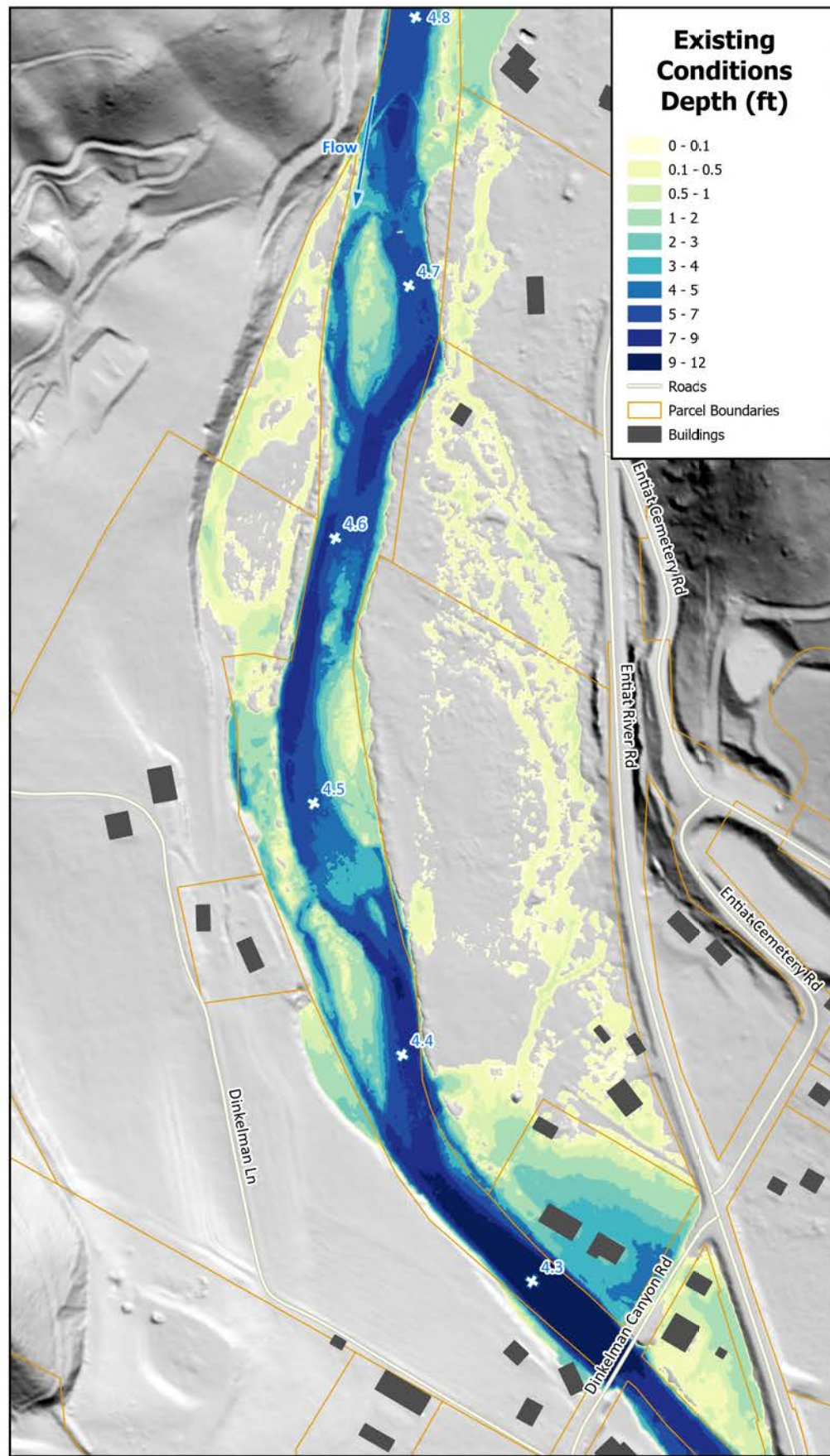
Lower Entiat 1D Reach (RM 4.3 - 4.8)
Hydraulic Model Output - 2yr Flow (3,130 cfs)

HEC-RAS 2D Hydraulic Model Results
Topobathymetric DEM generated using NV5 Geospatial (2022)
Lambert conformal conic projection, NAD 1983 State Plane
Coordinate System (WA North Zone).



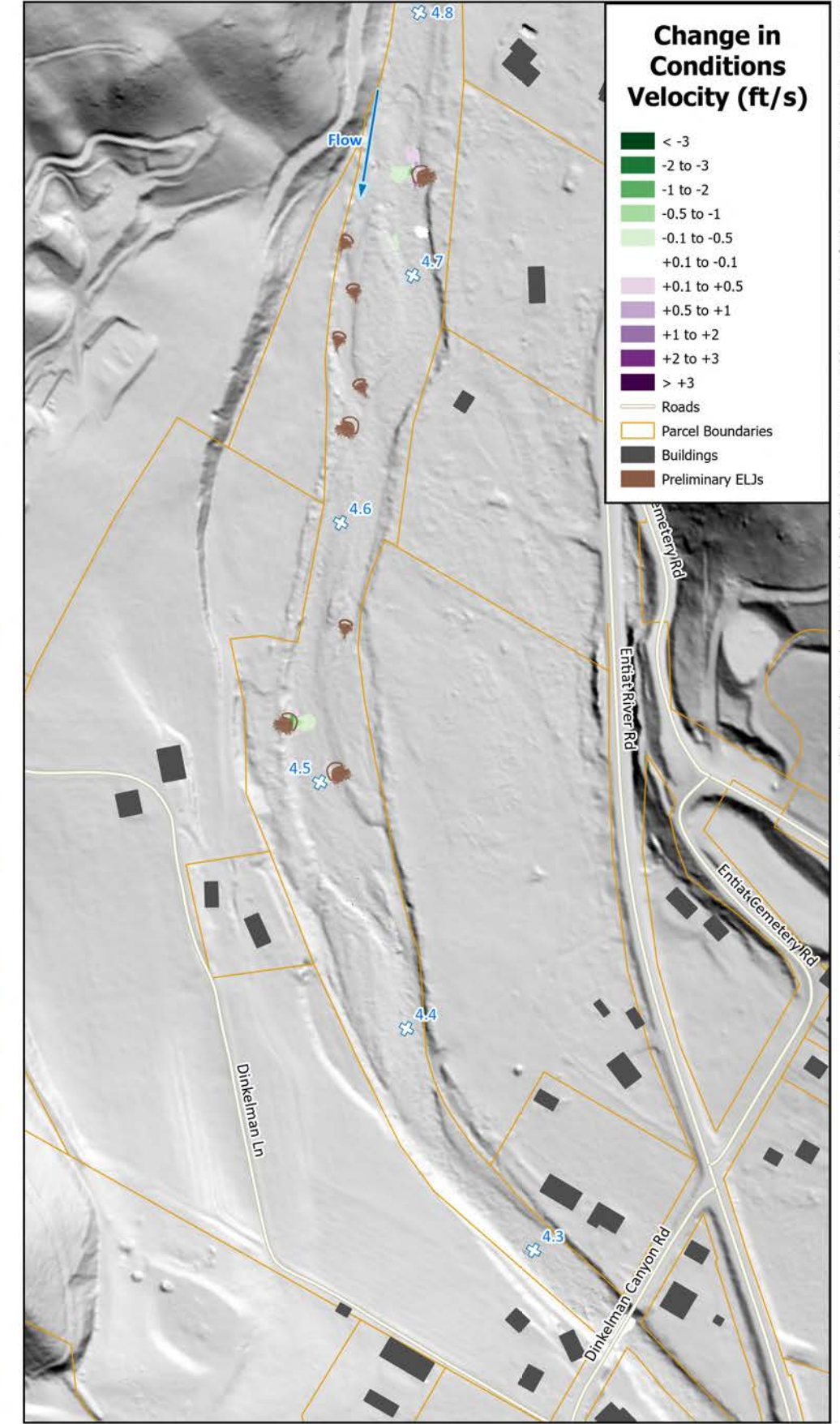
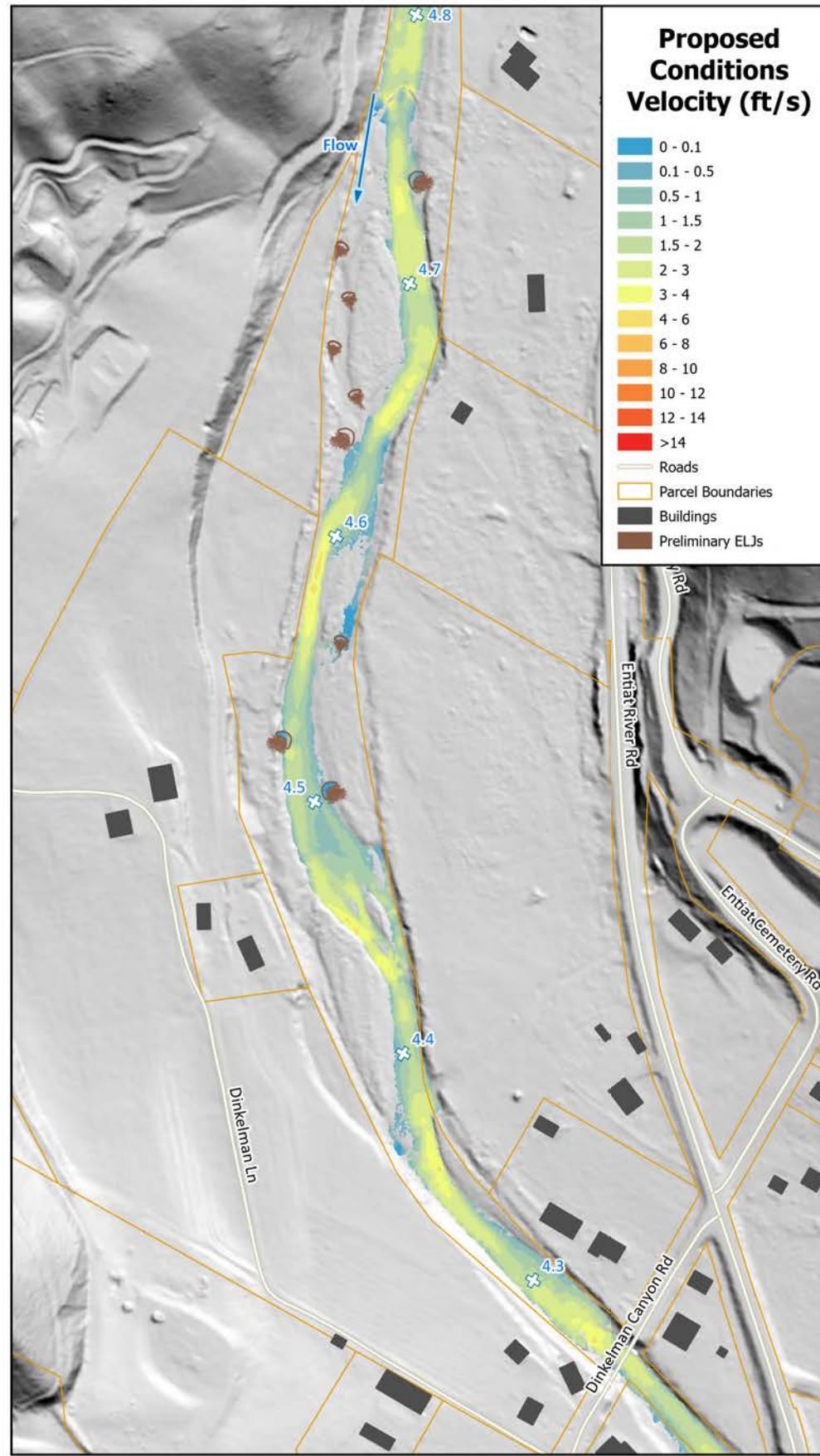
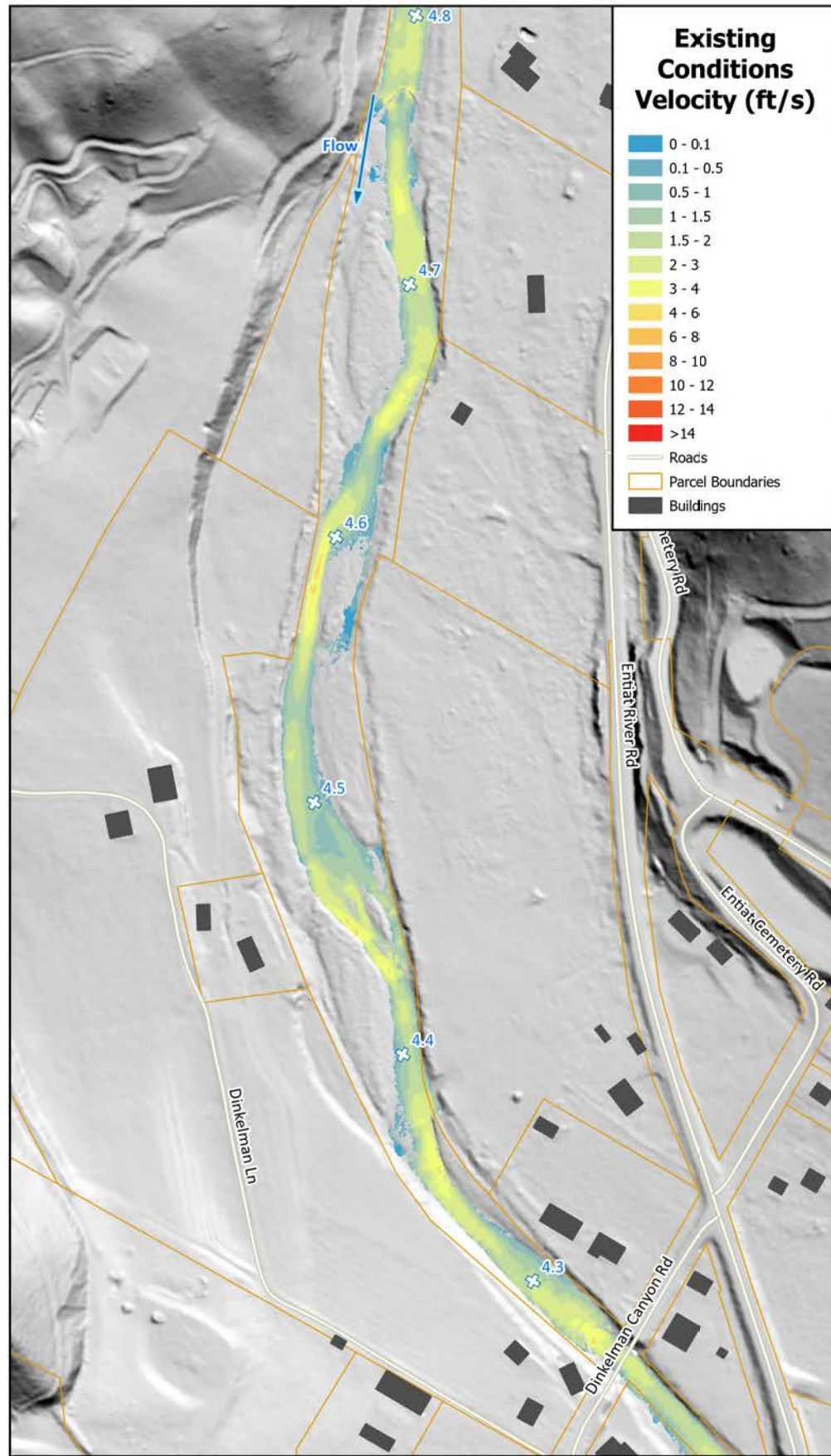
Lower Entiat 1D Reach (RM 4.3 - 4.8)
Hydraulic Model Output - 10yr Flow (5,600 cfs)

HEC-RAS 2D Hydraulic Model Results
Topobathymetric DEM generated using NVS Geospatial (2022)
Lambert conformal conic projection, NAD 1983 State Plane
Coordinate System (WA North Zone).



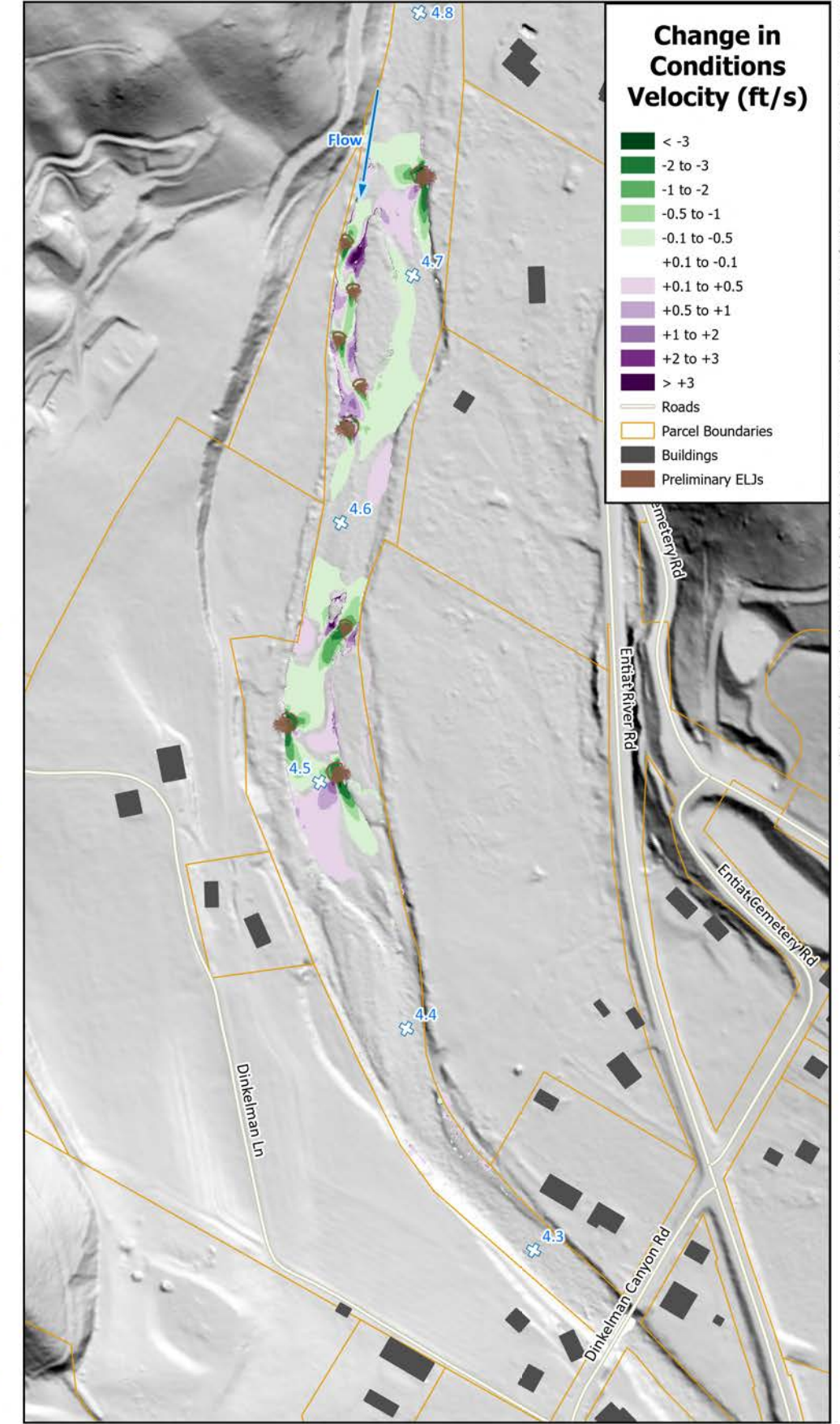
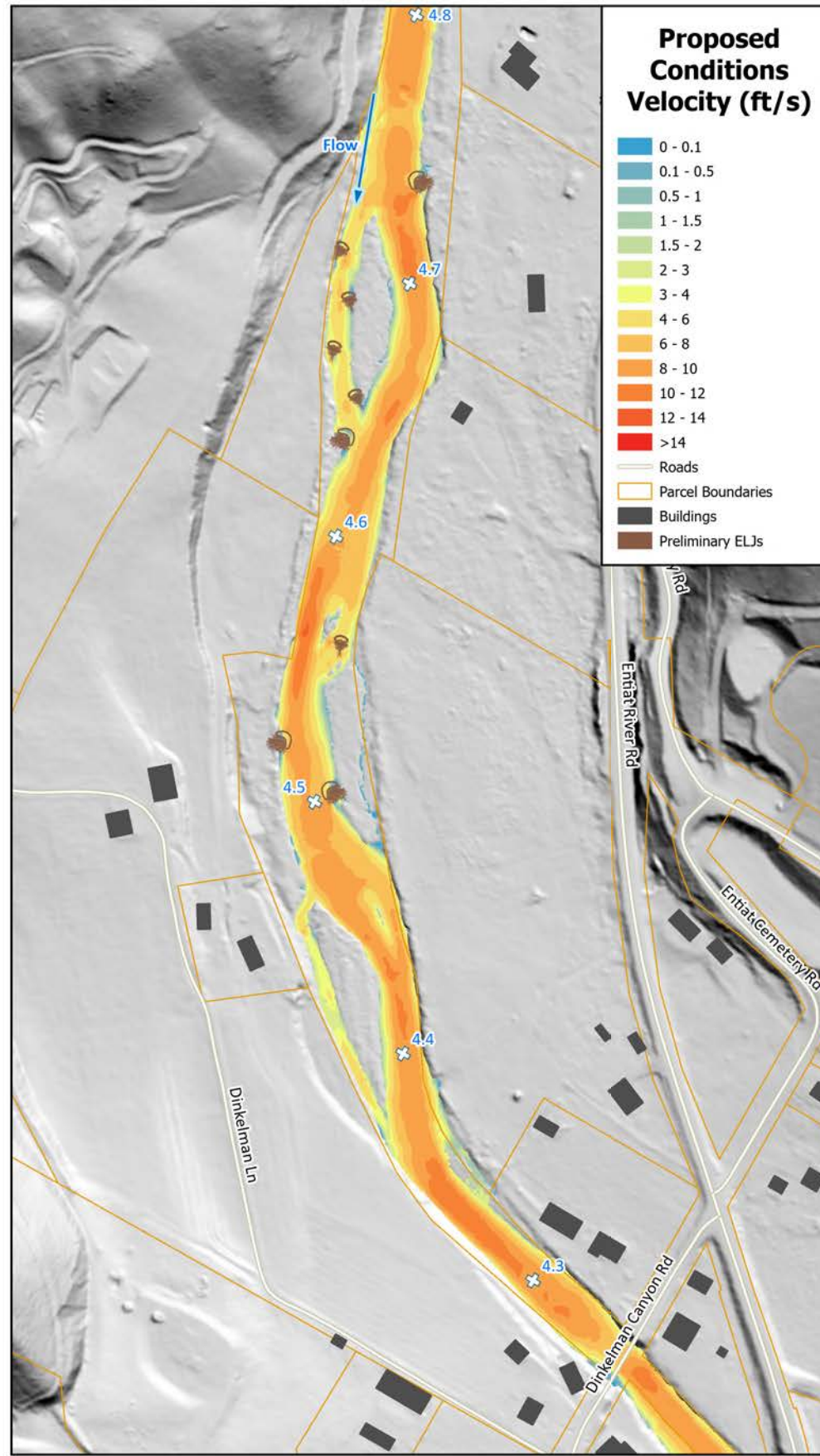
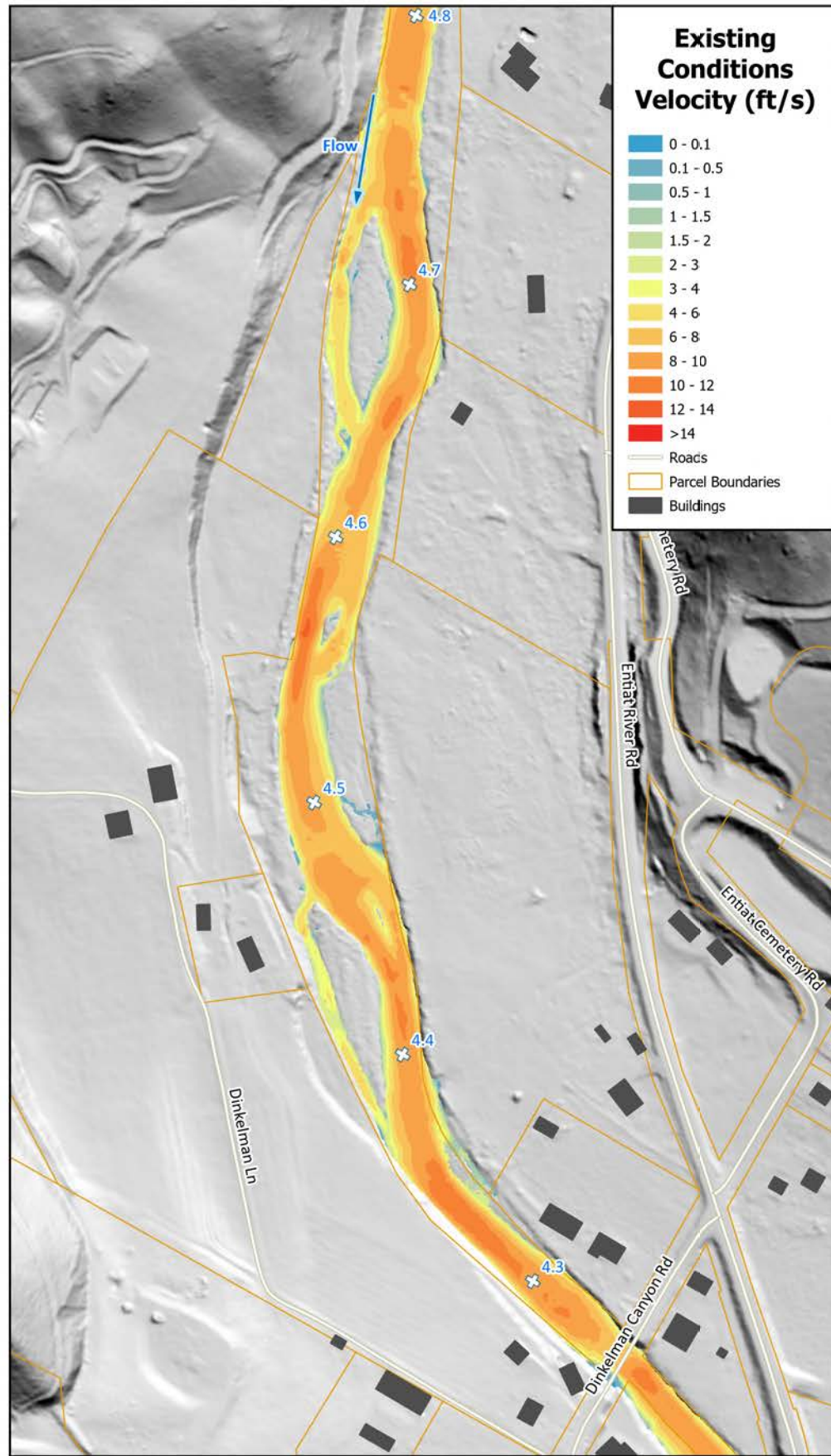
Lower Entiat 1D Reach (RM 4.3 - 4.8)
Hydraulic Model Output - 100yr Flow (8,300 cfs)

HEC-RAS 2D Hydraulic Model Results
Topobathymetric DEM generated using NV5 Geospatial (2022)
Lambert conformal conic projection, NAD 1983 State Plane
Coordinate System (WA North Zone).



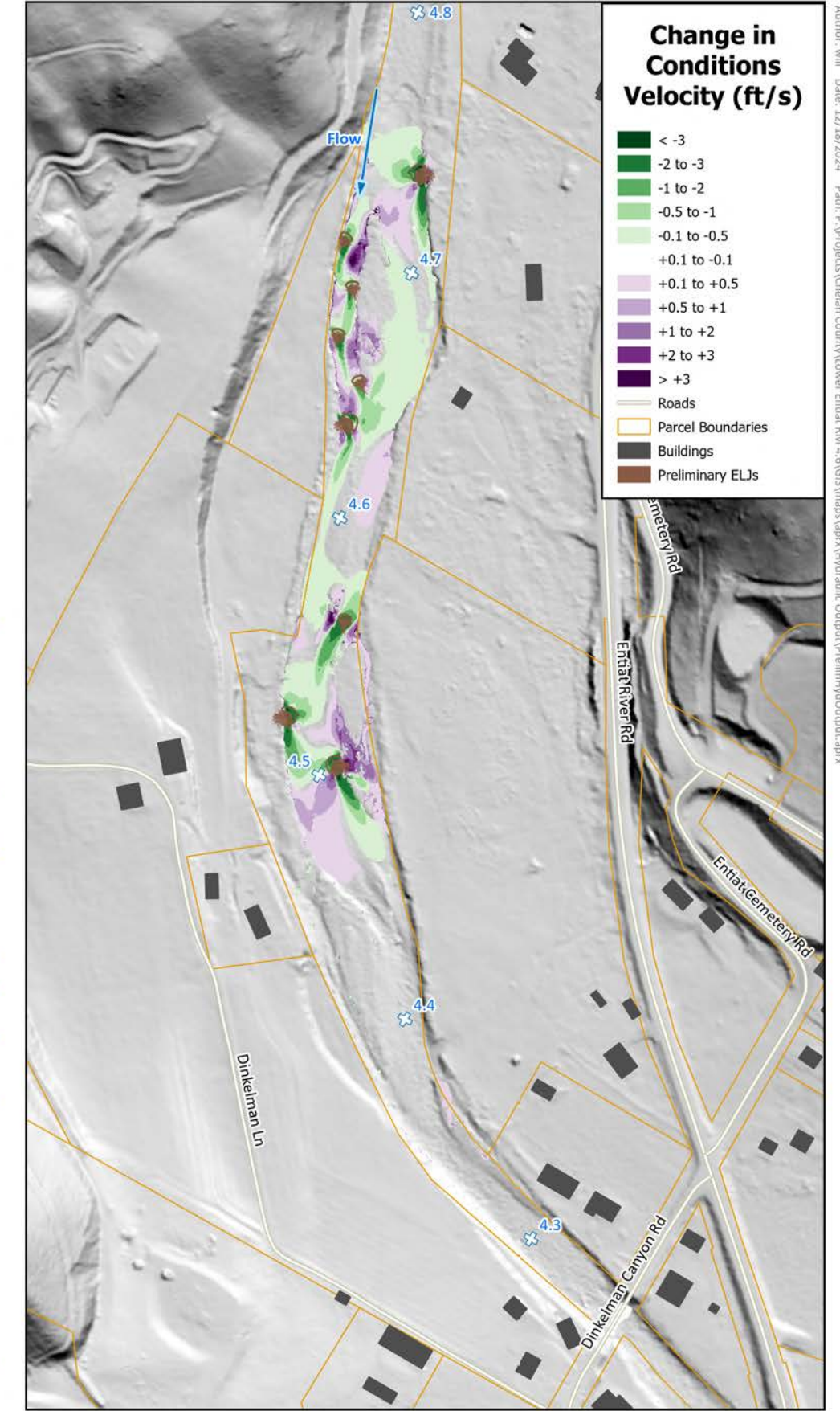
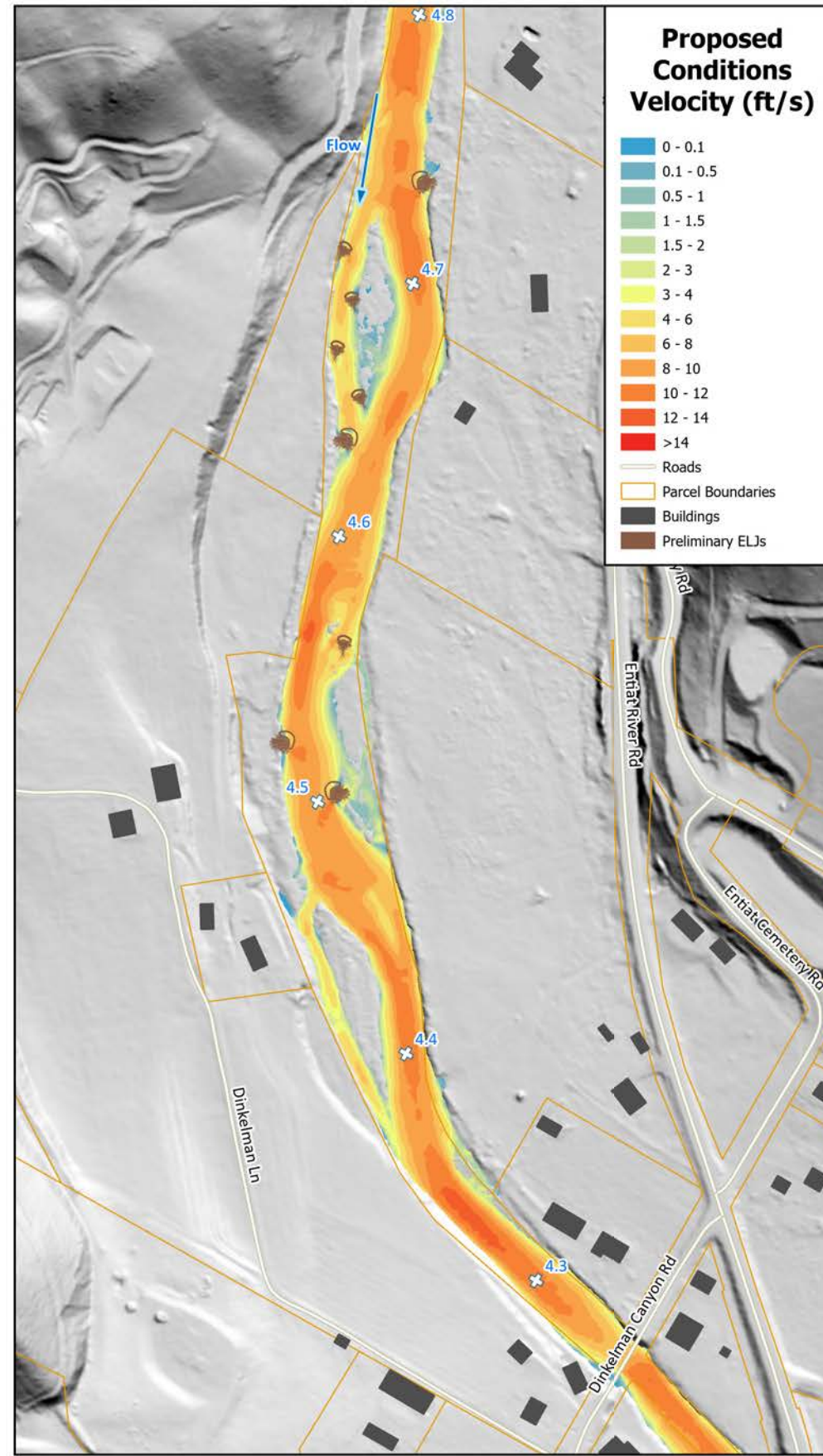
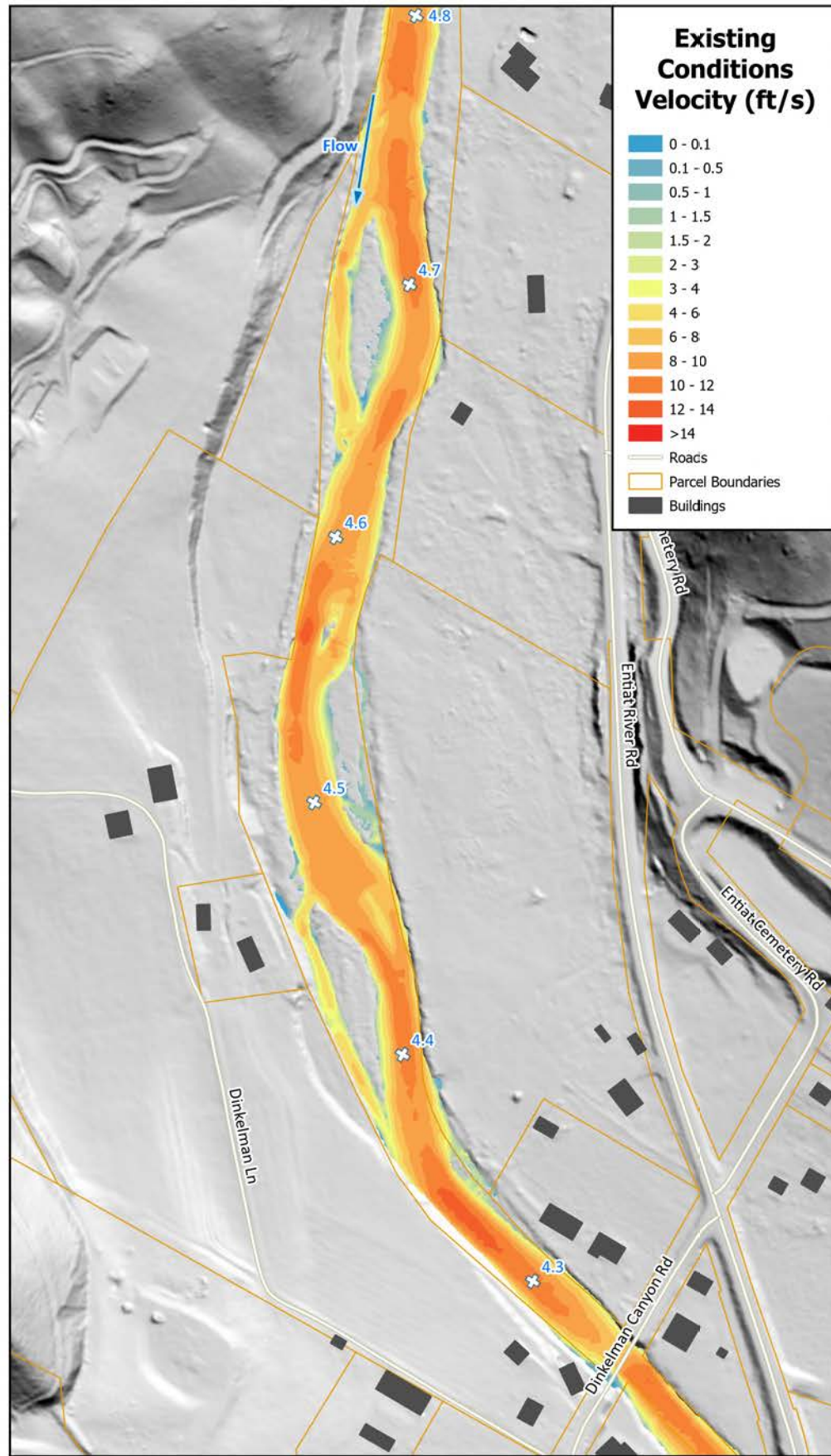
Lower Entiat 1D Reach (RM 4.3 - 4.8)
 Hydraulic Model Output - Summer Flow (100 cfs)

HEC-RAS 2D Hydraulic Model Results
 Topobathymetric DEM generated using NV5 Geospatial (2022)
 Lambert conformal conic projection, NAD 1983 State Plane
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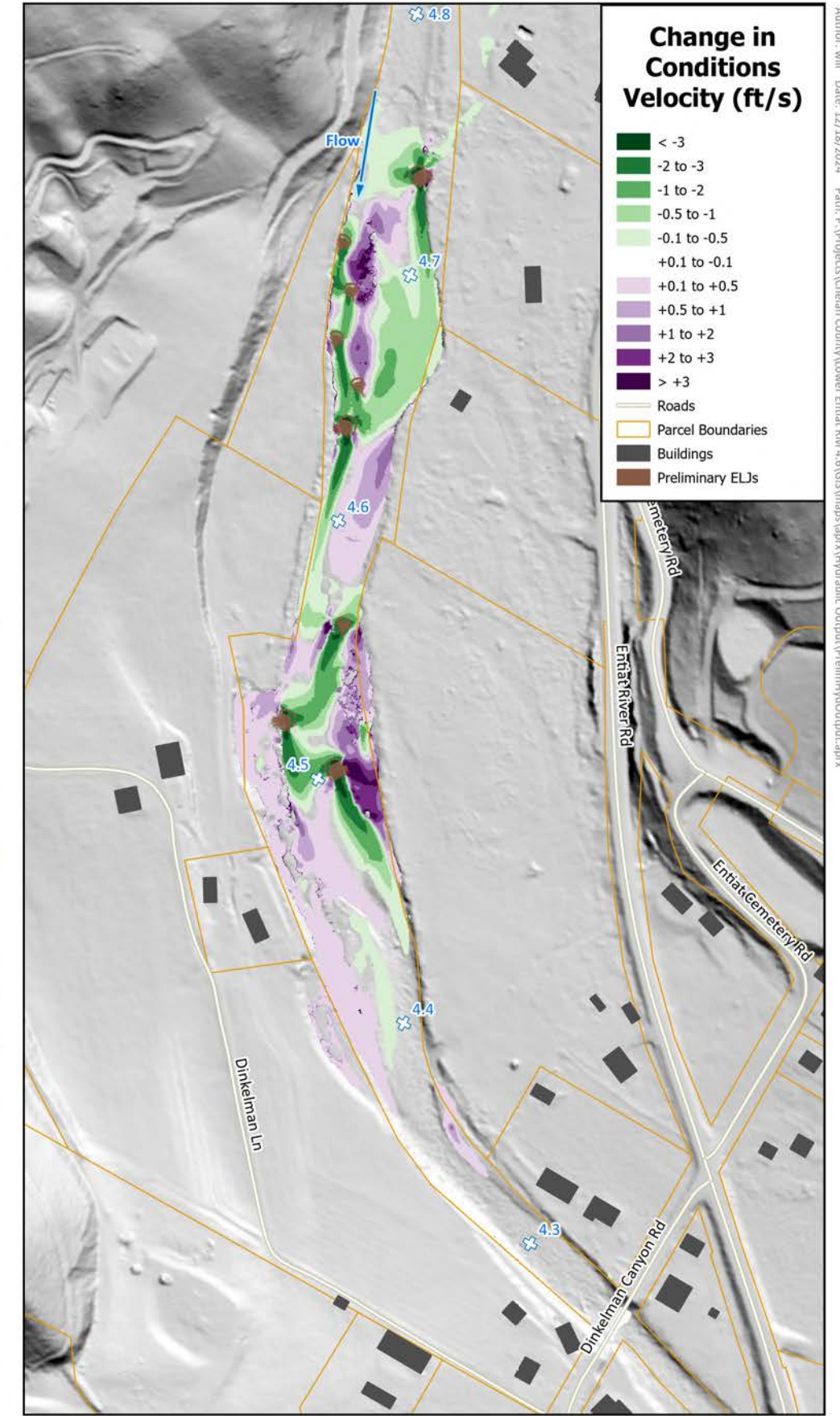
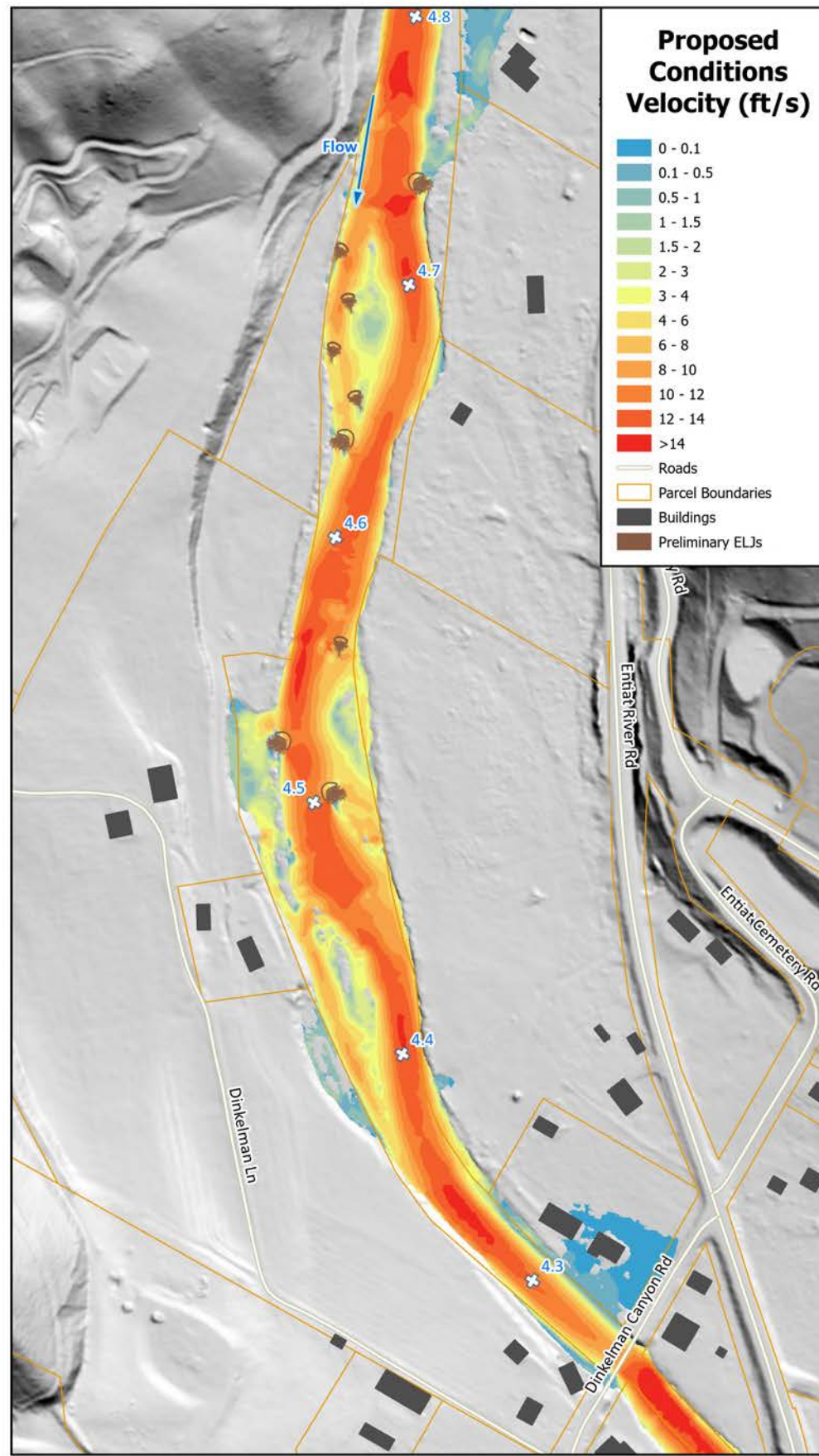
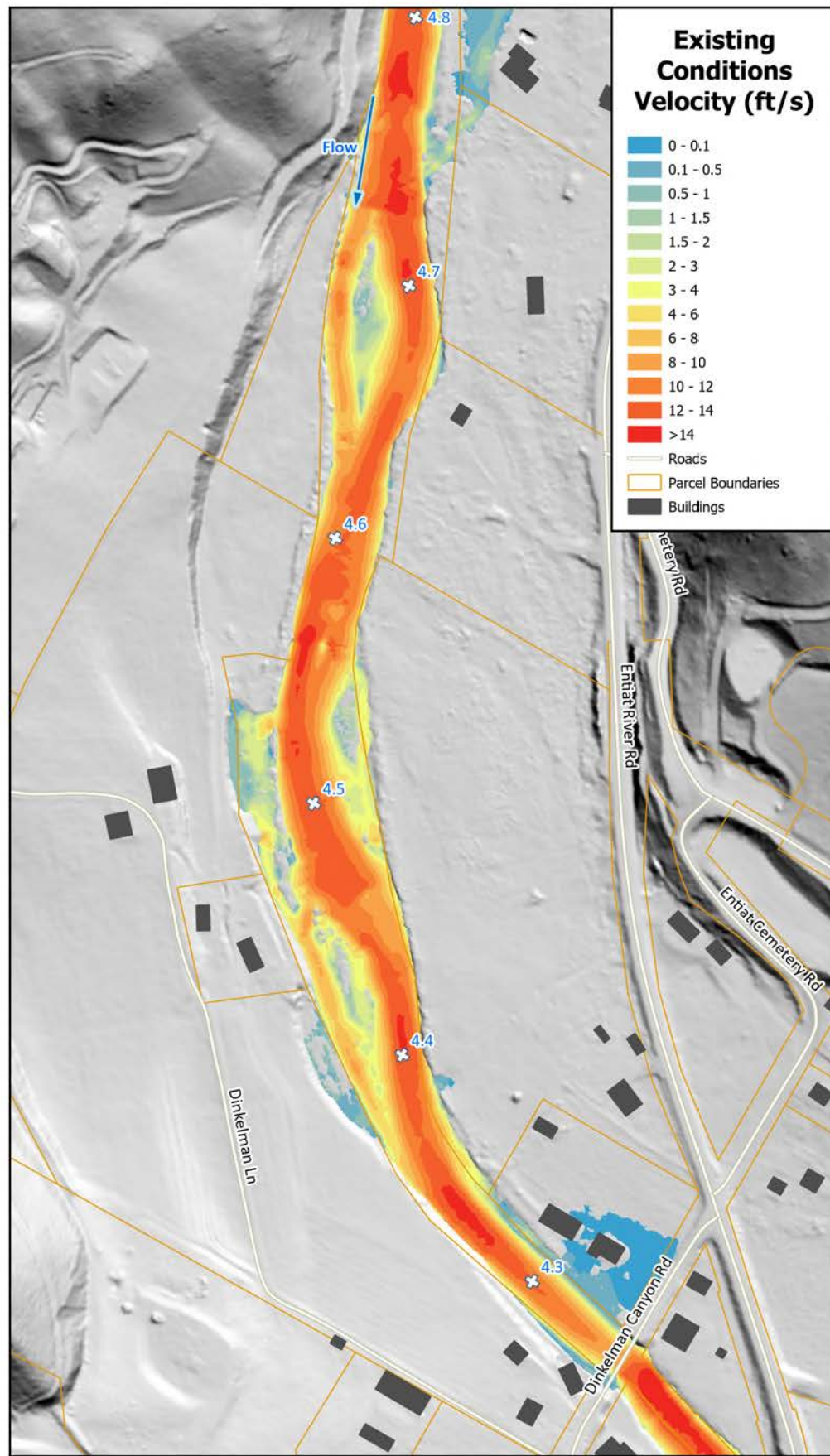
Lower Entiat 1D Reach (RM 4.3 - 4.8)
Hydraulic Model Output - 1.25yr Flow (2,370 cfs)

HEC-RAS 2D Hydraulic Model Results
Topobathymetric DEM generated using NVS Geospatial (2022)
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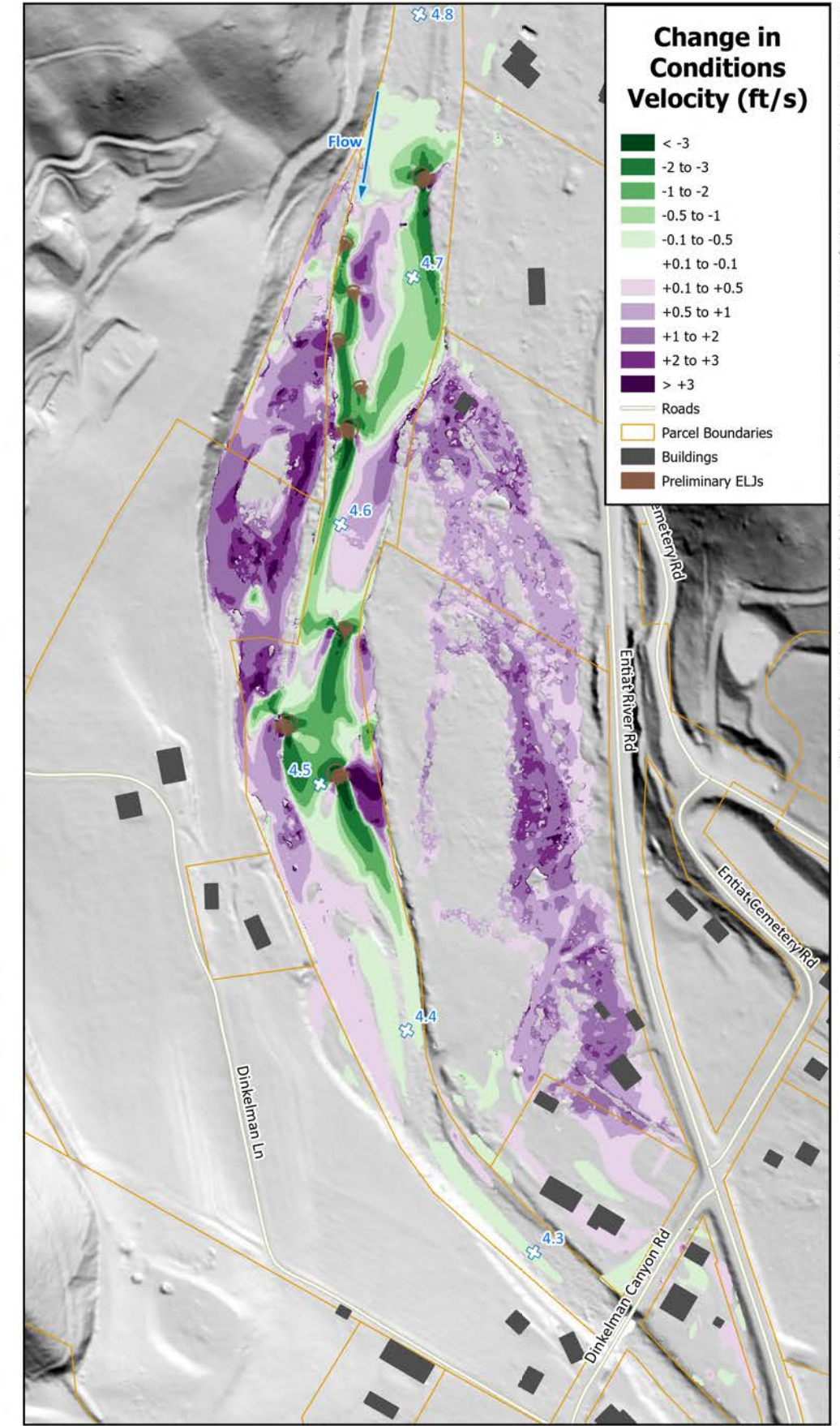
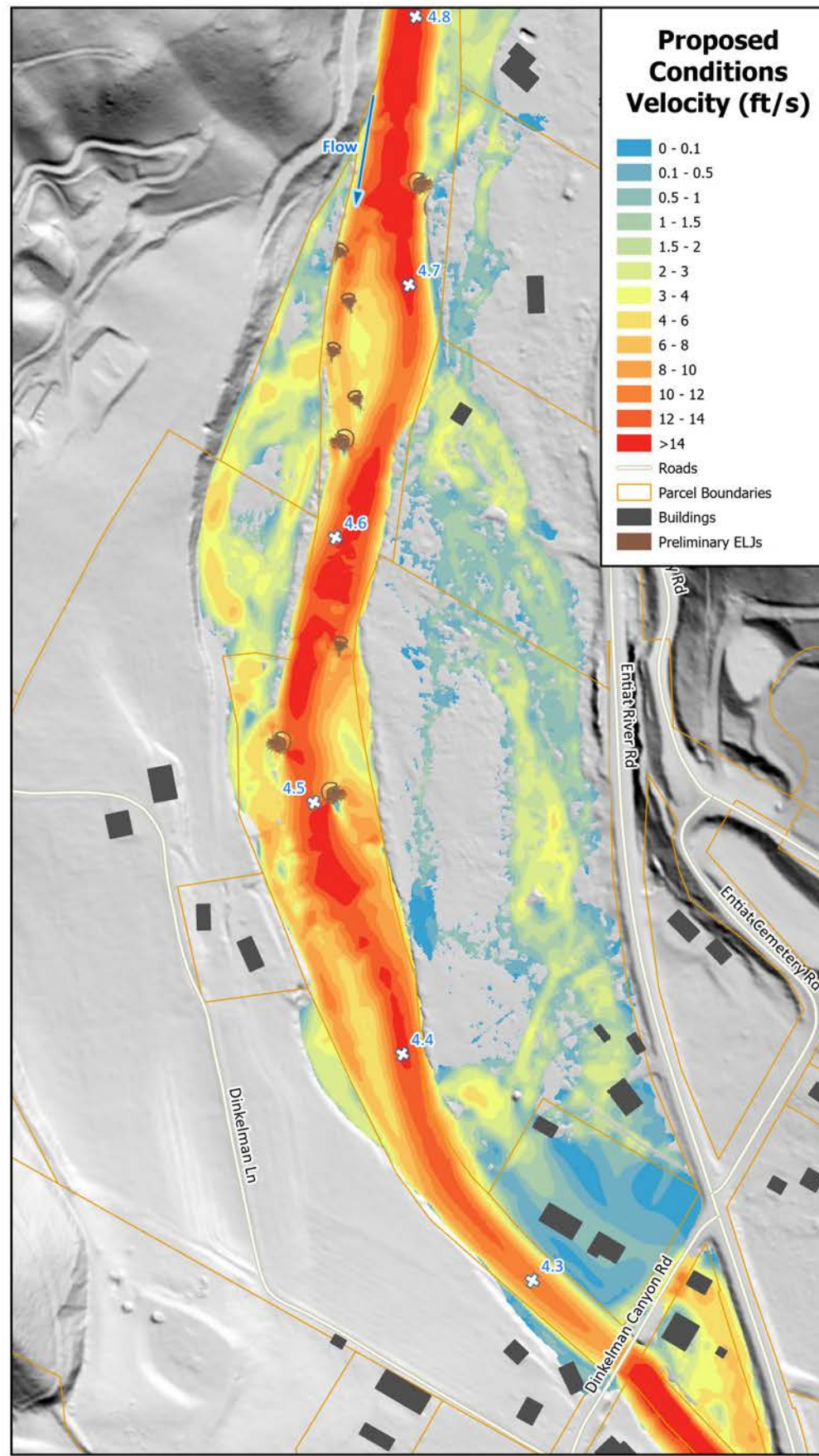
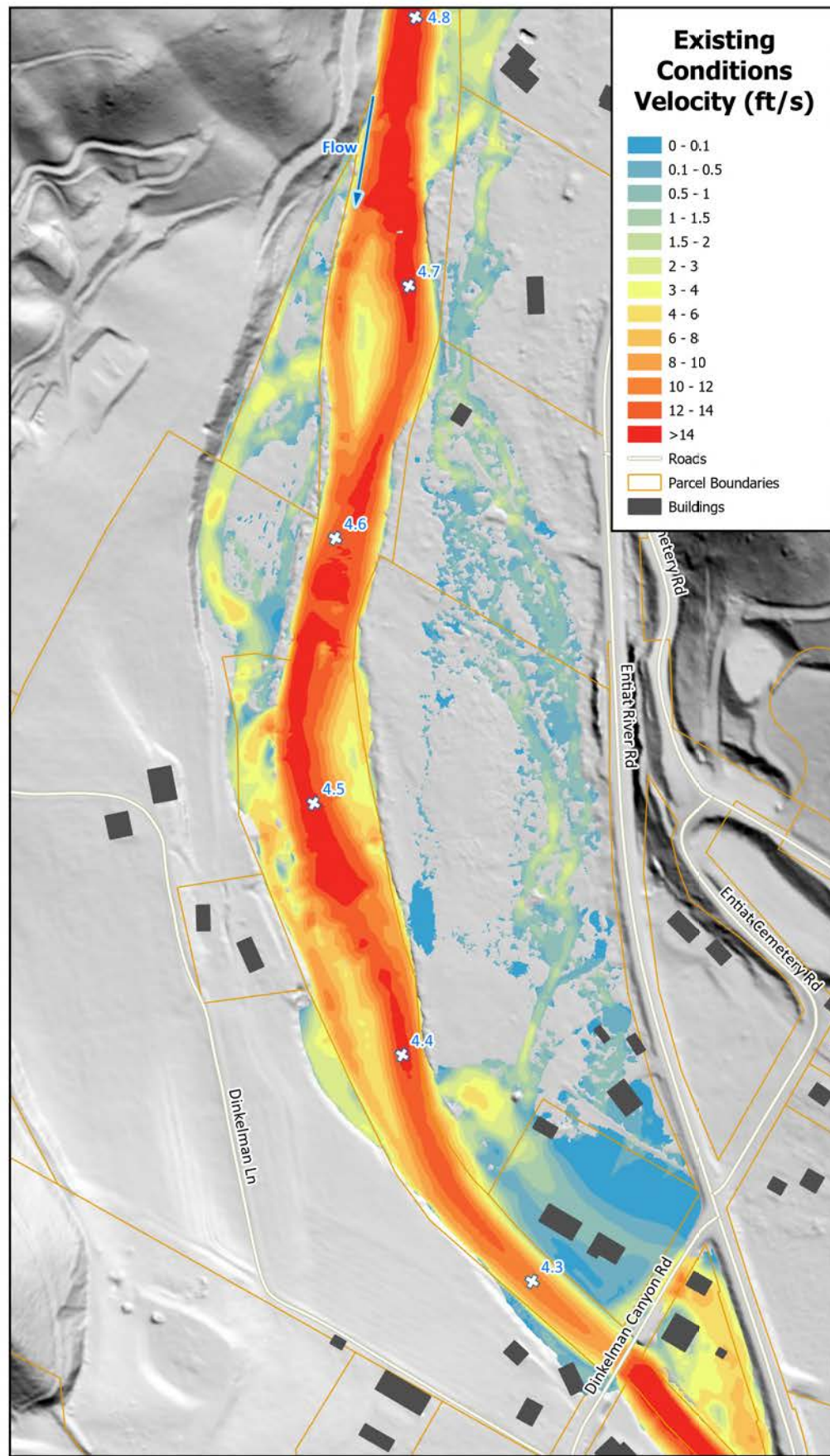
Lower Entiat 1D Reach (RM 4.3 - 4.8)
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HEC-RAS 2D Hydraulic Model Results
 Topobathymetric DEM generated using NV5 Geospatial (2022)
 Lambert conformal conic projection, NAD 1983 State Plane
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Lower Entiat 1D Reach (RM 4.3 - 4.8)
 Hydraulic Model Output - 10yr Flow (5,600 cfs)

HEC-RAS 2D Hydraulic Model Results
 Topobathymetric DEM generated using NVS Geospatial (2022)
 Lambert conformal conic projection, NAD 1983 State Plane
 Coordinate System (WA North Zone).



Lower Entiat 1D Reach (RM 4.3 - 4.8)
 Hydraulic Model Output - 100yr Flow (8,300 cfs)

HEC-RAS 2D Hydraulic Model Results
 Topobathymetric DEM generated using NVS Geospatial (2022)
 Lambert conformal conic projection, NAD 1983 State Plane
 Coordinate System (WA North Zone).

Appendix C

Preliminary Construction Cost Estimate

Construction Cost Estimate

Natural Systems Design

Project: Lower Entiat Reach 1D (RM 4.3-4.8)
Client: CCNRD
Project No: CCNRD-047

Analyst: G. Bacci
Latest Revision: 12/18/2024
Allowance for Indeterminates Included in Bid Items: 35%
Inflation to 2026 included in Item Cost: 10%

Construction

ITEM #	ITEM DESCRIPTION	WSDOT REF	QTY	UNIT	UNIT COST	ITEM COST
CO-1	MOBILIZATION		1	LS	\$ 60,800.00	\$ 60,800.00
CO-3	EROSION/ WATER POLLUTION CONTROL MEASURES		1	LS	\$ 84,100.00	\$ 84,100.00
CO-4	TEMPORARY ACCESS & STAGING		1	LS	\$ 34,753.60	\$ 34,753.60
CO-6	SEEDING		1	LS	\$ 7,435.24	\$ 7,435.24
	Subtotal					\$ 187,088.84
	Taxes (as % of Construction Sub-Total)		8.5%			\$ 15,902.55
Total (Construction)						\$ 202,991.40

Deflector Group 1

ITEM #	ITEM DESCRIPTION	WSDOT REF	QTY	UNIT	UNIT COST	ITEM COST
G1-1	DEFLECTOR ELJ		1	EA	\$ 76,630.53	\$ 76,630.53
	Subtotal					\$ 76,630.53
	Taxes (as % of Construction Sub-Total)		8.5%			\$ 6,513.59
Total (Deflector Group 1)						\$ 83,144.12

Side Channel Group 2

ITEM #	ITEM DESCRIPTION	WSDOT REF	QTY	UNIT	UNIT COST	ITEM COST
G2-1	STABILIZE EXISTING APEX		1	EA	\$ 24,404.89	\$ 24,404.89
G2-2	SIDE CHANNEL ELJ		4	EA	\$ 30,123.46	\$ 120,493.84
G2-3	DEFLECTOR ELJ		1	EA	\$ 76,630.53	\$ 76,630.53
	Subtotal					\$ 221,529.26
	Taxes (as % of Construction Sub-Total)		8.5%			\$ 18,829.99
Total (Side Channel Group 2)						\$ 240,359.25

Side Channel Group 3

ITEM #	ITEM DESCRIPTION	WSDOT REF	QTY	UNIT	UNIT COST	ITEM COST
G4-2	SIDE CHANNEL ELJ		1	EA	\$ 30,123.46	\$ 30,123.46
	Subtotal					\$ 30,123.46
	Taxes (as % of Construction Sub-Total)		8.5%			\$ 2,560.49
Total (Side Channel Group 3)						\$ 32,683.95

Deflector Group 4

ITEM #	ITEM DESCRIPTION	WSDOT REF	QTY	UNIT	UNIT COST	ITEM COST
G5-1	DEFLECTOR ELJ		2	EA	\$ 76,630.53	\$ 153,261.06
	Subtotal					\$ 153,261.06
	Taxes (as % of Construction Sub-Total)		8.5%			\$ 13,027.19
Total (Deflector Group 4)						\$ 166,288.25

Grand Total \$725,466.97



Harrison LWD pool



LWD structure Panorama



Existing side channel inlet and jam
on river right RM 4.5



Existing perennial side channel
Right bank RM 4.45

RM 4.6 Left bank island and flow split



Looking upstream from Dinkelman Bridge

